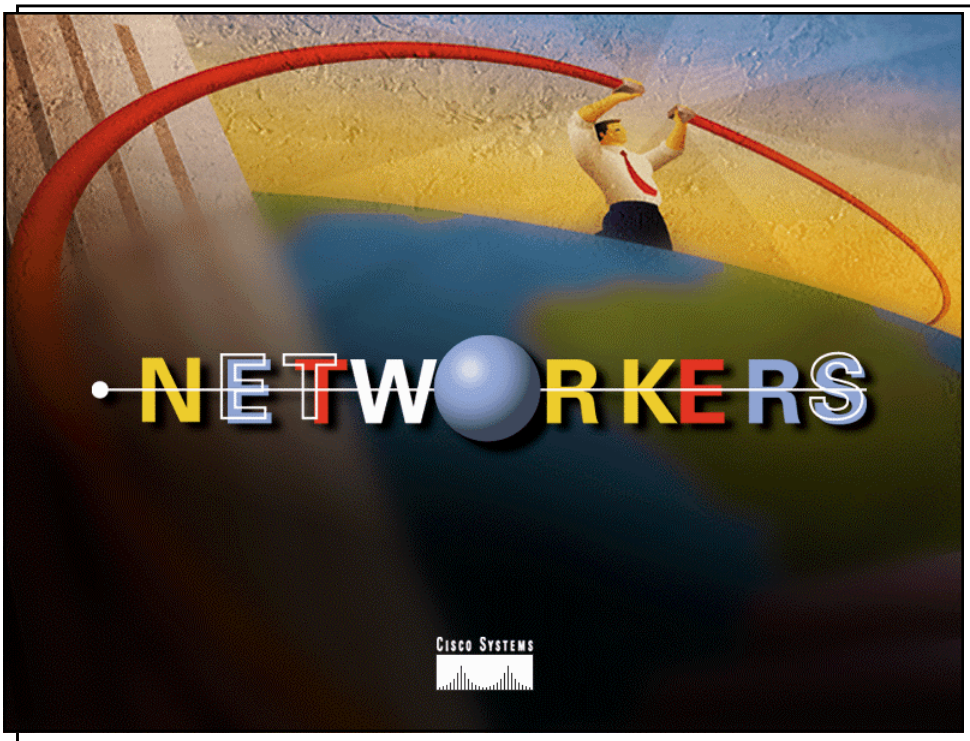

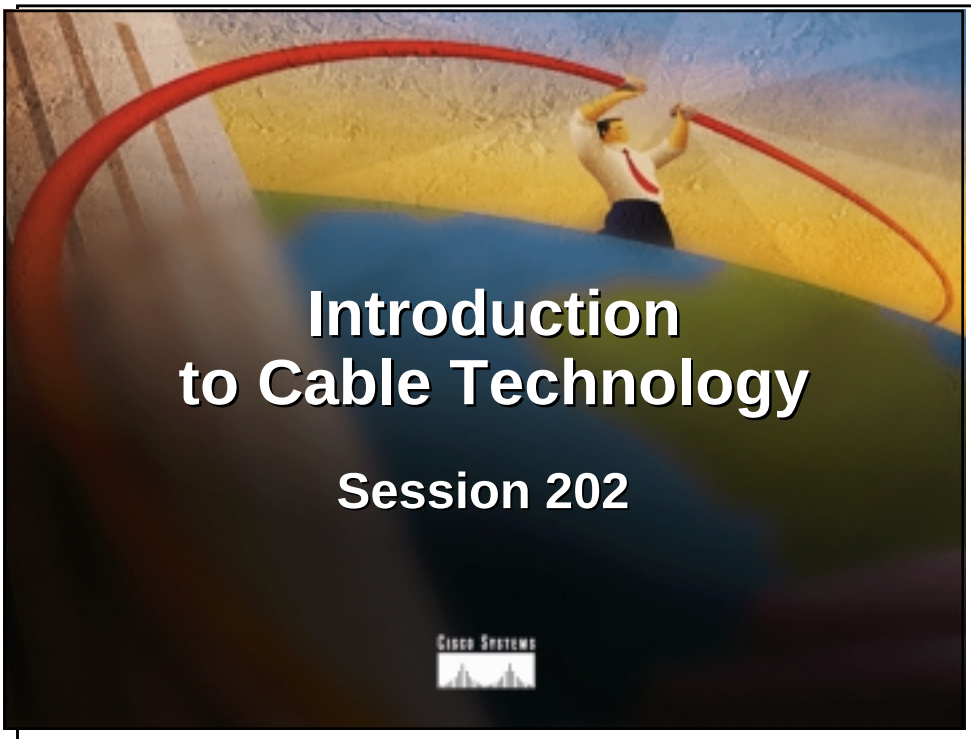

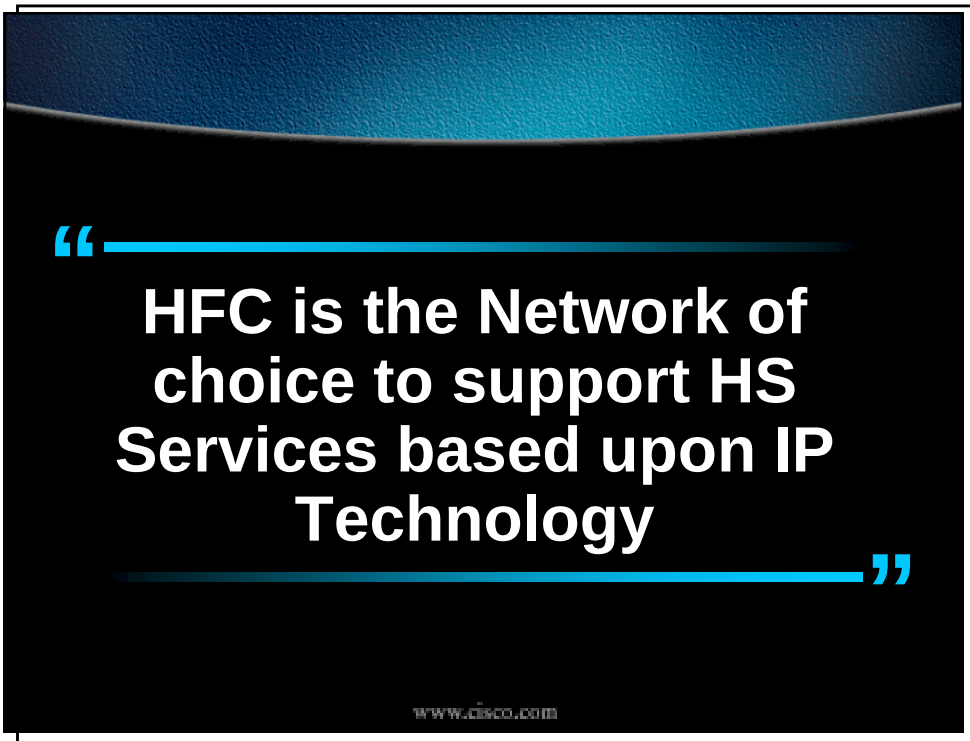

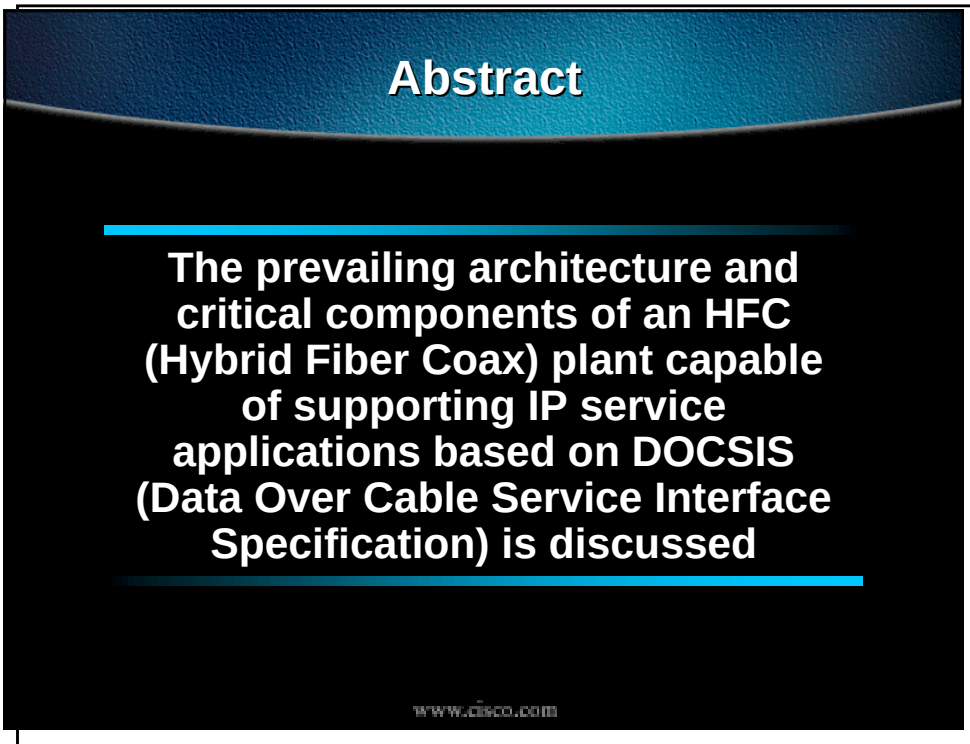

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- Early CATV Architecture
- Hybrid Fiber Coax Infrastructure
