



COMPUTER COMMUNICATION NETWORKS (UE22EC351A)

Department of Electronics and Communication Engineering

COMPUTER COMMUNICATION NETWORKS

**UNIT 1: INTERNET ARCHITECTURE AND APPLICATIONS –
Class 2 – Network Edge – Text book reference – Section 1.2
– Pages 39 - 51**

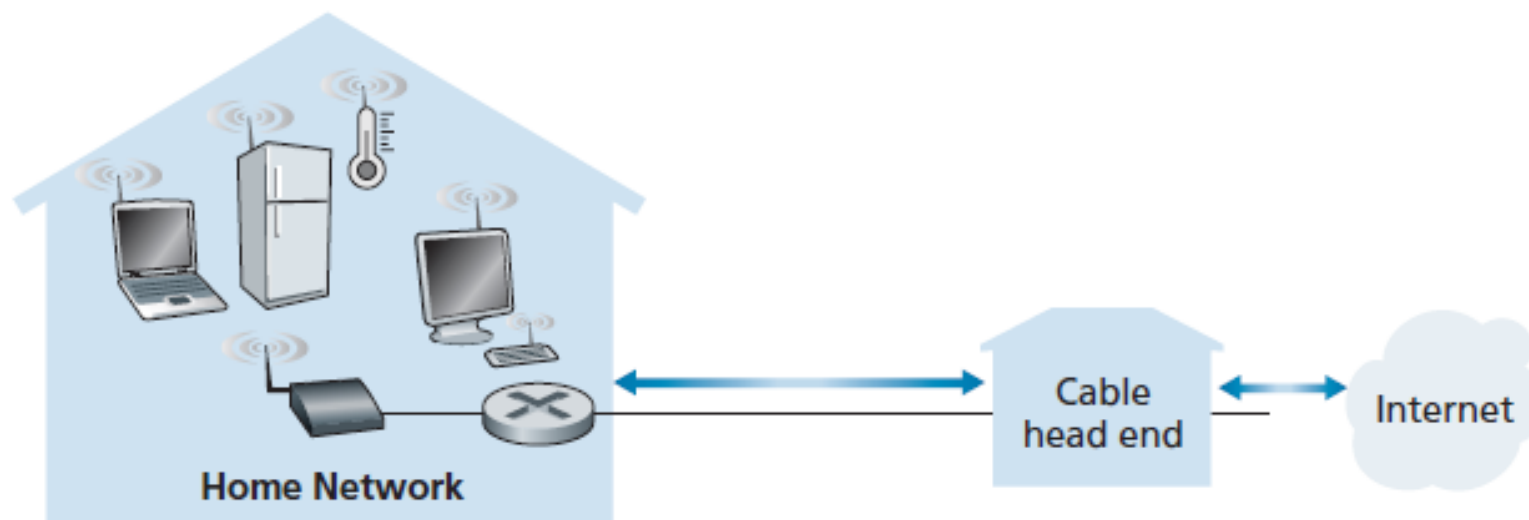
Class 2 - Network edge

- Computer networks that sit on the periphery of the internet constitute the **network edge** or the **access network**
- End-systems can be further classified as **clients** and **servers**
- Router which connect an access network to a regional/access ISP is referred to as gateway
- Access network nomenclature
- Based on size: Local area networks, home networks, wide area networks, etc.
- Based on topology: Tree, star, ring, bus, point-to-point.
- Based on physical media: Wired (DSL, Cable, Fiber to the home (FTTH)) or wireless

