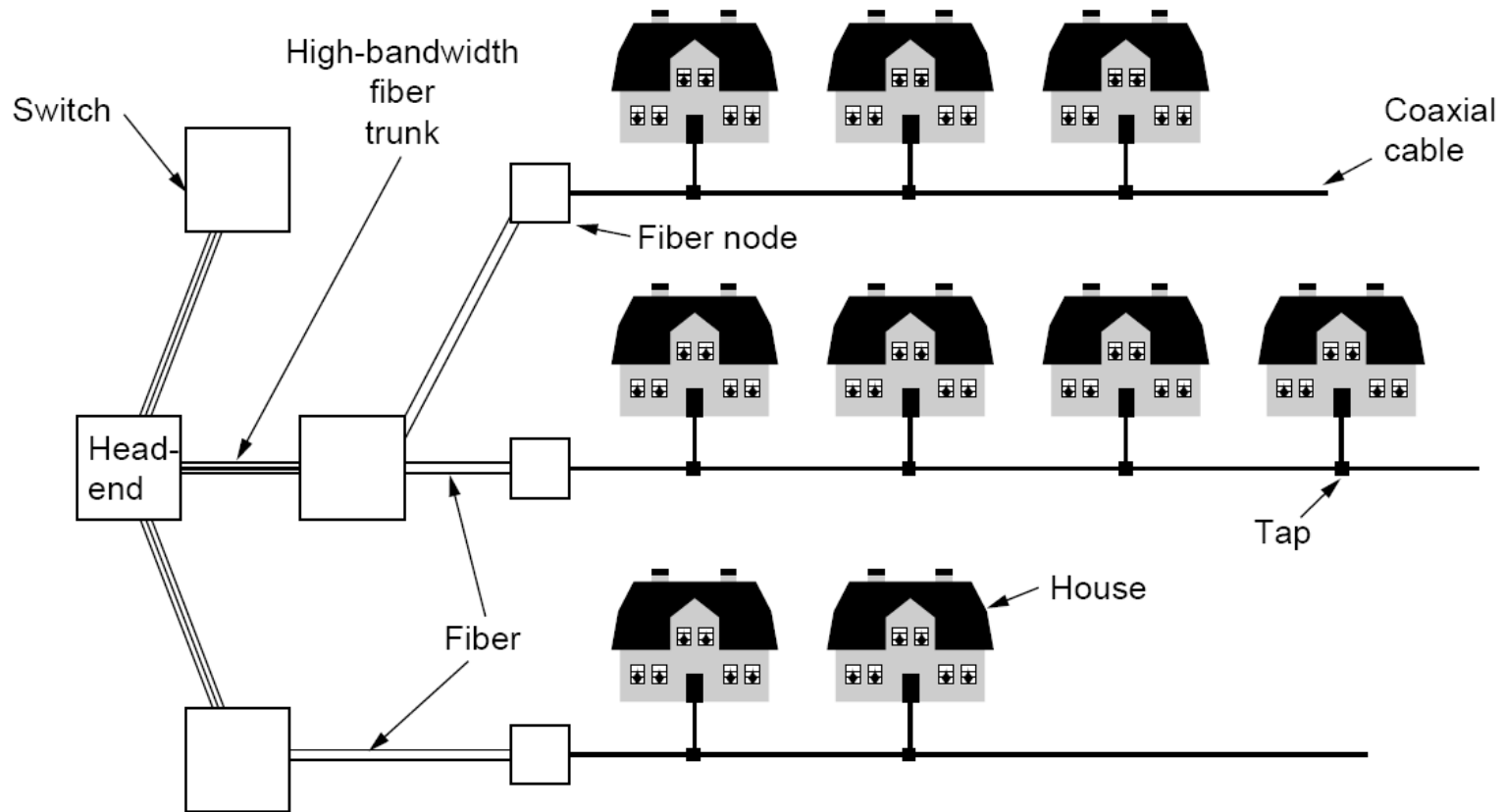


# Telecommunication systems

# Topology



500 to 2000 homes  
Distances up to 100 Km

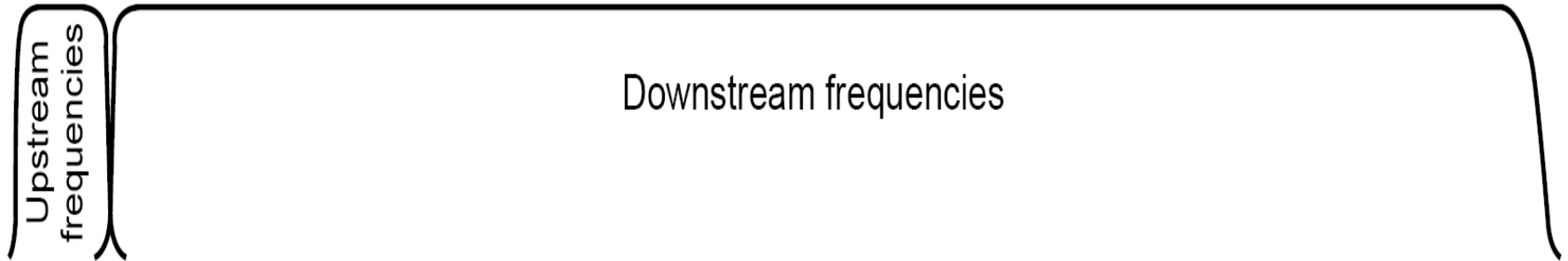
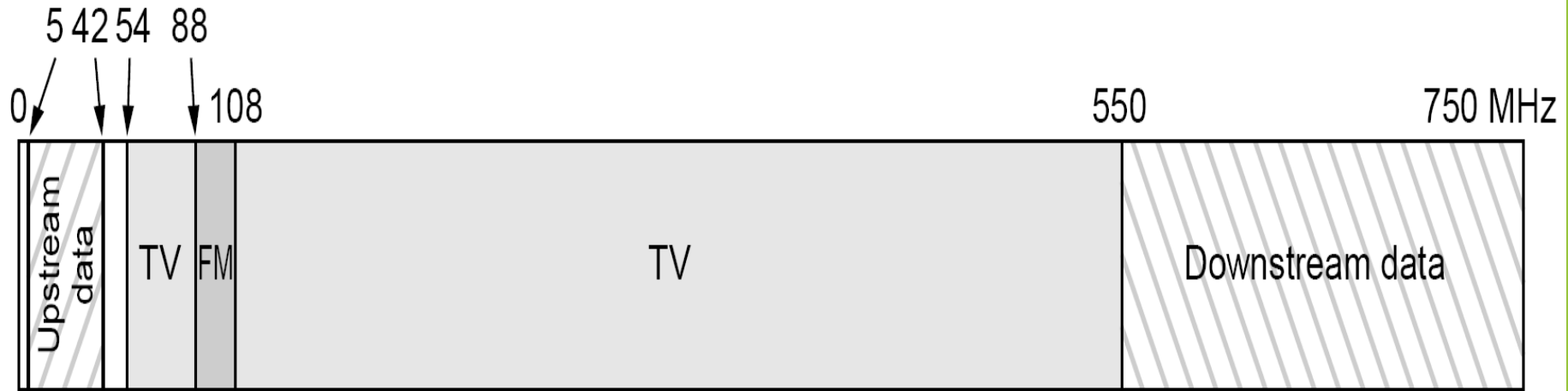
# Terminology

- ▶ CMTS: Cable Modem Termination System. Central device for connecting the cable TV network to a data network like the internet. Normally placed in the headend of the cable TV system.  
Downstream:
- ▶ Headend: Central distribution point for a CATV system. Video signals are received here from satellites and maybe other sources, frequency converted to the appropriate channels, combined with locally originated signals, and rebroadcast onto the HFC plant.
- ▶ MSO: Multiple Service Operator. A cable TV service provider that also provides other services such as data and/or voice telephony.

# Terminology

- ▶ Upstream: The data flowing from the Cable Modem to the CMTS.