  - Optical
  - Rings
  - Upgrade for Quality Service
- Friendly vs. Hostile Upstream Frequency
- Network Management of Physical System
- Attributes of HFC
- IP Access Platform
- HFC Network with IP Access
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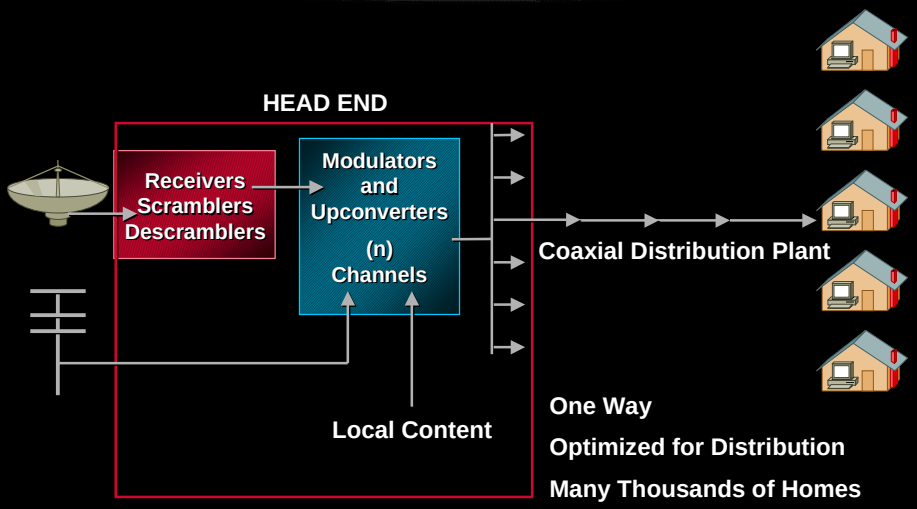
Typical Cable Distribution Plant



One Way

Optimized for Distribution

Many Thousands of Homes

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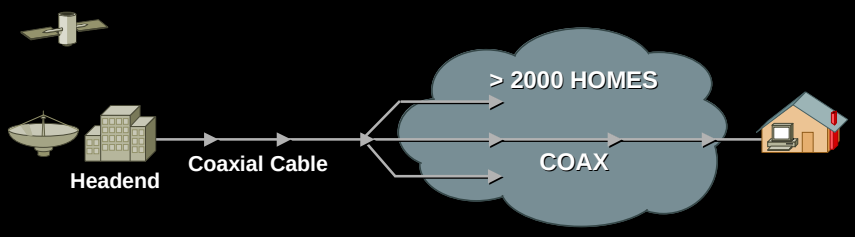
Early Coaxial Feeder Network