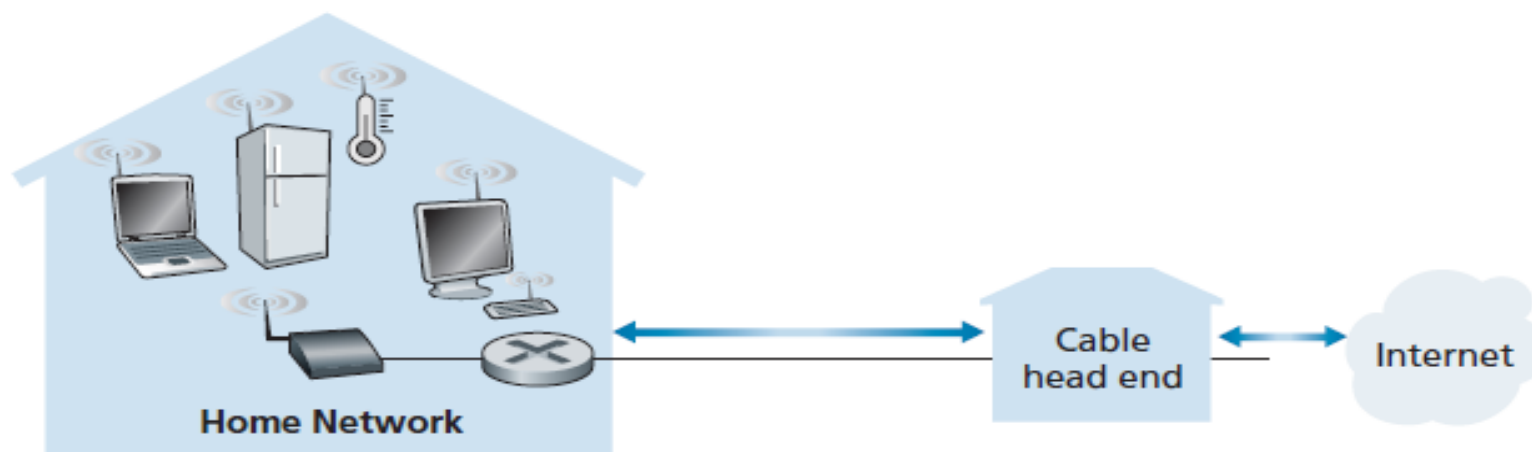
Class 2 - Network edge

- Home access networks

- The devices in the home are connected to the internet via a LAN or Wifi router
- Different physical media could be provided by different access ISPs to connect the home network with the internet

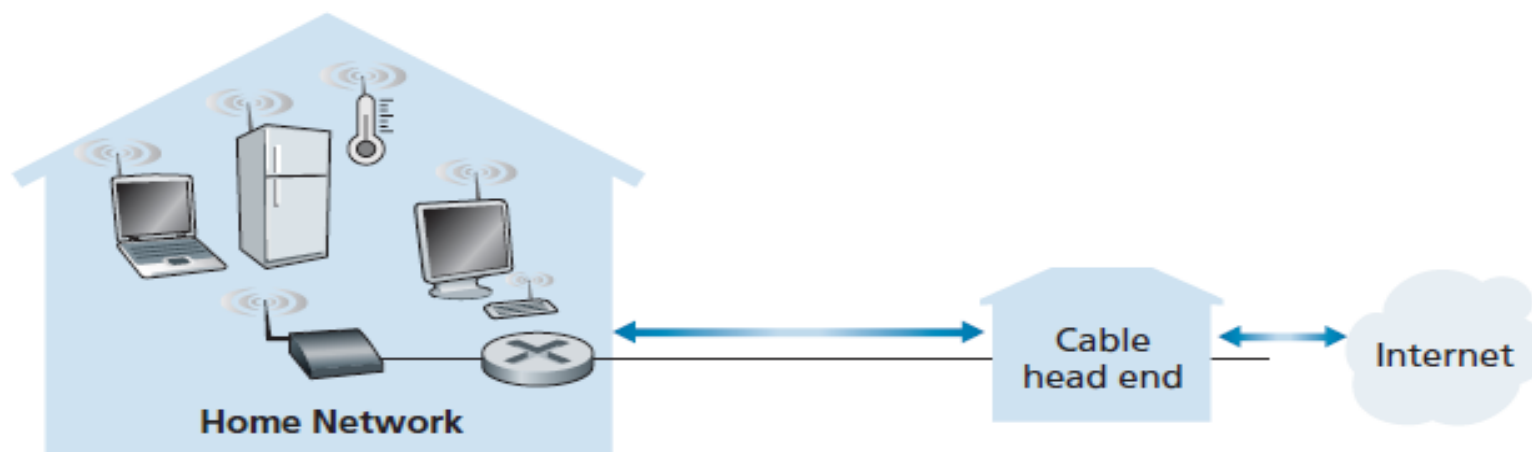


Class 2 - Network edge



- This home network consists of a **roaming** laptop, multiple Internet-connected home appliances, as well as a **wired PC**; a base station(**the wireless access point**), which communicates with the **wireless PC** and other wireless devices at home.