- ▶ Downstream: The data flowing from the CMTS to the cable modem.
- ▶ Ranging: The process of automatically adjusting transmit levels and time offsets of individual modems, in order to make sure the bursts coming from different modems line up in the right timeslots and are received at the same power level at the CMTS.
- ▶ SID (Service ID): Used in the DOCSIS standard to defines a particular mapping between a cable modem (CM) and the CMTS. The SID is used for the purpose of upstream bandwidth allocation and class-of-service management.

# Spektrum



Both upstream and downstream bands are shared by the subscribers.

### Upstream Sharing

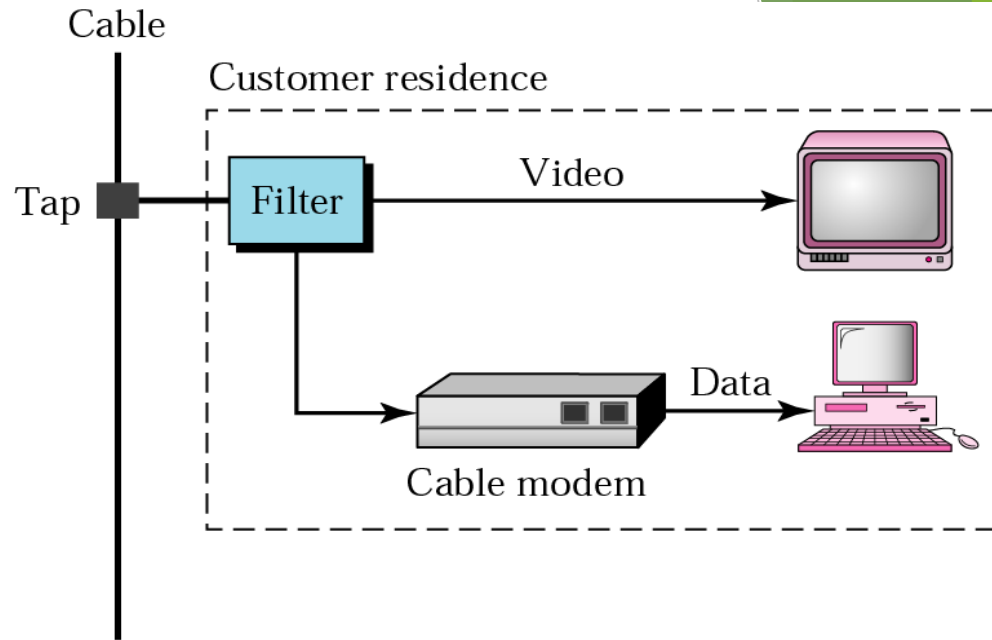
- Bandwidth is 37 MHz, there is 6 MHz channels.
- How can six channels shared in an area with 1000, 2000 or 100,000 subscribers.
  - The solution is time sharing by dividing the band into channels using FDM.
  - One channel is allocated for upstream for one subscriber.

