CSC 4350 – Computer Networks

Lecture 2 – More Intro to Terms/Chapter 1

August 27, 2024

Note

- Material used in this lecture is heavily borrowed from Kurose & Ross' "Computer Networking: A Top Down Approach, 8th Edition"
- Also: assuming no prior knowledge of networks

Hardware and Software

- End systems access Internet via Internet Service Providers (ISPs)
  - Each is a network of packet switches and communication links
  - Provide a variety of types of network access to the end systems
  - Provide Internet access to content providers, connecting servers directly to the Internet
  - Lower-tiered ISPs are connected to national/international ISPs
  - Net neutrality is big here, too
- Protocols – control the sending and receiving of information
  - TCP/IP
  - UDP

Hardware and Software

- Standards – need some agreement in place so that everyone can connect/do what they need to do
- Internet Engineering Task Force (IETF) – develops standards
  - Standards documents started out as general requests for comments to resolve network and protocol design problems

The Internet – A Services Description

- Can also be defined as an infrastructure that provides services to applications
  - Pretty much for anything you can do online – email, web, gaming, etc.
- Distributed applications – involve multiple end systems that exchange data with each other
- Internet applications run on end systems, not packet switches in the network core
- End systems provide a socket interface that specifies how a program running on one end system asks the Internet infrastructure to deliver data to a specific destination on another end system

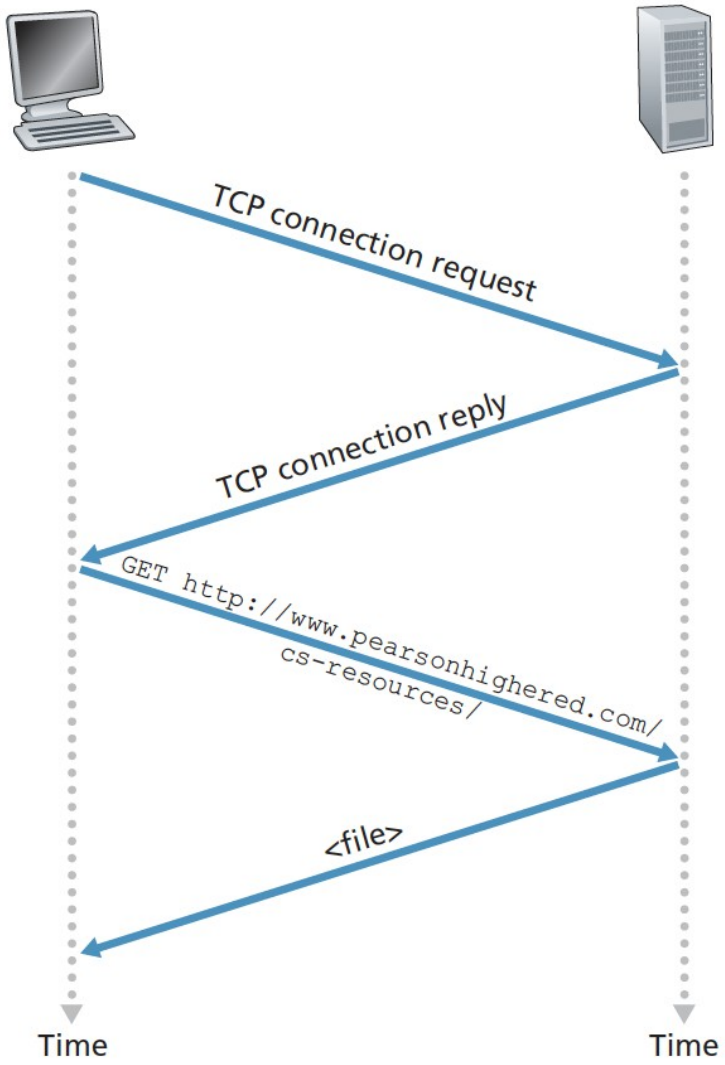
Protocol

- The human perspective
  - There are specific messages we send and specific actions we take in response to the received reply messages or other events (like no response)
  - Transmitted or received messages
  - Events
  - It takes 2+ communicating entities running the same protocol in order to accomplish a task.
  - Another analogy – question/answer session between student and faculty