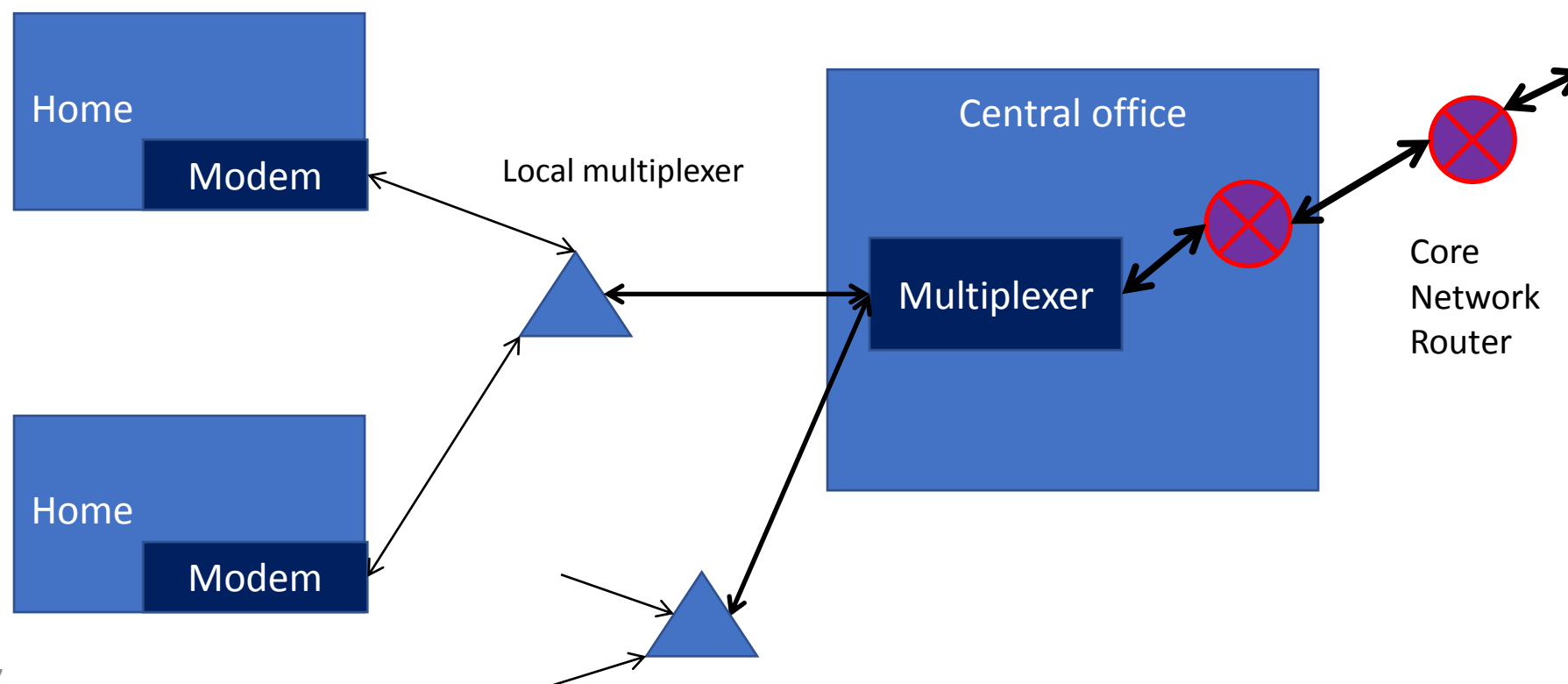
Class 2 - Network edge



- A **home router** that connects the wireless access point, and any other **wired home devices** to the internet.
- This network allows household members to have **broadband access** to the internet with one member roaming from the kitchen to the backyard to the bedrooms.

Class 2 - Network edge

- Home access networks
 - An infrastructure handled by a telecom or cable or fiber operator
 - General architecture is given below

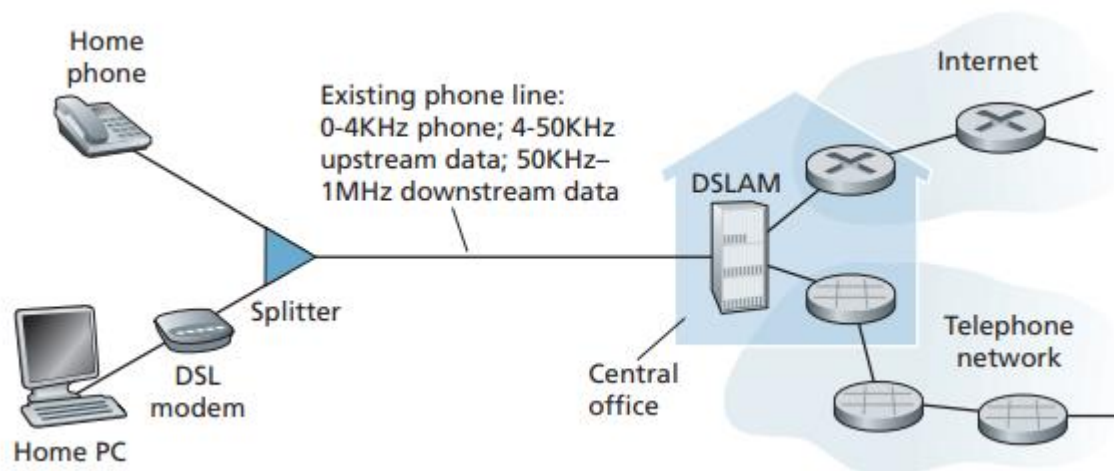


Class 2 - Network edge

| Feature | DSL based access network | Cable TV based access network | FTTH based access network |
|---------------------|---|---------------------------------------|-------------------------------|
| Modem | DSL modem | Cable modem | Optical modem |
| Local multiplexer | Splitter | Fiber node | Optical network terminator |
| Central office (CO) | DSL access multiplexer (DSLAM) | Cable modem terminating system (CMTS) | Optical line terminator (OLT) |
| Downlink rates | 12 Mbps [ITU 1999] and 24 Mbps [ITU 2003] | DOCSIS 2.0 standard 42.8 Mbps | 100 Mbps (cable length based) |
| Uplink rates | 1.8 Mbps [ITU 1999] and 2.5 Mbps [ITU 2003] | DOCSIS 2.0 standard 30.7 Mbps | 30 Mbps (cable length based) |

