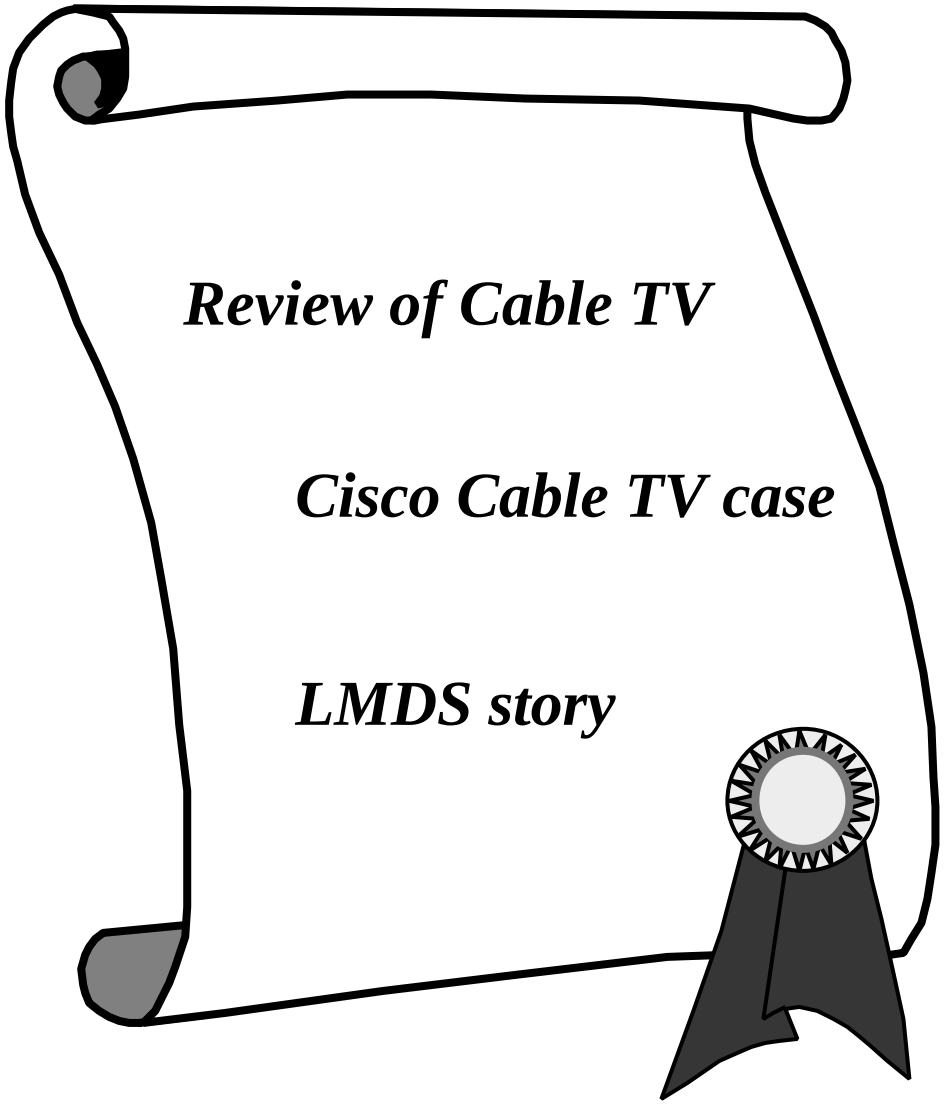
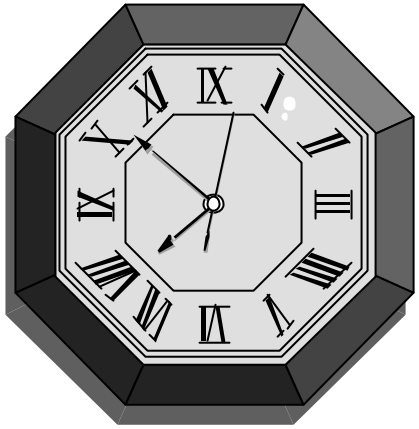
Today's Issue (May 4)