Network Protocols

- Entities exchanging messages and taking actions are hardware or software components of some device
- All activity in the Internet that involves two or more communicating remote entities is governed by a protocol
- Example – request to a web server (URL)
  - Computer will send a connection request message to the server and wait for a reply
  - Web server will receive request and return a connection reply message
  - OK to request the web document – your computer then sends the name of the web page it wants to fetch from the server in a GET message
  - Web server returns the web page (file) to your computer

Part of Figure 1.2 – Network Protocol



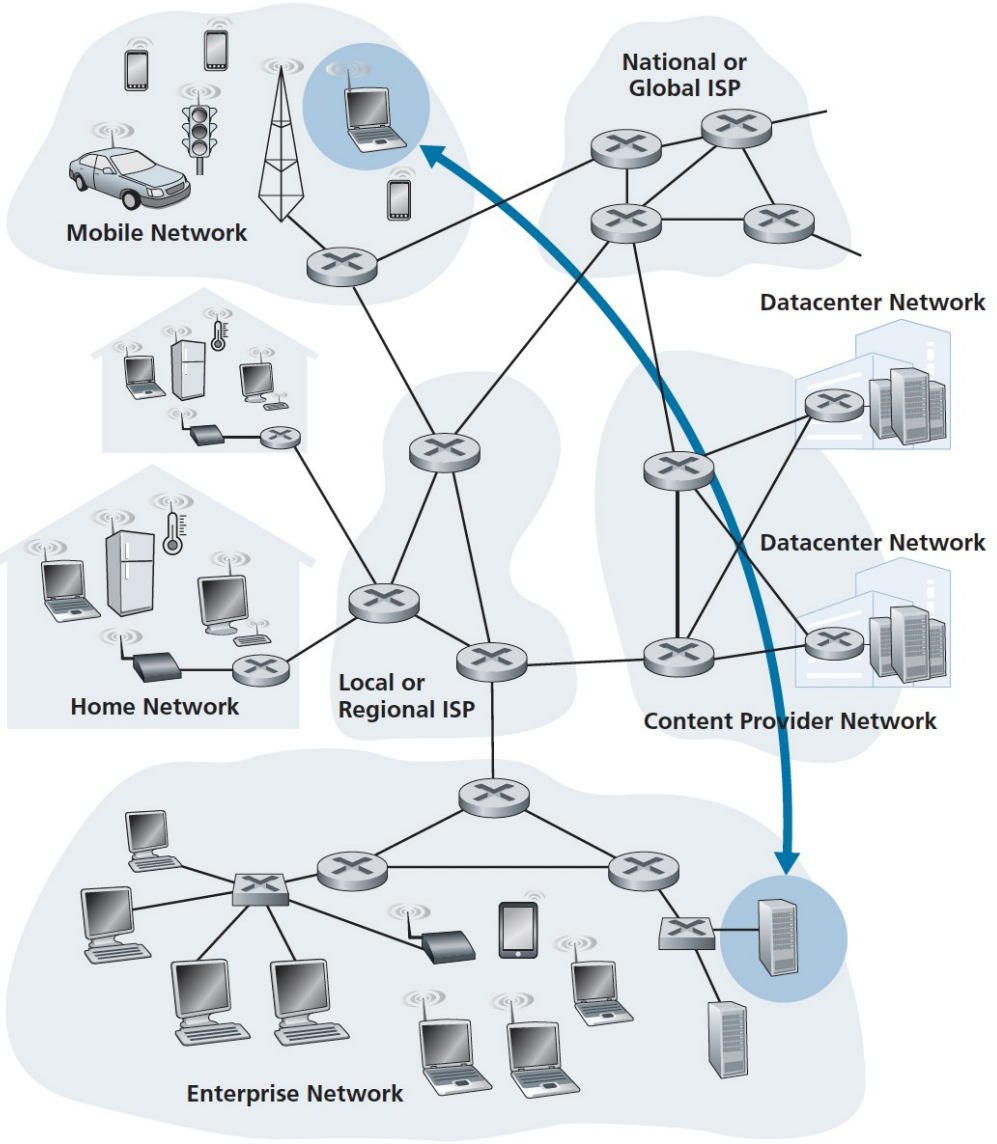
Protocol – Formal Definition

- Defines format and order of messages exchanged between two or more communicating entities
- Also: actions taken on the transmission and/or receipt of a message/other event