Class 2 - Network edge

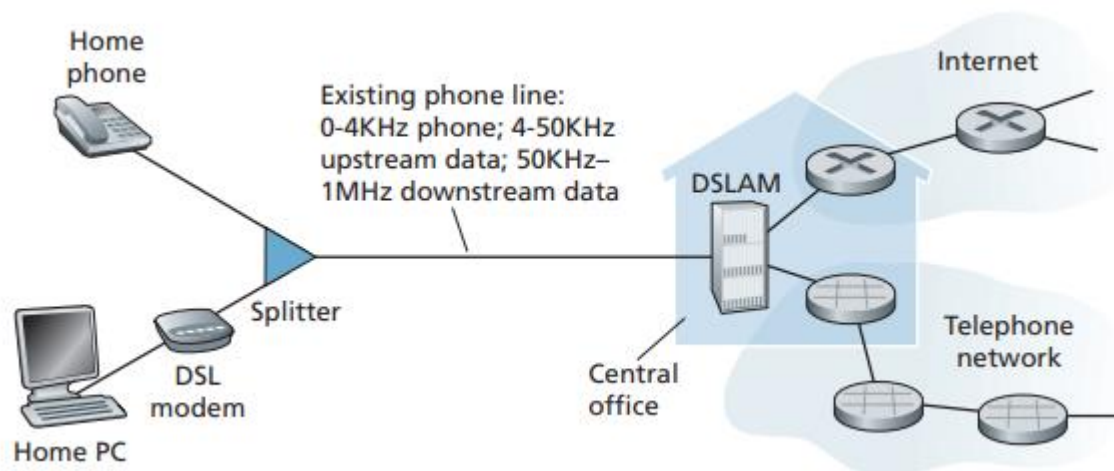
- DSL Internet Access



- DSL is used when a customer's telephone company is also its ISP.
- Each customer's DSL modem uses the existing telephone line exchange data with a digital subscriber line access multiplexer (DSLAM) located in telephone company's local central office

Class 2 - Network edge

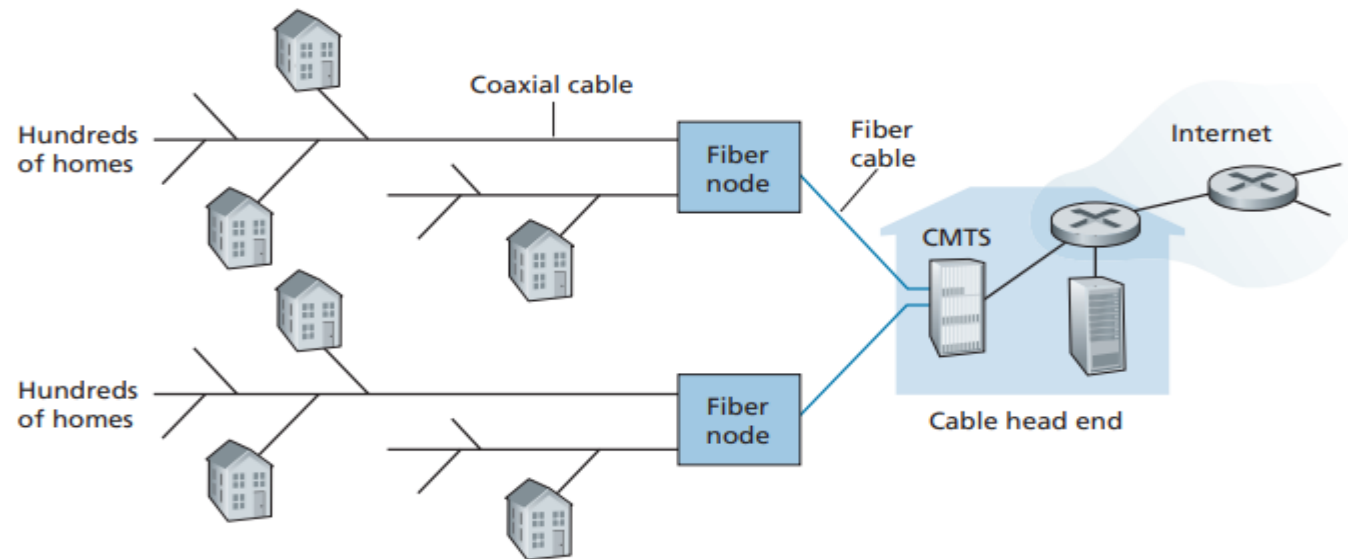
- DSL Internet Access



- The Home's **DSL modem** takes digital data and translates it into high frequency tones for transmission over telephone wires to the CO;
- The analog signals from many such houses are translated back into digital format at the **DSLAM**.

