

- Telephone
- "splitter" multiplexes the "telephone signal" & analog signal
- These multiplexed signal was passed to 'co' through "FDM".
- "co" gets "n" multiplexed signal. Each user is splitted (n users) into Telephone (as Voice) & Data (to Isp) by OSLAM

- * Existing Voice data : 0-4 kHz
 - * upload data : 4-50 kHz
 - * download data : 50K - 1MHz
 - * Ideal distance: 5-10 mile
- } white space through FDM

- Home DSL modem takes digital data and translates it to high frequency tones for transmission over telephone wires to the "CO"

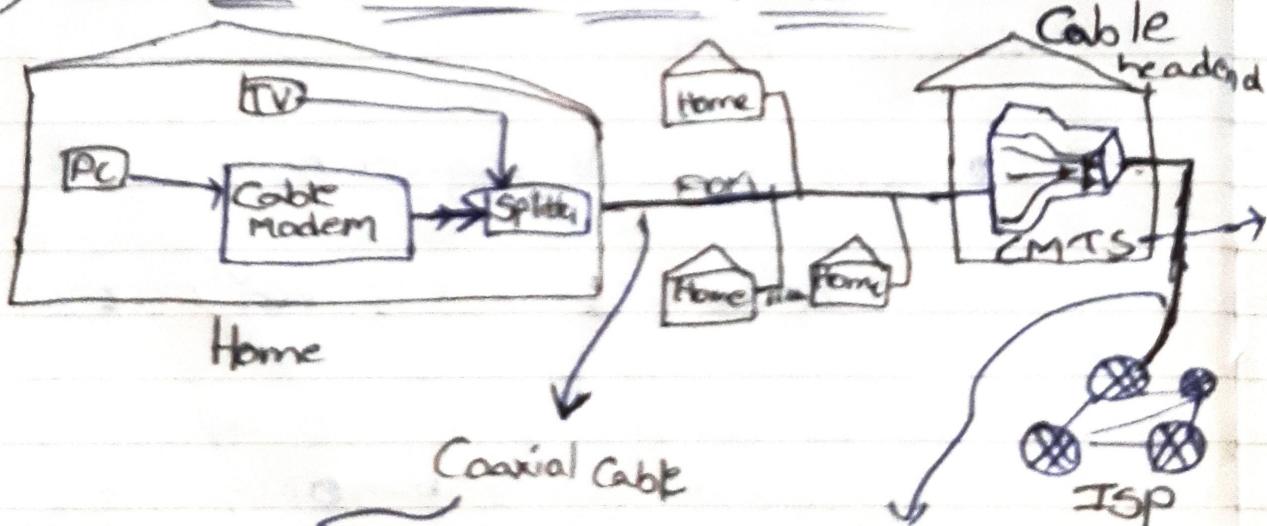
- If download speed & upload speed are different then it is known as "Asymmetric Network"
 - Hundreds, thousands of household connected to single 'DSLAM'
 - Each DSL has different standards (different transmission rate) like ITU 1999, ITU 2006
- | | | |
|---|---|--|
| ↓ | 12 Mb download speed
1.5 Mb upload Speed | 55 Mb/sec download speed
15 Mb/sec upload speed |
|---|---|--|

∴ It is Asymmetric Network (_{download & upload speed})

- The actual download & upload speeds achieved may be less due to distance and the degree of electrical Interference.

2.

Cable based Access networks:



It is same for Cable headend & homes.

→ So, data coming from all homes is multiplexed using **FDM**

So, Cable based Access Networks is also known as Hybrid Fiber Coaxial Cable networks (HFC).