Review of Cable TV

Cisco Cable TV case

LMDS story

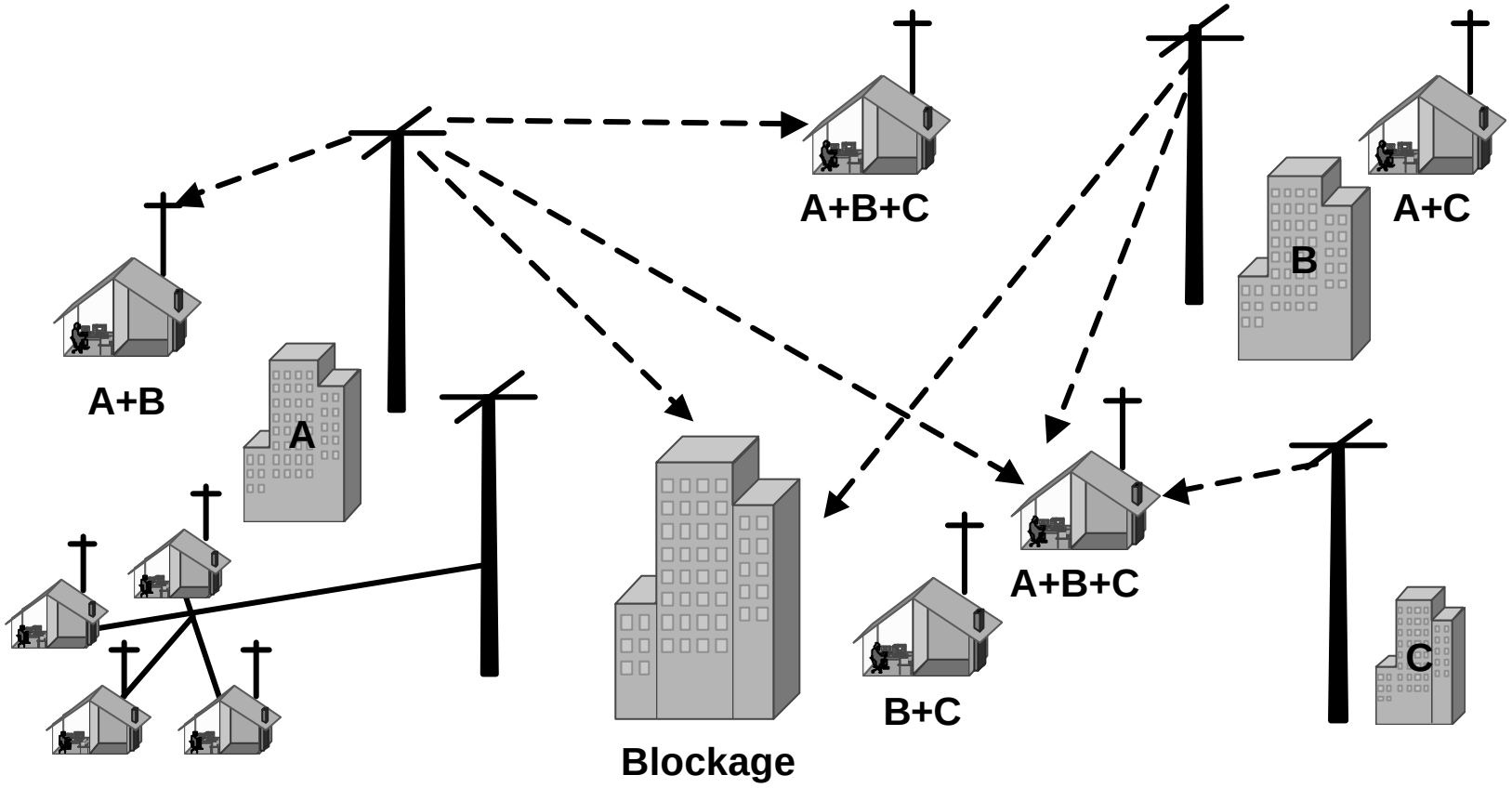


Cable

It’s not just for TV

Cable Systems can deliver data at 30 MB/s while also carrying telephone and TV traffic

Cable Network

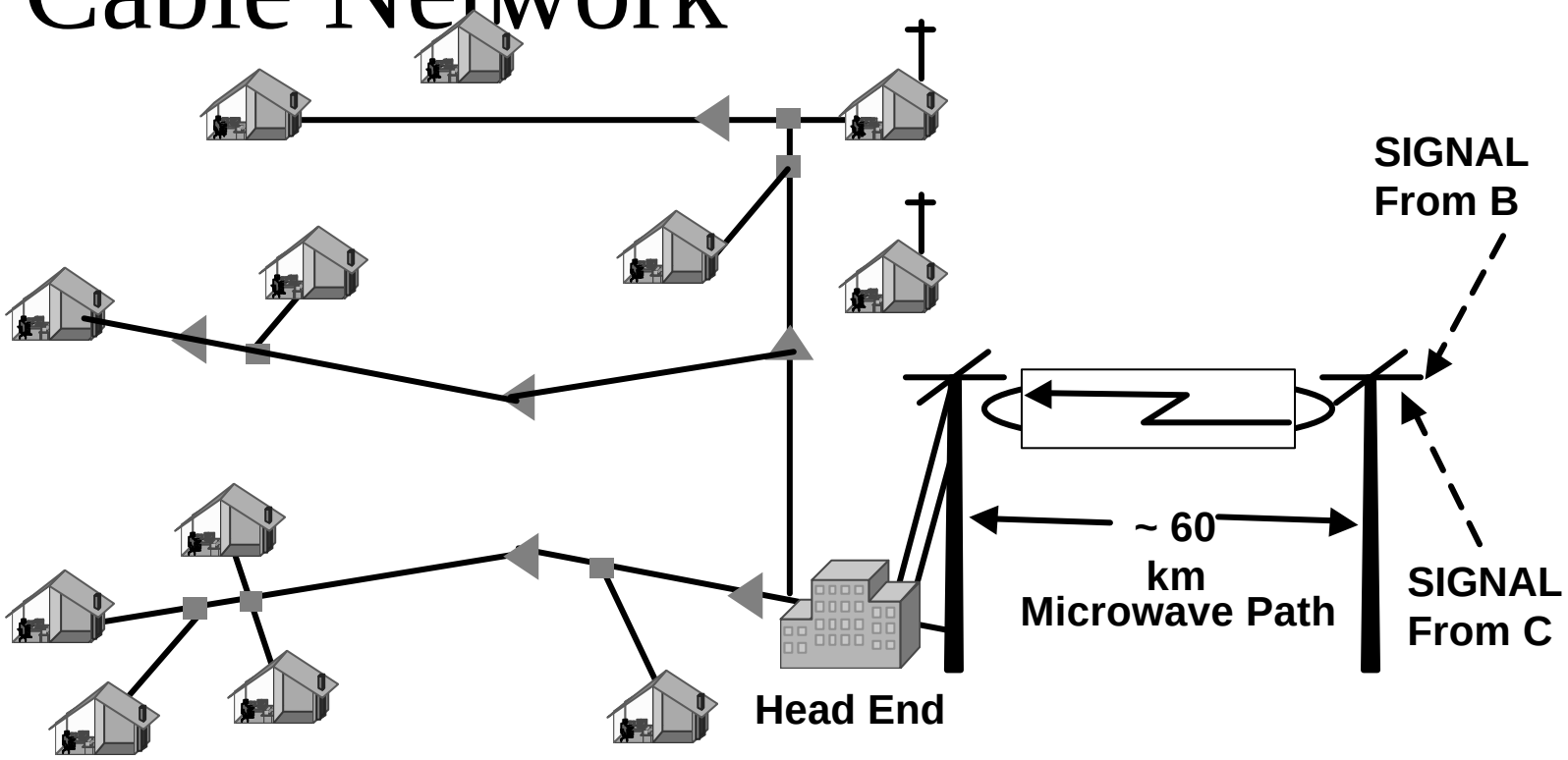


The Community Antenna **circa 1948**

- Few sources
- Limited content

= **Excellent to Poor Picture Quality Reception**

Cable Network



(Basic Networking into the 1990)