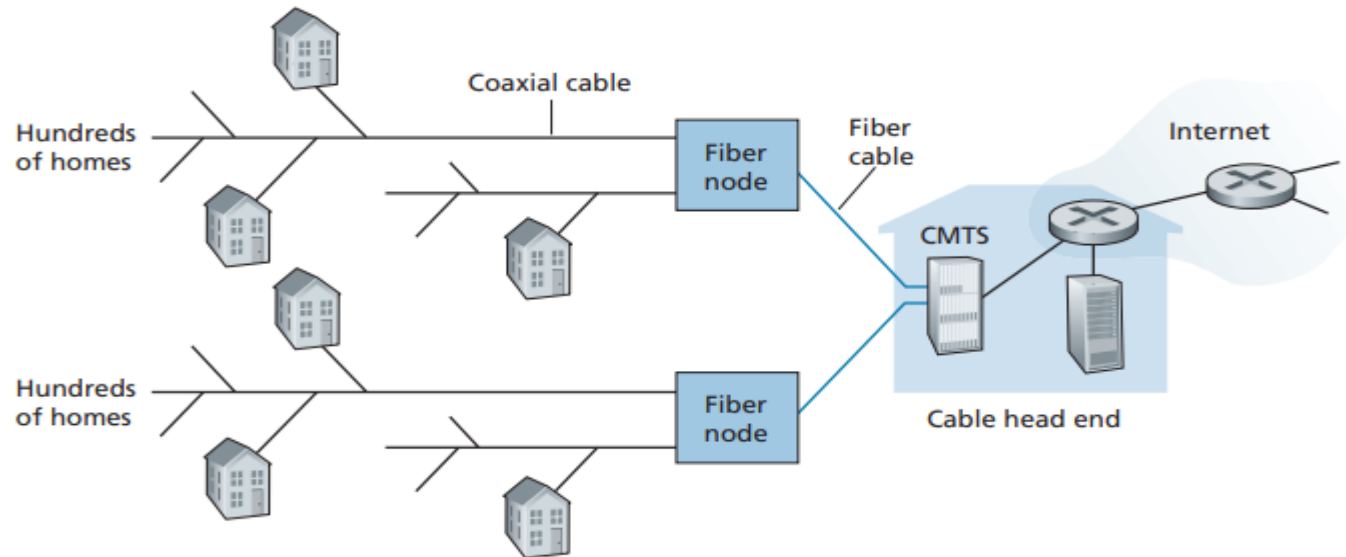
Class 2 - Network edge

- A hybrid fiber-coaxial access network



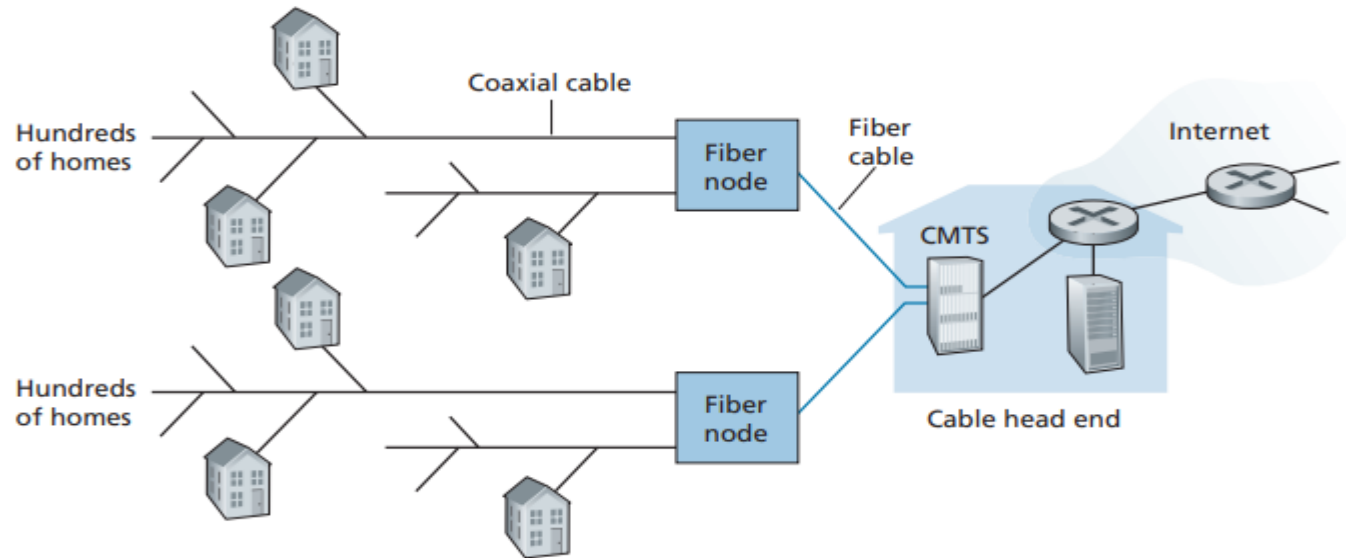
- **Fibre Optics** connect the cable head end to **neighborhood-level junctions**, from which traditional coaxial cable is then used to reach individual houses & apartments.