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Cable Modem Terminal System

Frequency division multiplexing

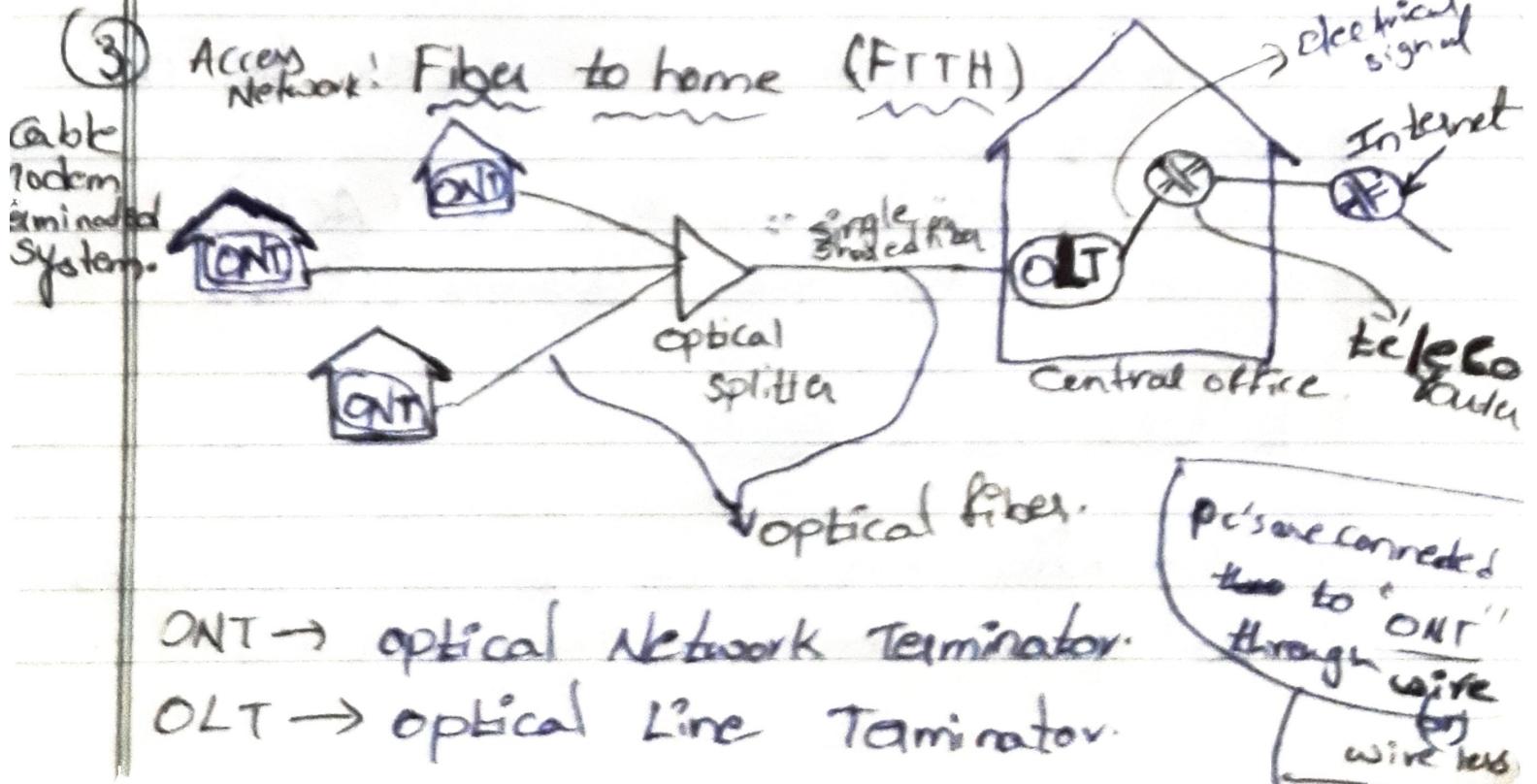
FDM:- Different channels are transmitted in different frequency bands.

- Each cable modem has different standards like "DOCSIS 2.0"
 - Download speed: 42.8 Mb/sec
 - Upload speed: 30.7 Mb/sec
- Same coaxial cable is shared between different houses (through FDM)

DRAW

Draw Backs:

- When all the houses are accessing more data then they will get slowly.



FTTH

provides optimal fiber path ~~directly~~ from the "CO" directly to home.

→ simplest optical distribution network is called direct fiber, with one (1) fiber leaving the "CO" for each home.

)

→ More ~~Commonly~~ But actually:

Each fiber leaving the CO is actually shared by many homes & then using Splitter ^{it will} ~~get~~ Optical splitter splits data to different houses.

→ we use optical splitter when the houses are closely together.

To perform optical splitting can be done in 2 ways

(1) active optical network (AONs)

(2) passive optical network (PONs)

FTTH using PON's

→ Each ^{home} has an ONT, which is connected to optical fiber to a neighborhood splitter.

→ Splitter Combines a no. of houses into a "Single Shared fiber" then it is connected to OLT

OLT :- Optical Line Terminator :-

→ It converts the data (coming from optical fiber) is converted to Electrical signal.