The Network Edge

- Reminder: Internet's end systems are machines and devices
- End systems referred to as hosts because they host application programs like a web browser program, web server, email client, etc.
  - Note – the book: host = end system
- Hosts can be further divided into clients and servers

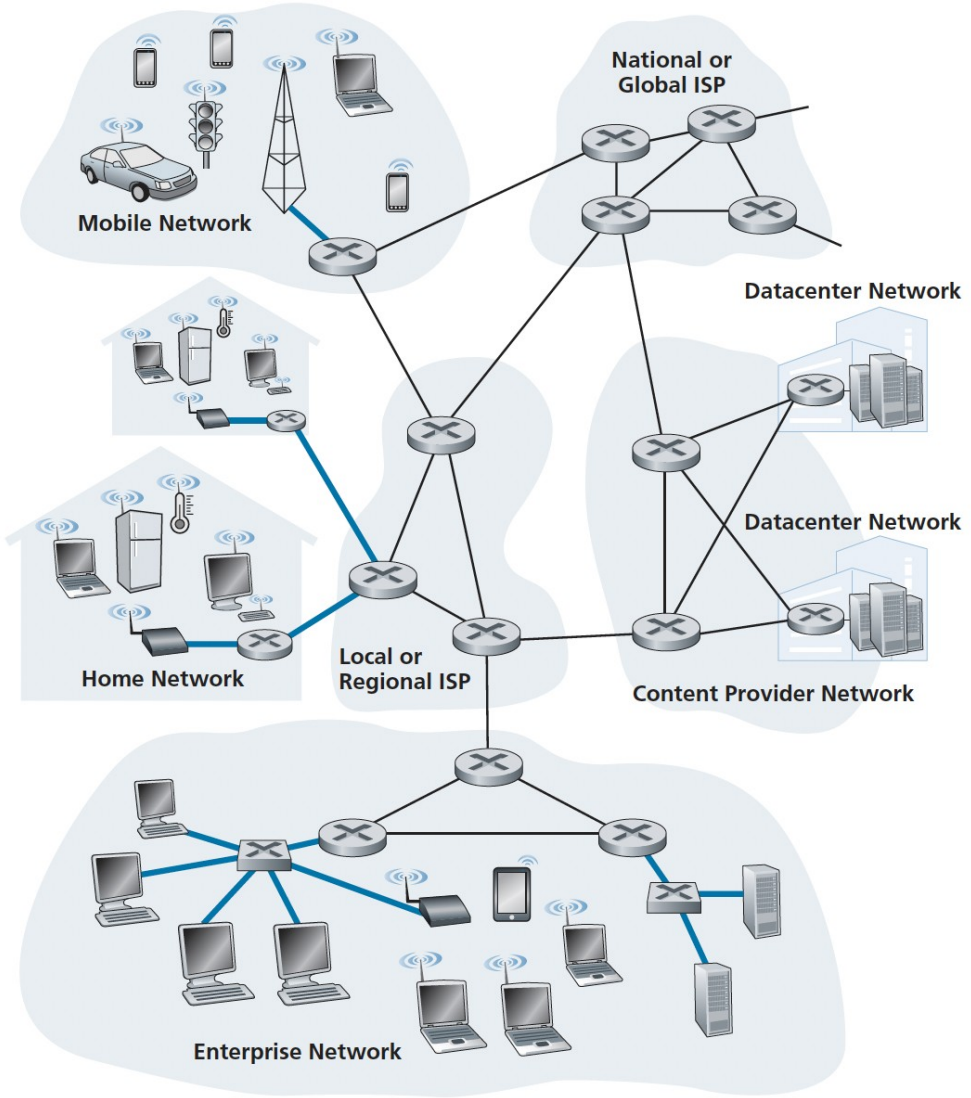
Figure 1.3 – End-System Interaction



Access Networks

- Network that physically connects an end system to the first router (known as “the edge router”) on a path from the end system to any other distant end system
- Home Access
  - DSL
  - Cable
  - FTTH
  - 5G Fixed Wireless