Class 2 - Network edge-A hybrid fiber-coaxial access network



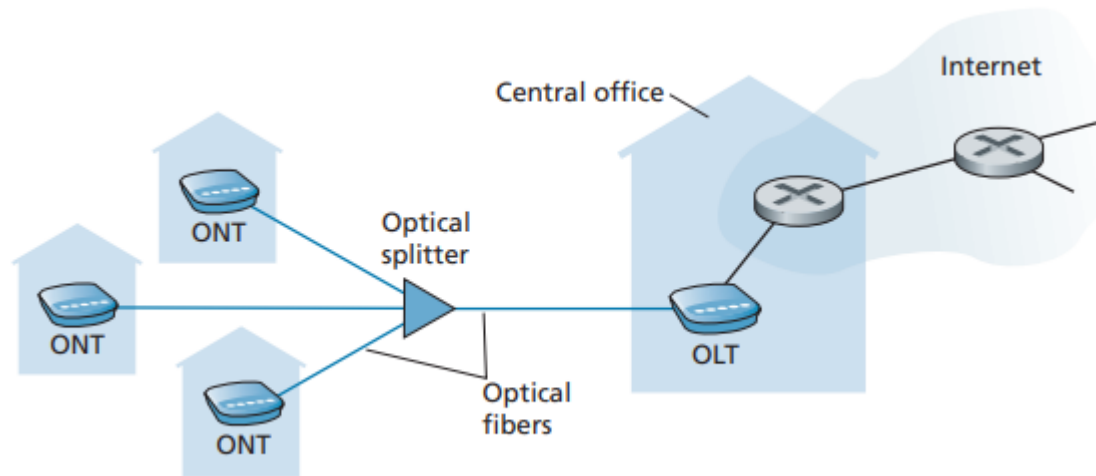
- Each neighborhood junctions typically supports **500 to 5,000** homes.
- Because both fiber & coaxial cable are employed in this system, it is often referred to as hybrid fiber coax (**HFC**).

Class 2 - Network edge-A hybrid fiber-coaxial access network



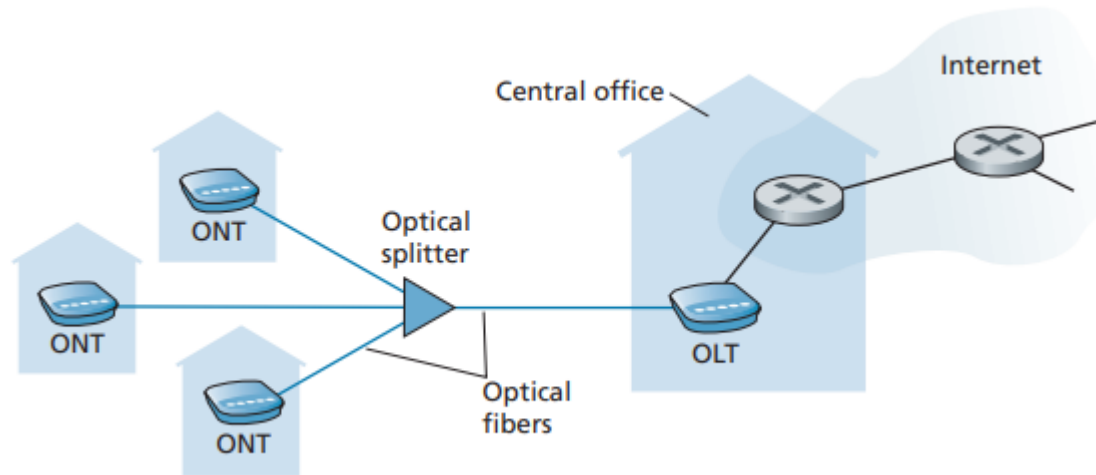
- At the cable head end, the **cable modem termination system** (CMTS) serves a similar function as the DSL network's DSLAM – turn the analog signal sent from the cable modems in many downstream homes back into digital format.

Class 2 - Network edge-FTTH Internet Access



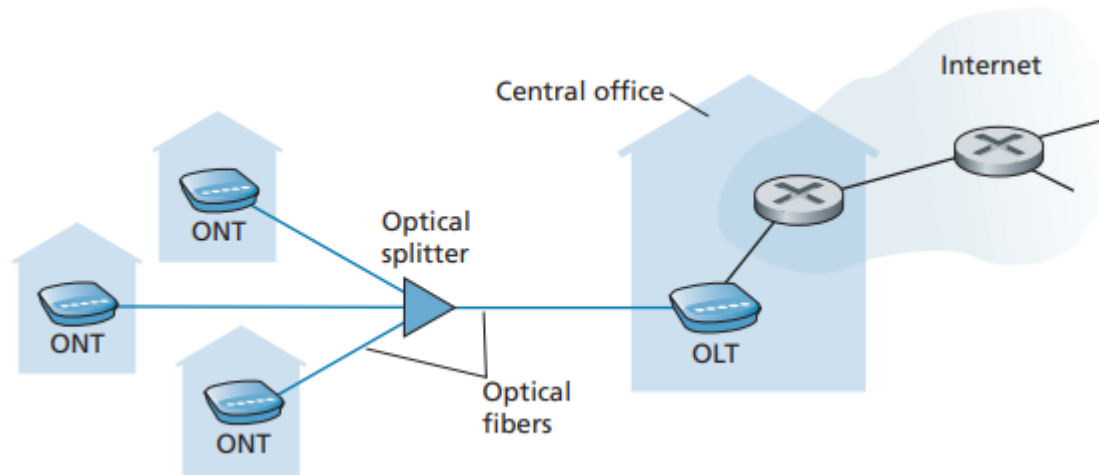
- Figure shows Fiber to the Home(**FTTH**) using Passive Optical Networks (**PON**) distributed architecture.
- Each home has an optical network Terminator (**ONT**) which is connected by dedicated optical fiber to a neighborhood splitter.