→ Electrical signal is passed through teleco's router
~~(it is converted to)~~
→ it is connected to Internet.

→ FTTH can provide internet access in gbps/sec

Satellite and Dial Up Connections:-

→ In some rural areas FTTH, Cable, DSL are not available. satellite link can be used for that locations.

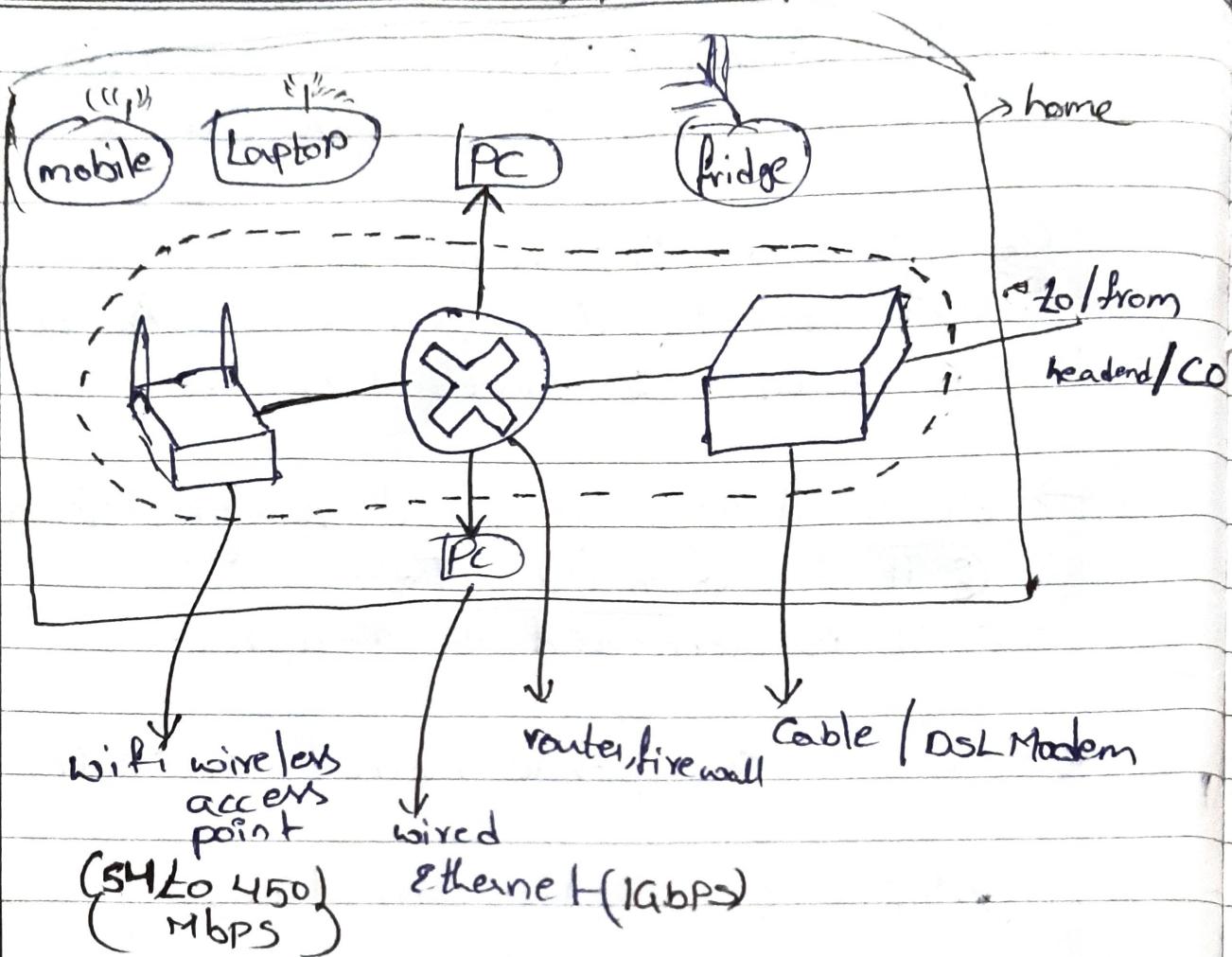
→ Satellite links provides more than 1mb/sec

→ Dial-up ^{Connection}: - It is used as similar to DSL
→ a home modem connects over a phone line to a modem in the ISP.