- One way distribution
- Cascade of many amplifiers
  - Degraded performance
  - Failure prone
- High operation and maintenance cost

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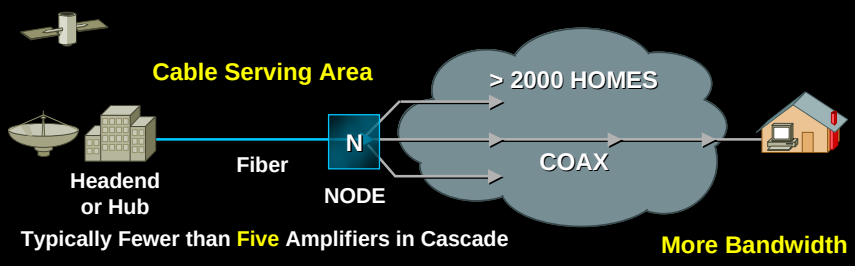
Hybrid Fiber Coax Infrastructure



- Video 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

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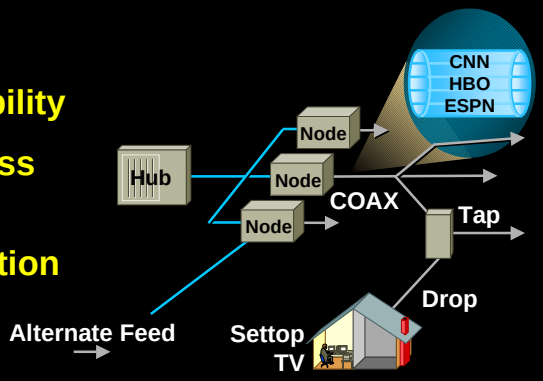
Hybrid Fiber Coax Infrastructure

- Optical nodes provide:
  - Small robust serving areas
  - Improved reliability
  - Increased access bandwidth
  - Two way operation



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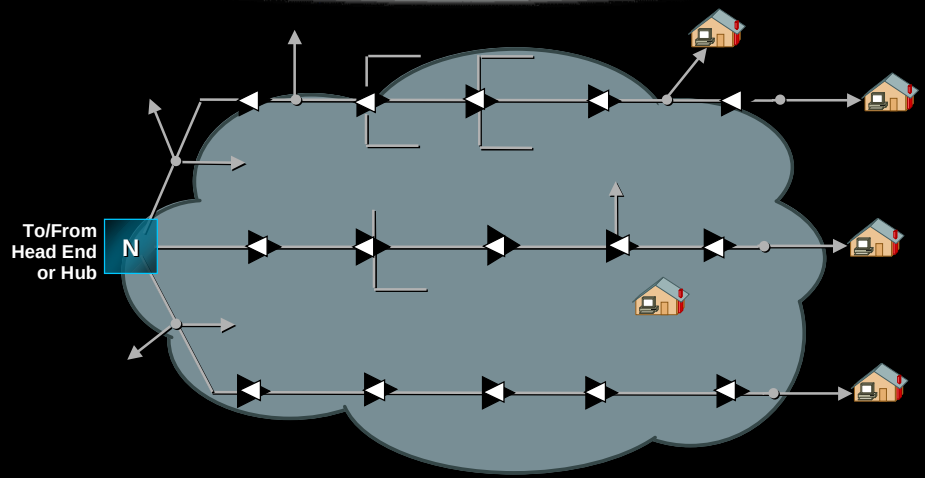
Hybrid Fiber Coax Infrastructure



Typically Fewer than Five Amplifiers in Cascade to Support up to 2K Homes

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Hybrid Fiber Coax Infrastructure

Benefits of HFC to Node level

- Increases RF bandwidth
  - 750 MHz (or more)
  - Source brought closer to subscriber
  - Facilitates introduction of two way
- Improves reliability and availability
  - Fewer failure components
  - Improves noise characteristics