Class 2 - Network edge-FTTH Internet Access



- The splitter combines a number of homes onto a single, shared optical fiber, which connects to an optical line terminator(OLT) in the telephone company's central office (CO)

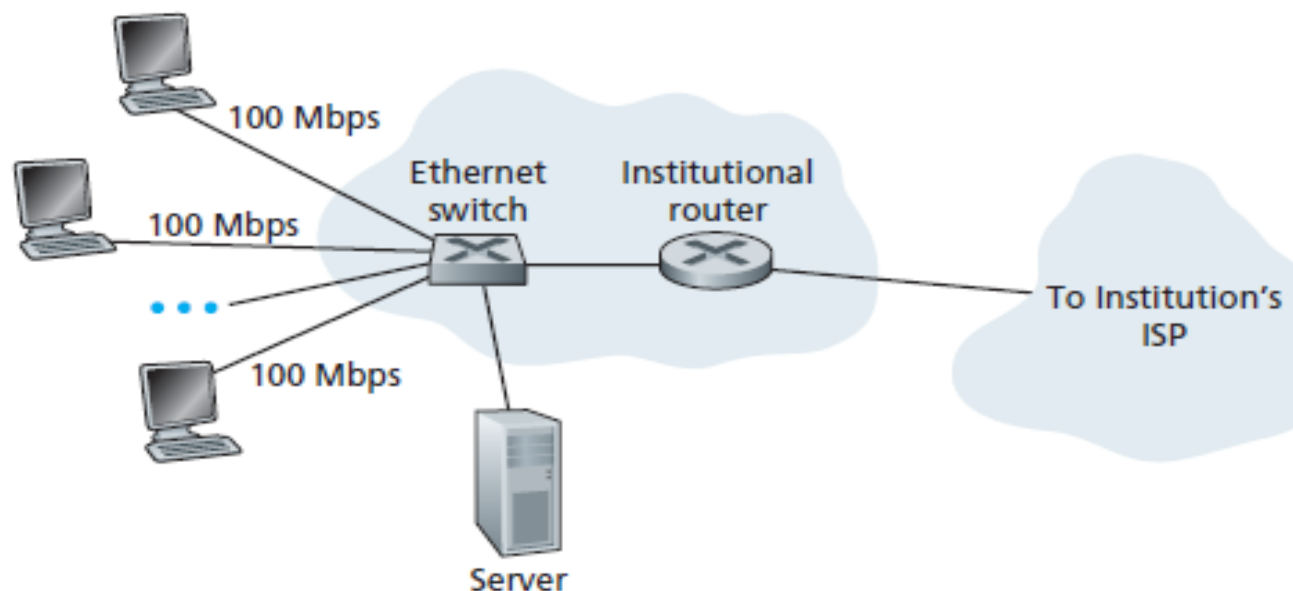
Class 2 - Network edge-FTTH Internet Access



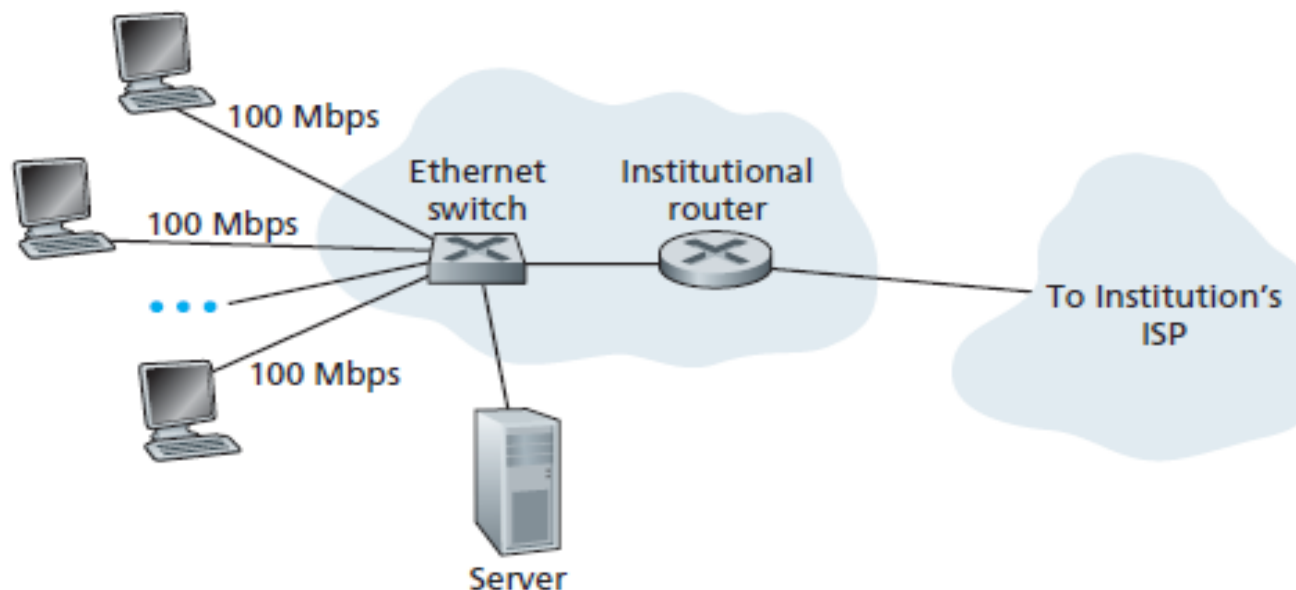
- The OLT, providing conversion between optical and electrical signals, connects to the internet via a telco router.