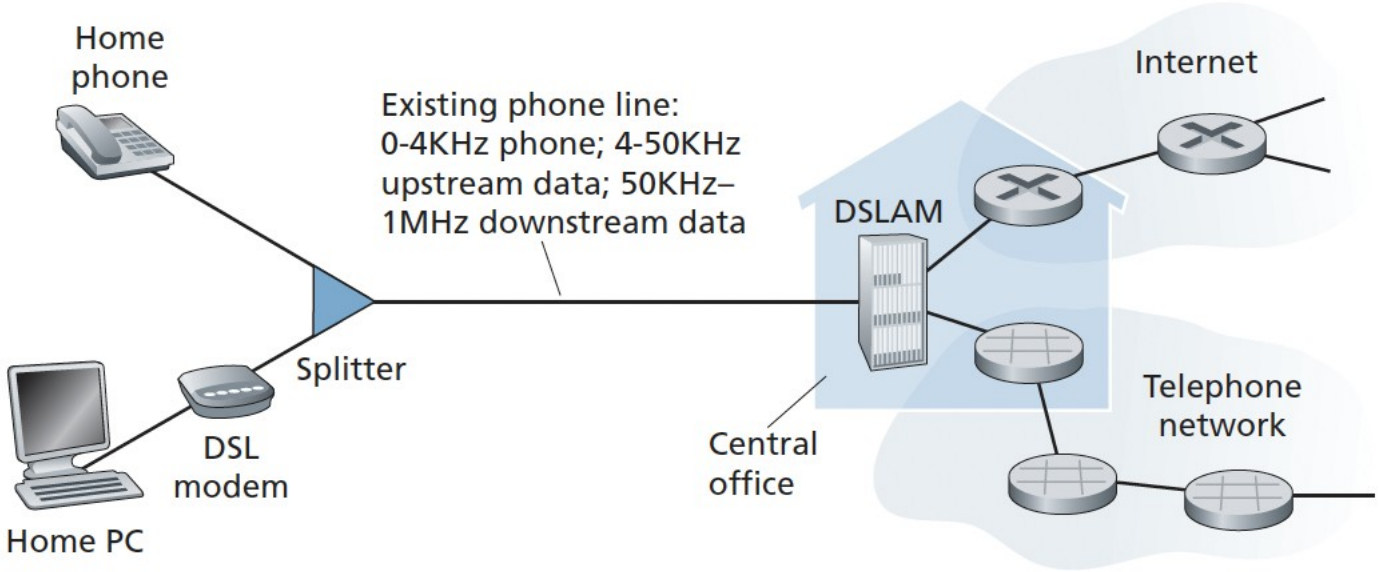
Figure 1.4 – Access Networks



Home Access

- Prevalent types of broadband residential access
  - Digital Subscriber Line (DSL)
    - Obtain Internet access from the same telephone company that provides wired local phone access
    - The ISP is the telephone company
    - Uses existing telephone line exchange data with a digital subscriber line access subscriber line access multiplexer in the local central office
    - Home’s DSL modem takes digital data and translates it to high-frequency tones for transmission over telephone wires
    - Residential phone line carries data and traditional telephone signals simultaneously
  - Cable