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Reliable, High Quality Access Bandwidth Provided by HFC Technology Validates that:

"HFC is the Network of choice to support HS Services based upon IP Technology"

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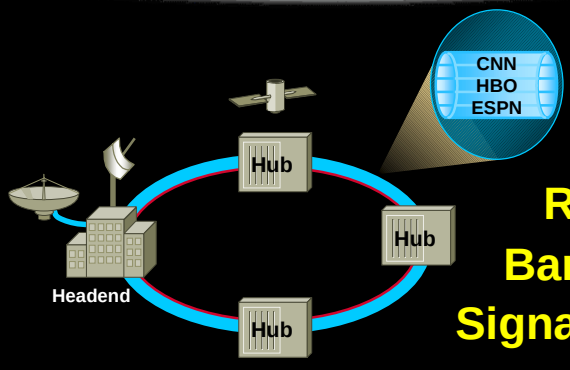
Hybrid Fiber Coax Infrastructure



Reliability
Bandwidth
Signal Quality

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

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Hybrid Fiber Coax Infrastructure

Benefits of RING Configuration

- Increases RF bandwidth
  - 750 MHz (or more)
  - Source brought closer to subscriber
  - Facilitates introduction of two way
  - Supports hub distribution
- Improves reliability and availability
  - Fewer failure components
  - Improves noise characteristics
  - Ring path protection

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Hybrid Fiber Coax Infrastructure

Upgrade for Quality Service

- High bandwidth (750 MHz or more)
- Two way operation
- Migration strategy to small nodes
- Minimize amplifier cascades
- Design to prevailing industry standards
- Incorporate DOCSIS plant specifications
- Design for maximum noise abatement
- Network management

Hybrid Fiber Coax Infrastructure

Upgrade for Quality Service

- Recognize home wiring ingress
- Ensure best upstream CNR
  (Carrier to Noise Ratio)
- Characterize the plant and maintain to the original level

Build to Minimum Noise Criteria

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Friendly vs Hostile Upstream Frequency

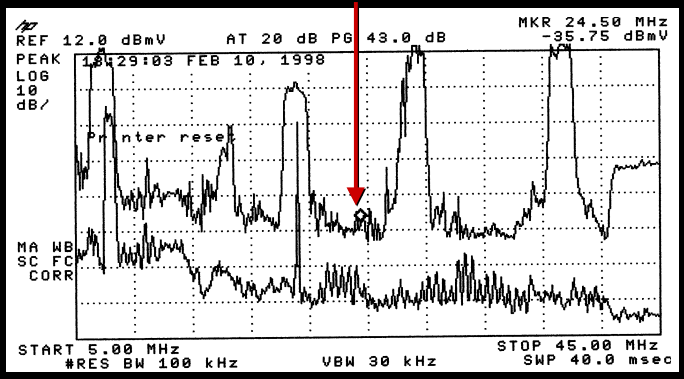
Characteristics of (US) Upstream Spectrum

- Subject to known potential interference
  - CB (Citizens Band Radio)
  - HAM (Amateur radio)
  - Government, Military, Naval radio, etc.
- Portions of the US lost to interference
- Only Portion of the US available for two way

Friendly vs Hostile Upstream Frequency

24.5 MHz

4 MHz per Division



Consider Operating within this Upstream Spectrum!

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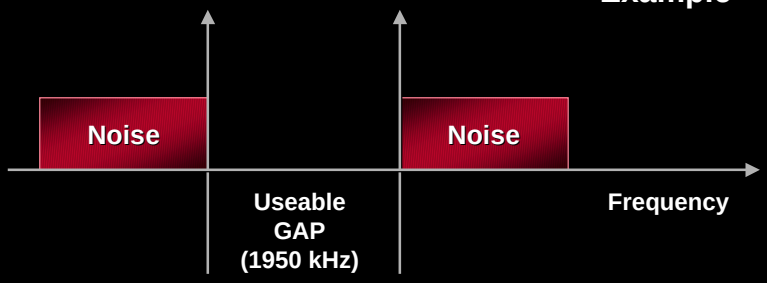
Friendly vs Hostile Upstream Frequency