Amplifiers Extend Distribution

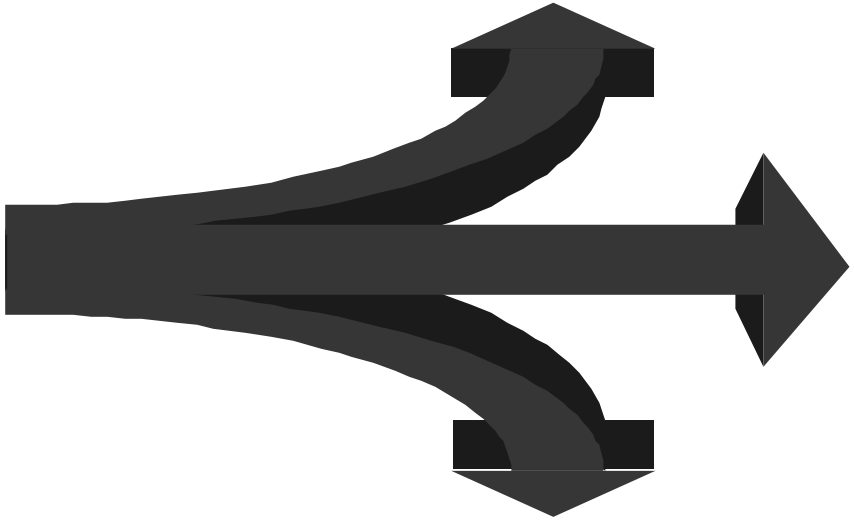
Signals Distributed to Subscriber Via Tap and Drop Cable

Role Change

- Cable TV operator
  - MSOs (Mutiple-System Operator)
- User Requirments
  - Video, Voice or Data
  - WEB
    - animations, slide shows and video or audio clips

High-Speed Cable Modem

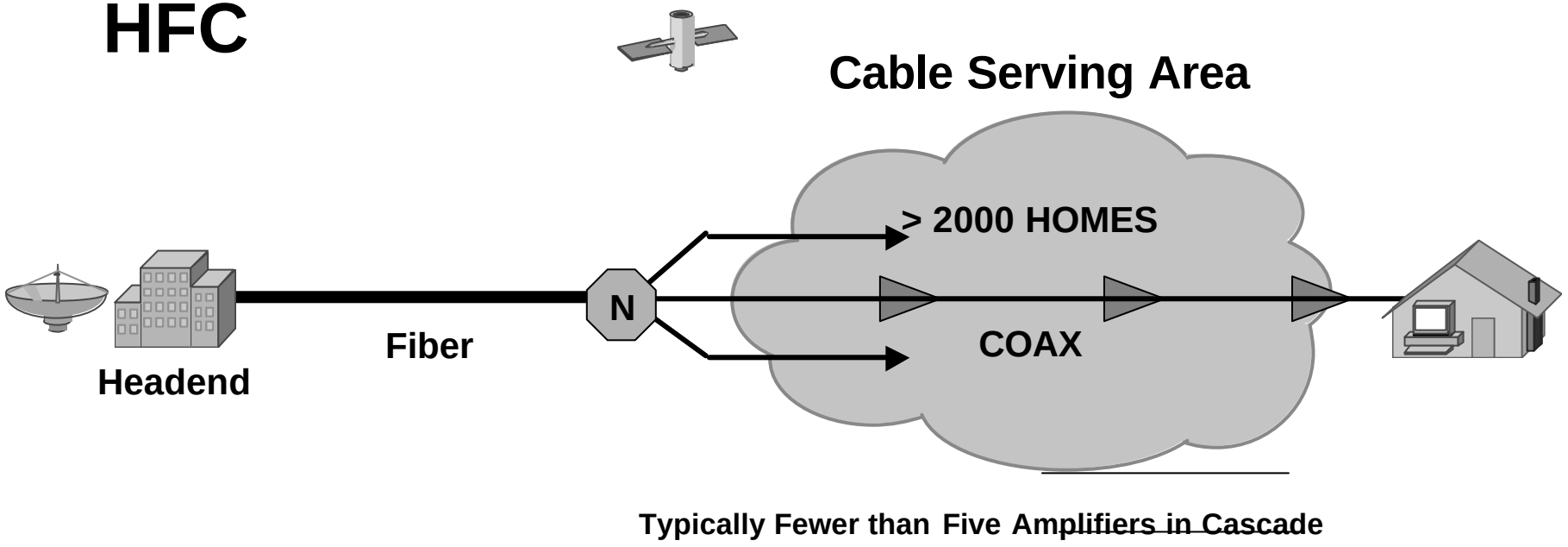
- Packet-based services for data, voice and video service



A typical TV Plant (HFC)

- Fiber from Cable Company facility (Head End) to
- Neighbor Nodes and cable carriers the signal the rest of the way t individual residences
- HFC, tree like hybrid fiber-coax is a sensible compromise -? Fiber all the way..

Cable Network



- The video signal is transmitted over fiber to the node, where it is converted to an electrical signal and forwarded to the subscriber over existing coaxial cable
- Provision is made to support return traffic for future services