Figure 1.5 – DSL Internet Access



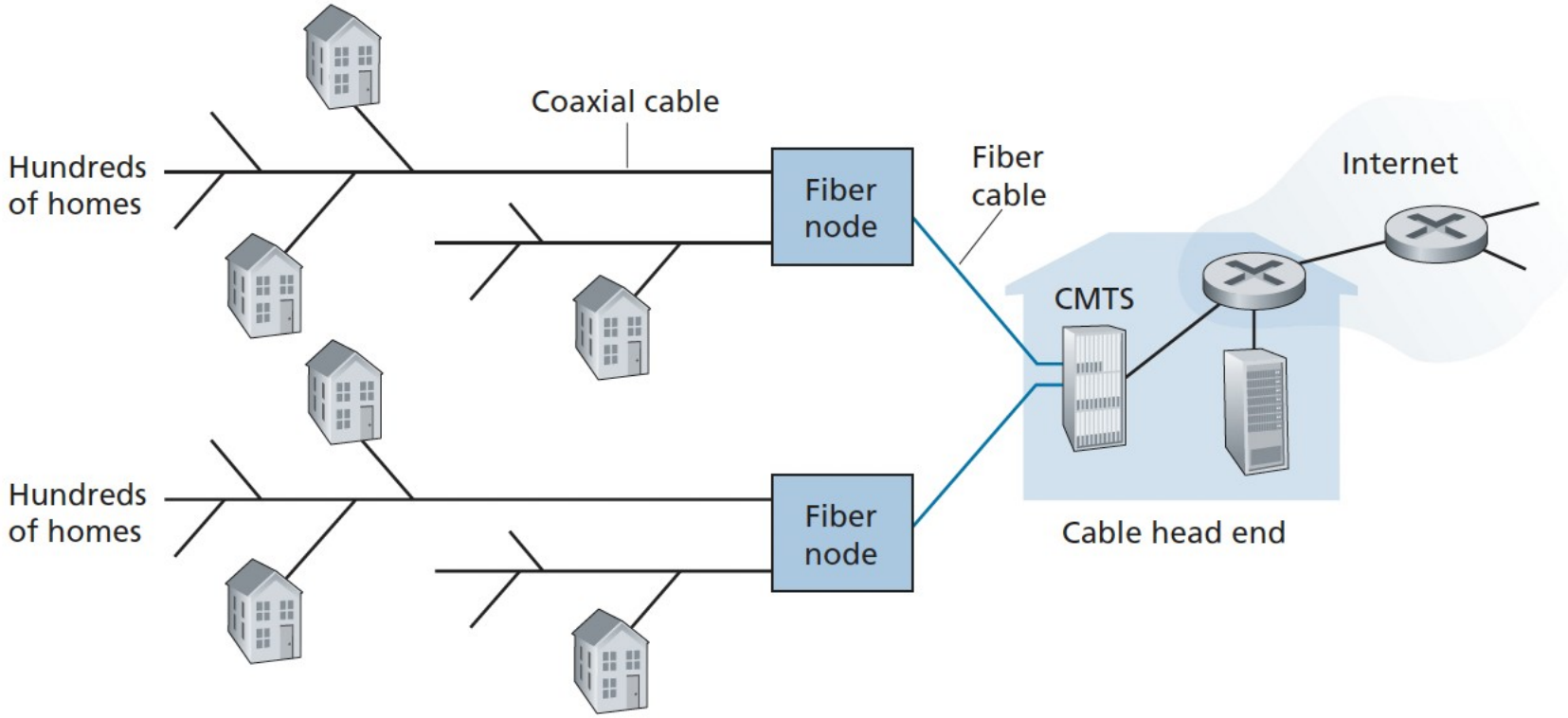
Cable Internet Access

- Makes use of the cable company's existing cable infrastructure
- Residence obtains cable Internet access from same company that provides its cable television
- Coax/fiber optics connect cable head end to neighborhood-level junctions, from where traditional coax cable is used to reach houses/apartments
- Requires special models
- At cable head end, modem termination is similar DSL
  - Analog signal sent from cable modems in downstream homes back into digital format
- Both DSL and Cable are asymmetric
  - Download channel allocated a higher transmission rate than upstream channel

More On Cable

- Shared broadcast medium
  - Every packet sent travels downstream on every link to every home and every packet sent by a home travels on the upstream channel to the head end
  - If several users are downloading simultaneously a video file, the actual rate at which each user receives its video file will be significantly lower
  - Conversely – fewer people online/web browsing – closer to full downstream rate