15.6 MHz

17.55 MHz

Example



- **Useable gaps dictate**
  - Upstream channel selection and bandwidth
  - Spectrum management options
  - Upstream data throughput

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Friendly vs Hostile Upstream Frequency

Useable Spectrum Gaps

From (KHz)	To (KHz)	GAP (KHz)	200 (KHz)	400 (KHz)	800 (KHz)	1600 (KHz)	3200 (KHz)
5000	5950	950	4	2	1	0	0
6200	7000	800	4	2	1	0	0
7300	9500	2200	11	5	2	1	0
9900	10100	200	1	0	0	0	0
10150	11650	1500	7	3	1	0	0
12050	13600	1550	7	3	1	0	0
13800	14000	200	1	0	0	0	0
14350	15100	750	3	1	0	0	0
15600	17550	1950	9	4	2	1	0
17900	18068	168	0	0	0	0	0
18168	21000	2832	14	7	3	1	0
21850	24980	3040	15	7	3	1	0
24990	25670	680	3	1	0	0	0
26100	26960	860	4	2	1	0	0
27410	28000	590	2	0	0	0	0
29700	40000	10300	51	25	12	6	3

HFC Infrastructure Provides Adequate Useable Quality Bandwidth Validating that:

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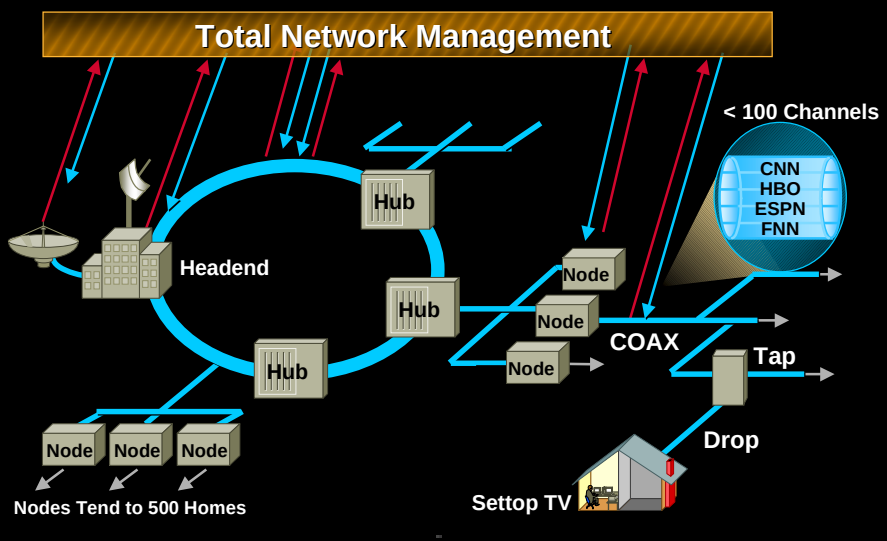
Network Management of the Physical System



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Network Management of the Physical System

Network Management

- Means to identify and diagnose faults
- Permits preventive maintenance
- Assures reliability and high availability
- Provides valuable maintenance aid
- Helps maintain customer satisfaction

Install One, and Reap the Benefits!!!

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HFC Infrastructure can Be Provisioned with Enhanced Network Management to Ensure that:

"HFC is the Network of choice to support HS Services based upon IP Technology"

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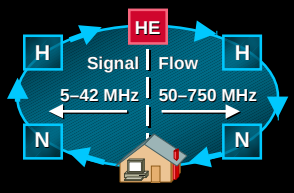
Attributes of HFC

- High reliability
- Increased bandwidth:
  - Downstream “rebuilds” to 750 MHz
  - Wide band amplifiers etc…
- Two way operation
  - Upstream (5–42 MHz) “Provisioned” and “Operational”