Class 2 - Network edge – Enterprise Access Network

- Enterprise access network
 - ISP can be telecom operator
 - Built using Ethernet cables, switches and hubs
 - Ethernet switches are preferred over routers in a LAN
 - Routers are used for separating the network into subnets

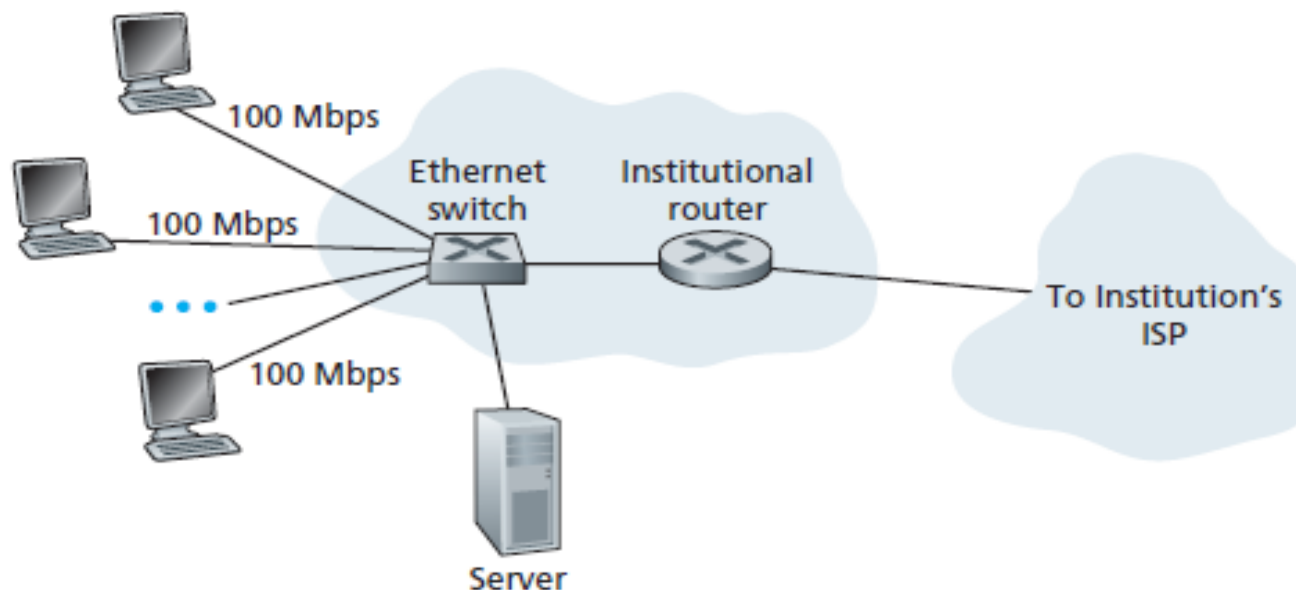


Class 2 - Network edge – Enterprise Access Network



- Ethernet users use **twisted-pair copper** wires to connect to an Ethernet switch.
- The Ethernet switch, or a network of such interconnected switches, is then connected into the larger internet.

Class 2 - Network edge



- With Ethernet access, users typically have **100 Mbps** to tens of Gbps access to the **Ethernet switch**, whereas servers may have 1 Gbps or 10Gbps access.

Class 2 - Network edge

- **Wireless networks:**
 - Classified according to radio access technologies
 - Spread spectrum, frequency hopping, random access, polling methods, etc.
 - More complex compared to wired access networks
 - Packet losses and time varying wireless channel characteristics
 - Wireless networks can be **WiFi-based** or **cellular-based**
 - Wireless networks are usually supported by telecom ISPs
 - Span of wireless networks can be few meters to several kilo meters
 - Wireless networks have undergone tremendous evolution especially with the exploding data requirements of the users

Class 2 - Network edge

- Satellite access networks:
 - Remote end systems get access to the internet via satellite links
 - Implemented when other access networks are not feasible
 - Has lowest data rates among access networks
 - The delays are higher. It depends on the distance between the satellite and the users and the type of satellite

Class 2 - Network edge

- **Satellite access networks:**
 - A communication satellite links two or more Earth-based microwave transmitter/receivers, known as ground stations.
 - The satellite receives transmissions on one frequency band, regenerates the signal using a repeater and transmits the signal on another frequency.
 - Types of satellites: **geostationary satellites** and **low-earth orbiting (LEO) satellites**
 - Geostationary satellites permanently remain above the same spot on earth.
 - This stationary presence is achieved by placing the satellite in orbit at **36,000 kilometers** above Earth's surface.
 - This huge distance from ground station through satellite back to ground station introduces a substantial **signal propagation delay**.



THANK YOU

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