Cable TV plant

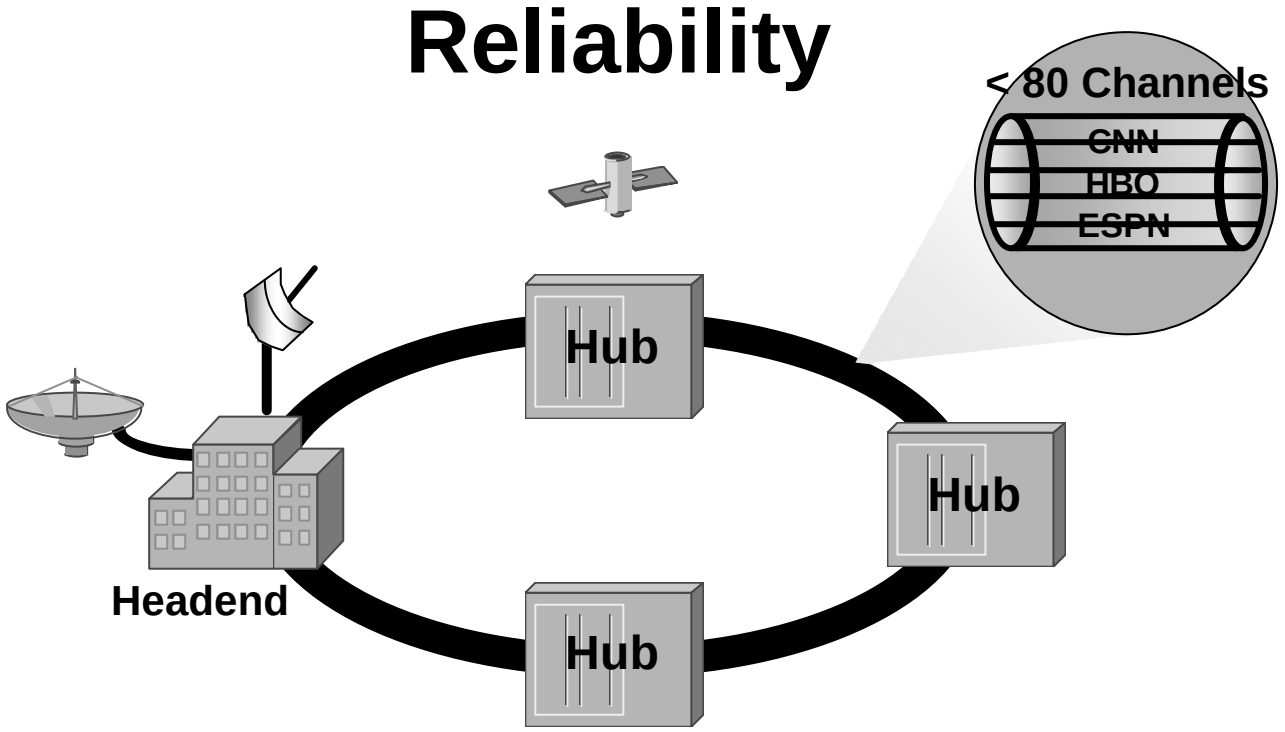
- Head End:
  - might get program from Satellite
  - put into commercial or Advertisement or local interest
- Hub
- Nodes

Cable Network

Cable Plants Are Upgraded for:

- Improved reliability
- Smaller serving area
- Increased bandwidth
- Increased availability
- Improved end-to-end signal quality
- Advanced network management
- Two way operation
- Platform for advanced services

Cable Network

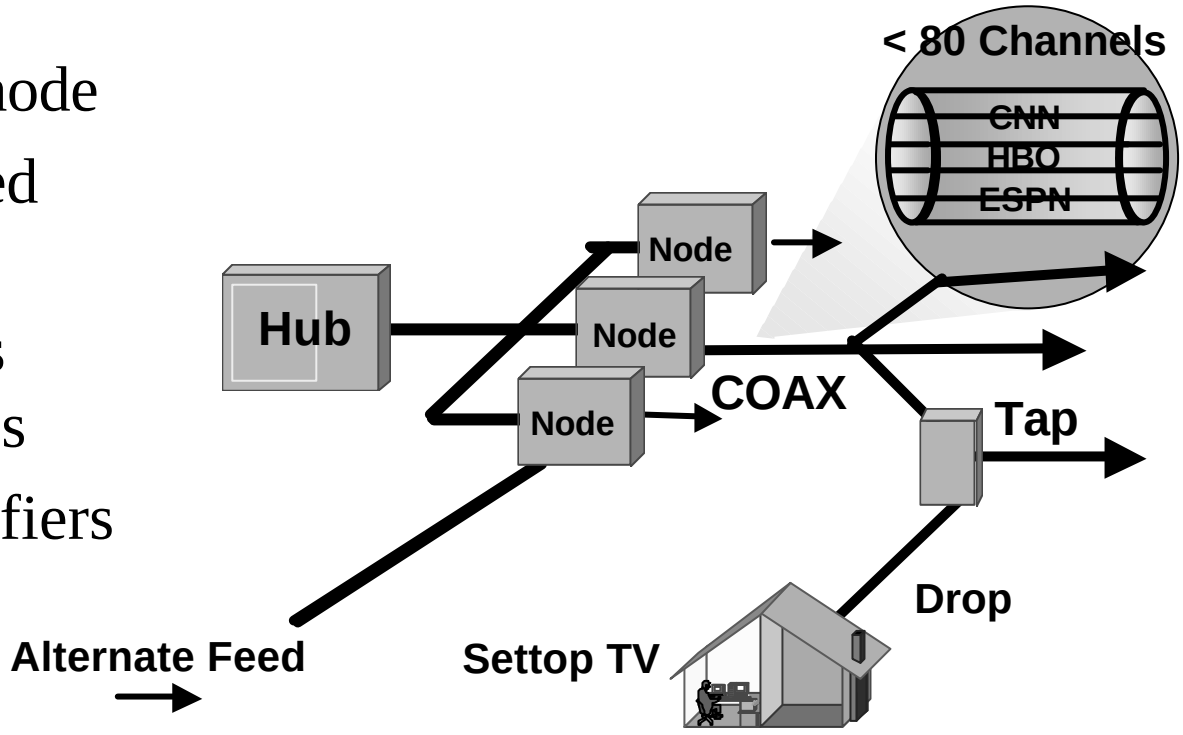


- RING architecture
- Analog fiber RING for broadcast video
- Headend/hub to improve reliability
- SONET/SDH RING overlay for reliability of advanced services

Cable Network

Reliability, Increased Access Bandwidth

- Smaller, robust serving areas:
  - HFC to the node
  - Alternate feed to the node
  - Target nodes of 500 homes
  - Fewer amplifiers



Typical Traffic

- TV signal, each channel requires a bandwidth of 6 MHz, (54-550MHz)