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Cisco IP Access Platform

uBR904 SOHO CM
uBR924 SOHO Cm e/w VoIP

uBR7246

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Cisco IP Access Platform

- Universal broadband router
  - uBR7246 and uBR7223
  - Router integrated with DOCSIS CMTS
  - (Cable Modem Terminating System)
- Cisco subscriber cable modem
  - uBR904 CM for data
  - uBR924 CM for data and voice
  - Partner cable modem products
- Interoperable multivendor CM products

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A Field Proven Interoperable DOCSIS IP Platform Is now Available to Support that:

"HFC is the Network of choice to support HS Services based upon IP Technology"

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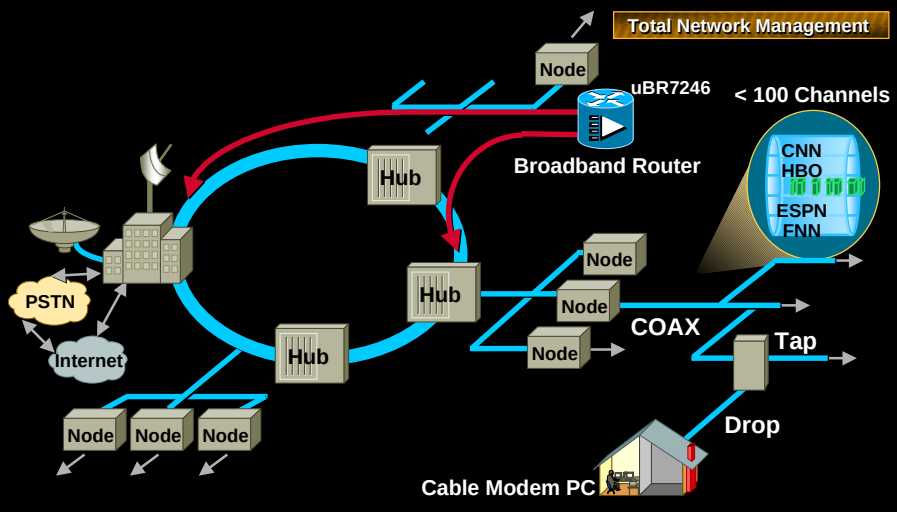
HFC with IP Access



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HFC Networks Provisioned with A Proven Interoperable DOCSIS IP Platform Ensures without Doubt that:

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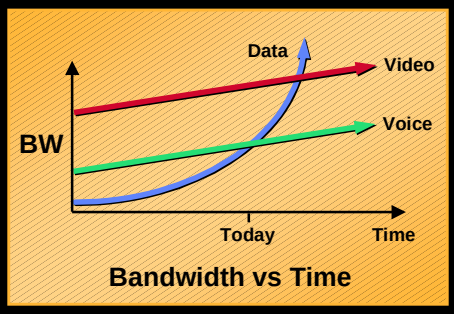
Promise of IP

Data, a "Growth Opportunity"

- Acceptance and penetration of the Internet
- Data bandwidth/ cost beating Moore's Law
- Open standards for DOCSIS and digital TV



Bandwidth vs Time

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Promise of IP

Recent CATV Consolidations

- AT&T purchase of TCI
- AT&T purchase of Media One
- Adelphia purchase of Century
- Cox purchase of TCA
- Cox purchase of Media General

High Capacity HFC Cable Plants Is the Common Denominator

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Market Dynamics and the Growth of the Internet Indicate that HFC Cable Plants Are the Platform of the Future Indicating that:

"HFC is the Network of choice to support HS Services based upon IP Technology"

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Conclusion

- HFC plants can be built to provide
  - Reliable transmission media
  - High access bandwidth
  - High-speed IP access using DOCSIS
- HFC plants with HS IP access offer
  - A viable business opportunity for
    - Data
    - Voice (VoIP)
    - Interactive video
    - Future advanced services

Is your CATV Plant Being Upgraded to HFC?

Are Plant Upgrades Meeting Current Standards?

Is Network Management Included?

Is a DOCSIS IP Network Considered?

What about Noise Control?