→ Dial ^{up} ~~speed~~ connection: provides very low speed

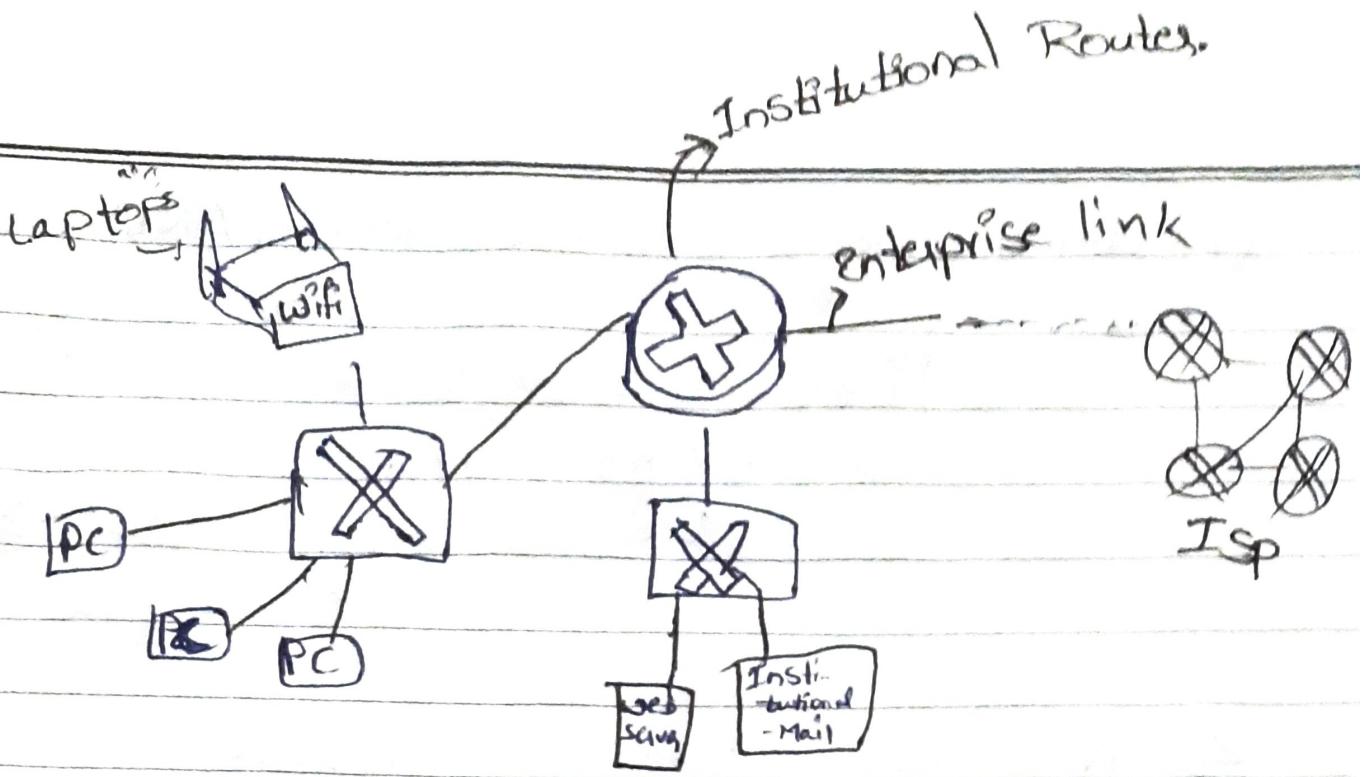
• (56 K b/sec)

Access Networks! Home Network!



Access Networks! Enterprise Network

- "Institutional router" is connected to Enterprise Link
- "Enterprise link" is connected to ISP
- Institutional router is connected to packet switches.
- 1 packet switch is connected to "Institutional web server".



→ 2nd packet switch is connected to end systems.
 ↳ wired or wireless.

→ Using LAN (Local Area network) we connect "end system to packet switch".

→ Ethernet :- wired access at 100 mb/sec, 1Gb/sec
 ↳ Ethernet users use twisted-pair copper wire to connect ethernet switch.

→ wifi :- wireless access points at 11, 54, ~~150~~^{Mb/sec}
 ↳ speed based on type of router.

Wireless access networks:-

→ It shares wireless access network connects end system to router.
 (via "access point")

→ It is of two types