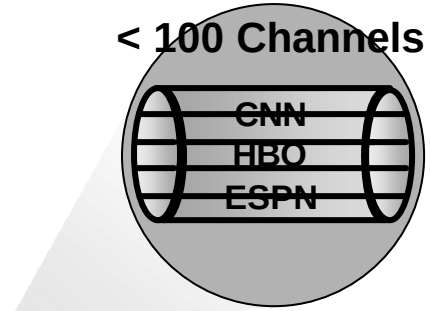
Bi-directional information flow

- 5-42 MHz is allocated for upstream signals
- 200 ~ 600 US dollar for househod
- Security Issues?
  - Every one shared the same upstream and downstream

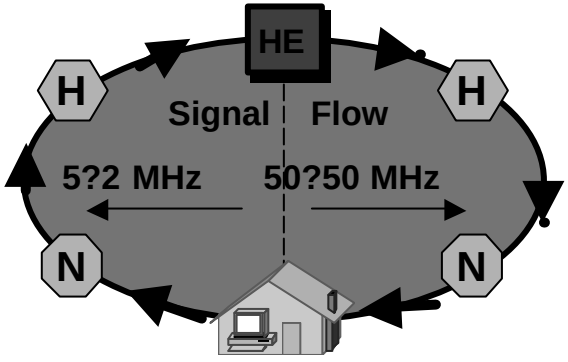
Enter the Internet

- Web Surfing
  - Typically asymmetrical
- How fast is fast?
  - Text, 40 kb/s downstream, 4 kb/s upstream
  - 6 MHz TV channel can support around 420 customers (30~50 Percent active)
- Head End -DS-3 (45 Mb//s)

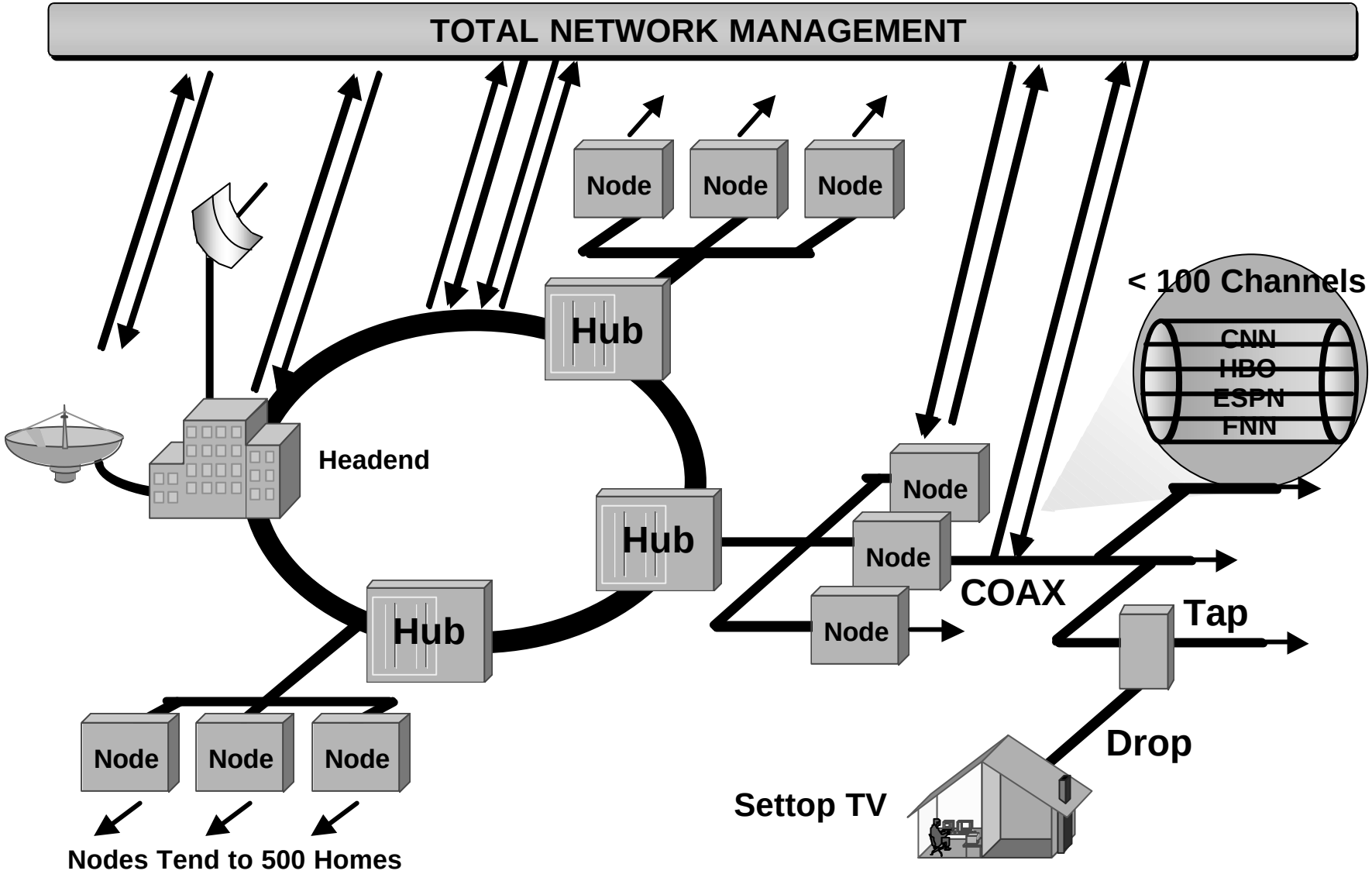
Cable Network



- Increased bandwidth:
  - Downstream rebuilds?to 750 MHz
  - Wide band amplifiers etc
- Two way operation:
  - Upstream (5?2 MHz) Provisioned? and operational



Cable Network



Modulation

- 64QAM (quadrature and amplitude modulation , one symbol can carry 6 bits of information) -> 6 MHz of bandwidth can carry up to 30 Mb/s