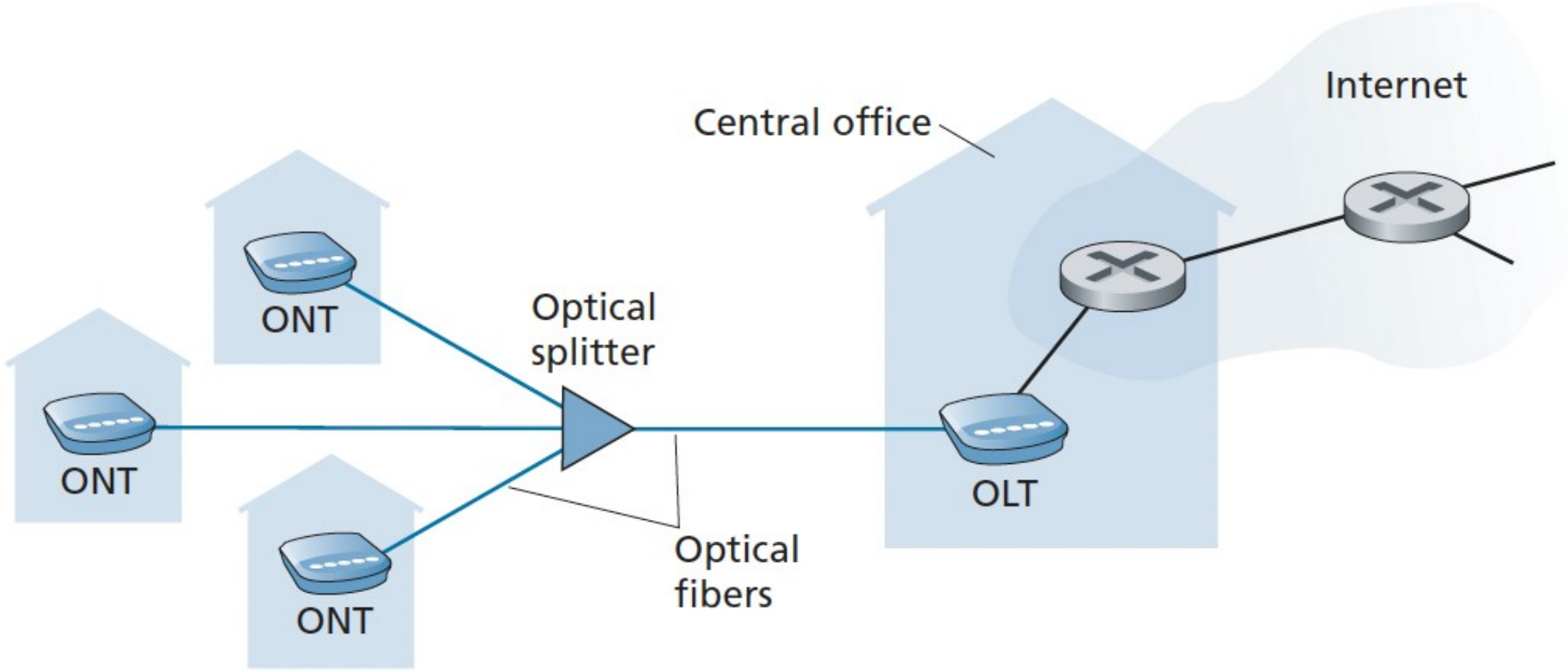
Figure 1.6 – A Hybrid Fiber-Coaxial Access Network



Fiber to the Home (FTTH)

- “Up-and-coming” technology for higher speeds
- Provide an optical fiber path to the home
- Direct fiber
  - One fiber leaving the central office for each home
- Another way with fiber
  - Each fiber leaving the central office is actually shared by many homes
  - Fiber is split when relatively close to a cluster of homes/customer-specific fibers
  - Splitting fiber
    - Active Optical Networks (AONs)
    - Passive Optical Networks (PONs) – if interested, read up on Verizon’s FiOS service
      - All packets sent to the splitter are replicated at the splitter

Figure 1.7 – FTTH Internet Access



5G Fixed Wireless

- Supposed high-speed residential access
- Will do so without installing costly and failure-prone cabling from the central office to the home
- Beam-forming technology – data is sent wirelessly from a provider’s base station to the modem in the home

Ethernet Internet Access

- Local Area Network (LAN)
  - Corporate
  - University setting
- Most prevalent technology in LANs
- Use twisted-pair copper wire to connect to an Ethernet switch
- Switch is then connected into the larger Internet
- Users – 100 Mbps to tens of Gbps access
- Servers – 1-10 Gbps access

Figure 1.8 – Ethernet Internet Access