### Downstream sharing

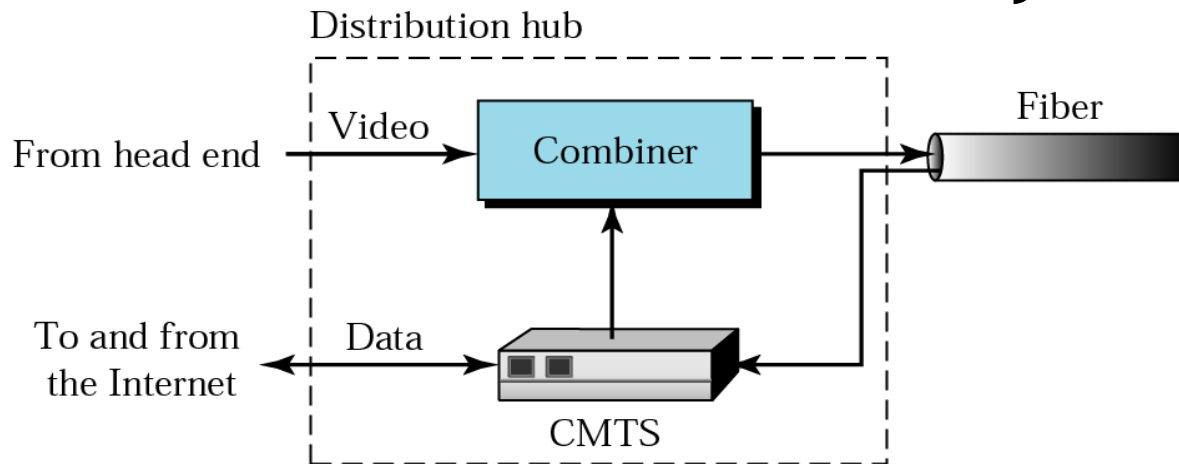
- Has 33 channels of 6 MHz.
- Each channel must be shared between a group of subscribers.
- Here we have a multicasting situation.
  - Subscriber with the matched address receives the data and the other subscribers discard the data.

# CM and CMTS

- Cable Modem



- Cable Modem Transmission System



# Upstream

- ▶ The CMTS allocates bandwidth to the CMs by reserving mini-slots in the upstream direction.
- ▶ The mini-slots have a certain time length depending on the modulation. A typical length of a mini-slot is 0.0125 milliseconds, and 16 byte.



# DOCICS

DOCSIS defines all the protocols necessary to transport data from a CMTS to a CM.

## Upstream Communication

1. The CM checks the downstream channels for a specific packet periodically sent by the CMTS. The packet asks any new CM to announce itself on a specific upstream channel.
2. The CMTS sends a packet to the CM, defining its allocated downstream and upstream channels.
3. The CM then starts a process, determines the distance between the CM and CMTS. This process is required for synchronization between all CMs and CMTSs for minislots used for timesharing of the upstream channels.
4. The CM sends a packet to the ISP, asking for the Internet address.
5. The CM and CMTS exchange some packets to establish security parameters.
6. The CM sends its unique identifier to the CMTS.
7. Upstream communication can start in the allocated upstream channel: the CM can contend for minislots to send data.

## Downstream Communication

The CMTS sends the packet with the address of the receiving CM, using the allocated downstream channel.

# Upstream

- ▶ The upstream bandwidth is 37 MHz.
- ▶ There are six 6-MHz channels available.
- ▶ *How can the channels be shared in an area with 1000,2000 or even 200,000 subscribers?*
- ▶ Using FDM/timesharing.
- ▶ Subscribers have to contend for the channels with others.

# Downstream

- ▶ The downstream band has 33 channels of 6 MHz.
- ▶ We have a multicast situation.
- ▶ If there is data for any of subscribers in the group, the data are sent to that channel.