Multimedia Support

- Cable Modem
  - 10BASE-T frame
  - IP telephony
  - Request for a Web Site, QPSK (2 bits/symbol)
  - 10-30 Mb/s (Down), 768-10 Mb/s
- Set-top box

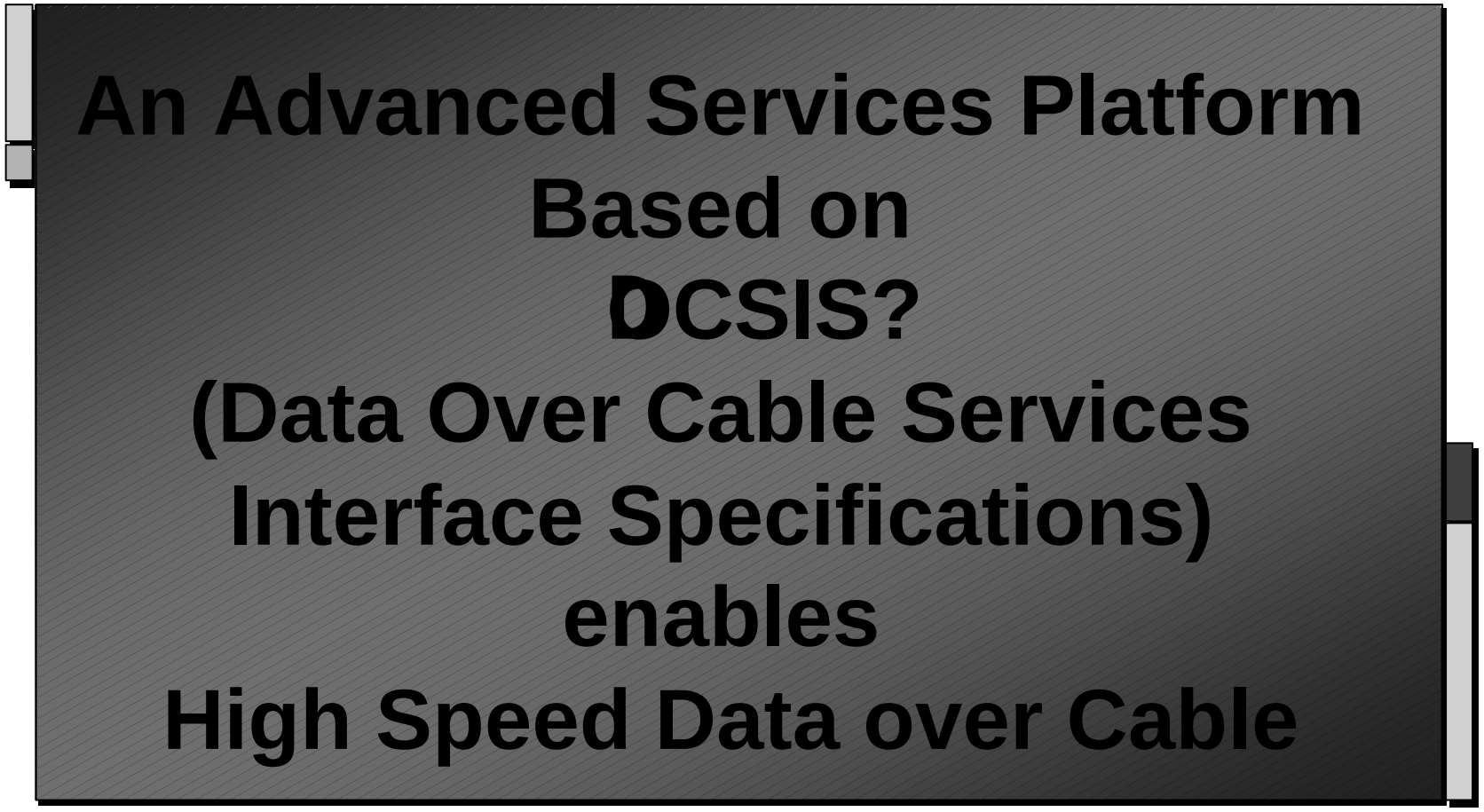
Always on

- Packet Switch- always active
- Proxy Server to interface with the outside world-dynamically assigns an IP number
- Telephone Service
- Virtual Private Network
  - possible symmetrical data flows

Where standards stand

- MSO (multiple system operator)
- 802.14 (1994)
  - consider DVB (Digital Video Broadcasting) and Digital Audio and Video Council (Davic)
- MCNS (Multimedia Cable Network System Partners, 1995)
  - CATV operator
  - first release of Docsis, December 1996

Cable Network



Docsis

- Manufacturers have been shipping these devices
- Based on the internet Protocol (IP)
  - Docsis can deliver constant bit-rate services such as voice or video over HFC
- Security Issue

Data Packets

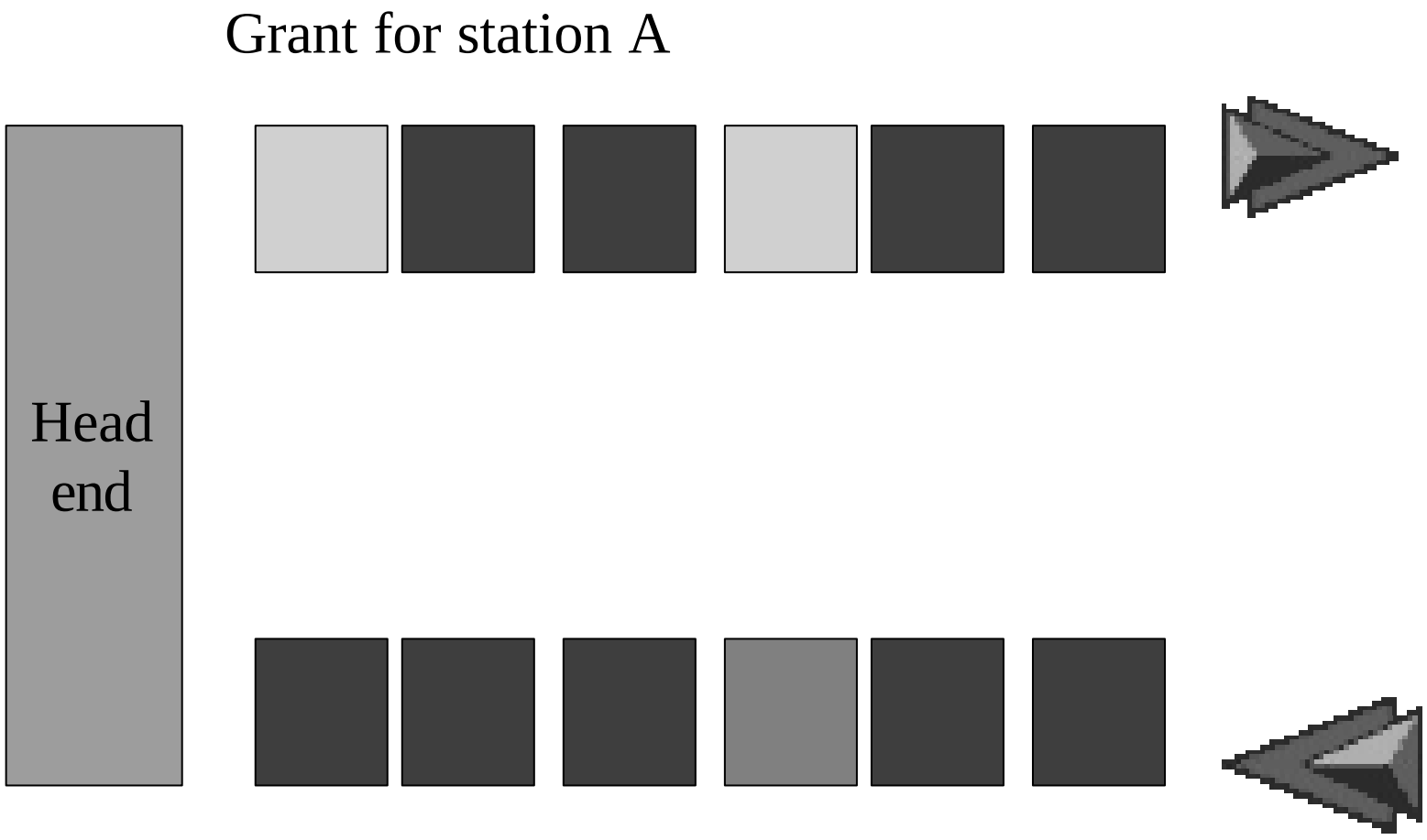
- Jitter (delay and delay variations)
- tradeoff
  - small packets (delay down, but overhead)
  - long packets (overhead down, but delay)
  - 1515 bytes (IEEE Ethernet Packet)

MAC

- CSMA/CD is not working for Cable Data
  - cable modems do not transmit and receive in the same frequency
  - only head end station receives packet from all stations and can sense a collision
- TDMA has been chosen to coordinate the upstream hybrid fiber coax transmission

Procedure

- Initialization procedure
  - Synchronization (Head End broadcasting)
- Requesting permission
  - 6-byte packet to the head end
- Grant
  - A scheduler in head end assigns the stations


Grant for station A
Head end
Request from station C

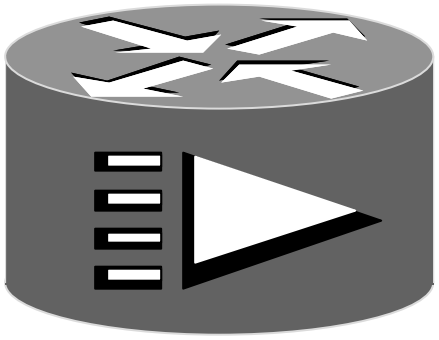
MAC solutions

- Request/Grant by variable length through mini slots
- request, grant and data transmission
- through synchronization procedure

S-CDMA

- Synchronous code division multiple access
  - especially used for noisy cable plant
- client stations transmit packet through mutually orthogonal digital codes over the same frequency

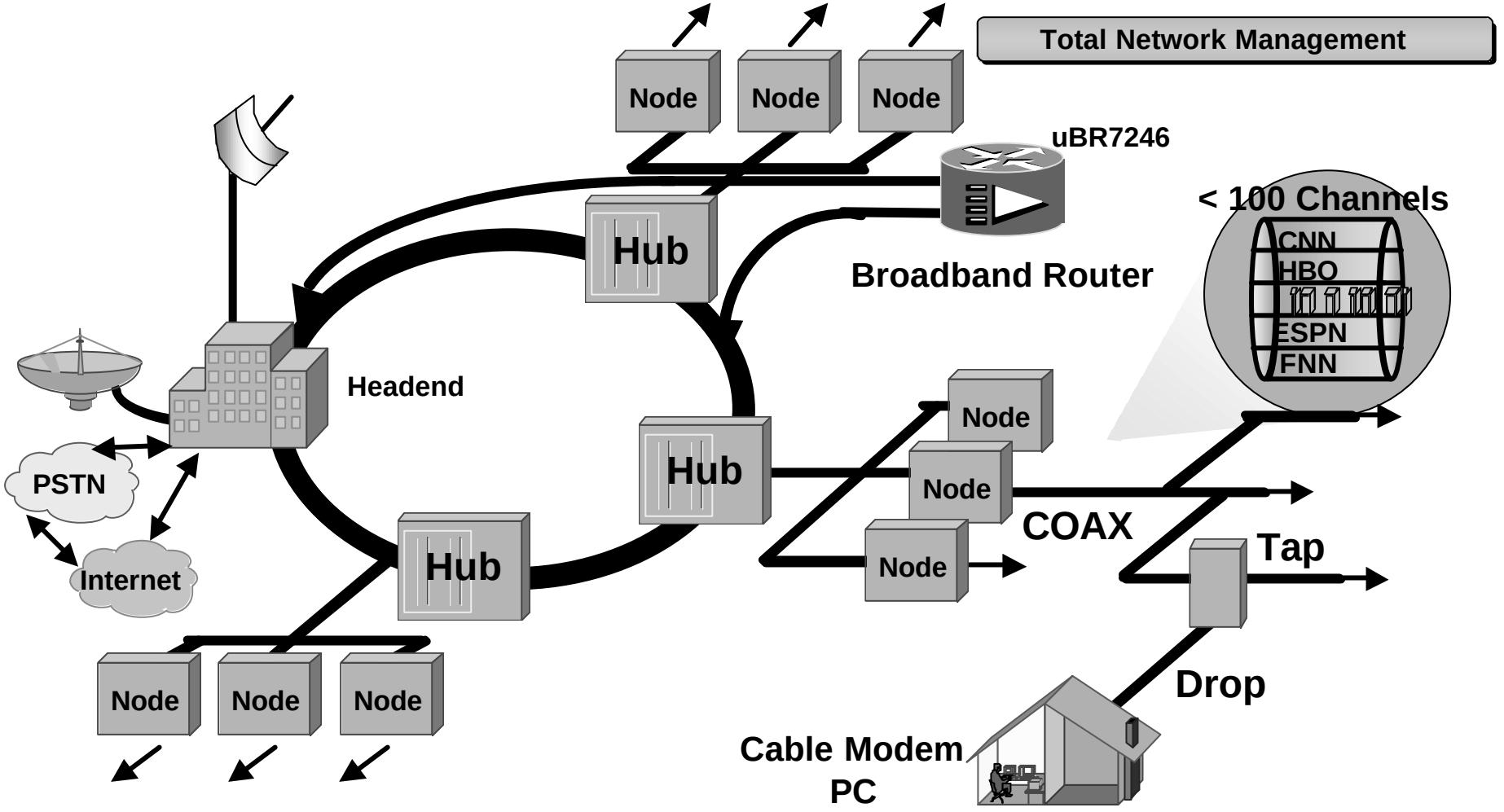
Cable Network



Cisco Universal Broadband Router
uBR 7246

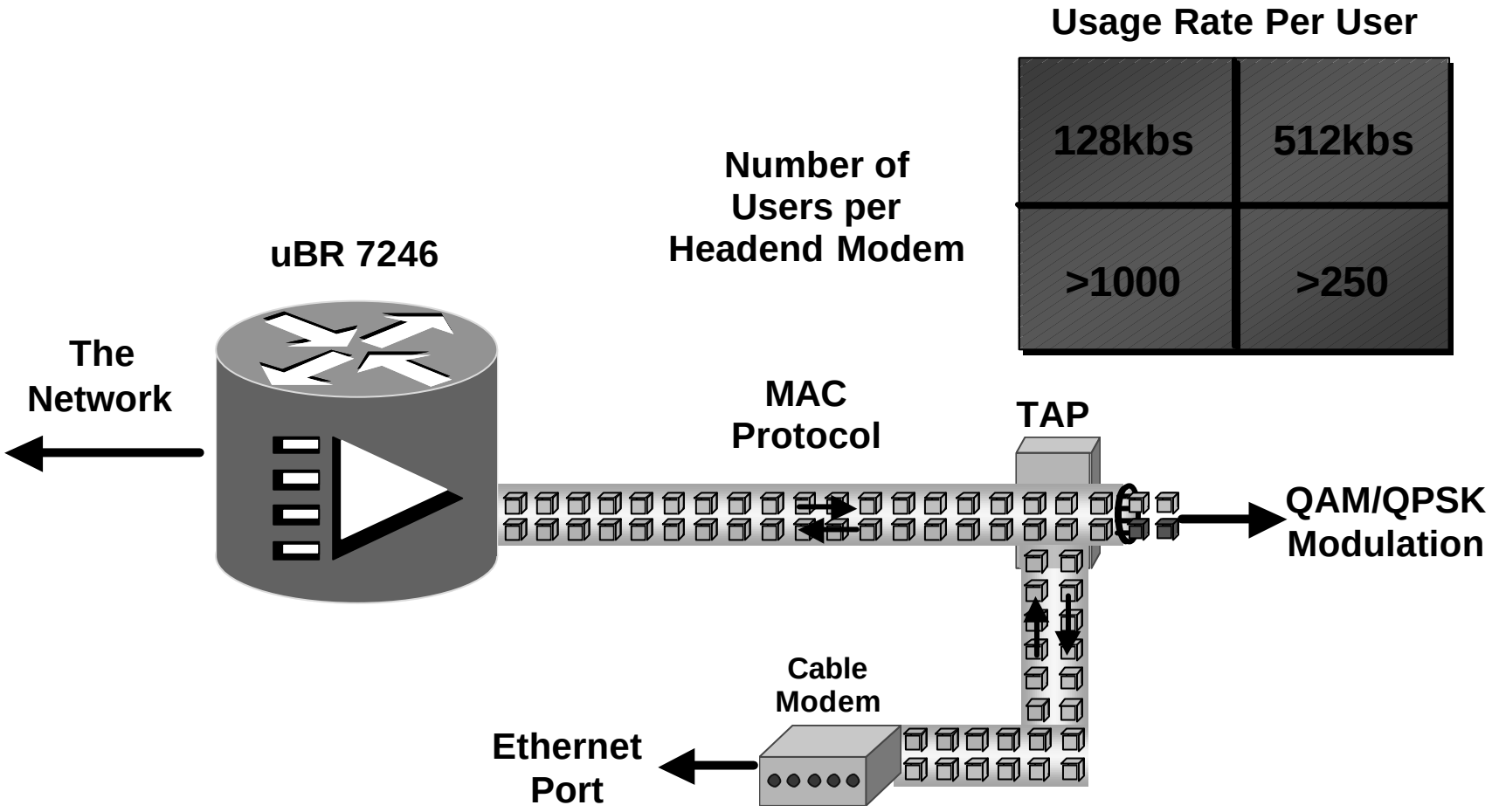
Cable Network

Advanced Services



Cable Network

DOCSIS Standard DATA Platform



Configuration Approach

- Original Plan
  - AT&T 420 customer for one 6 MHz
- New plan
  - Either devote extra 6-MHz channel for broadband data
  - split each fiber node into four nodes