

Cable Data Networks for SOHO Applications



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- Integrated Cable Network Vision
- Cable End-to-End Equipment
- Universal Broadband Router
- Summary and Questions





- Goals and opportunities
- Services
- Network structure
 - Backbone network Head ends and hubs Access network
 - **Residence network**
- Applications
- Summary



Goals

- Utilize latent asset: cable plant bandwidth Much more than POTS, ISDN
- Enable new revenue through new services

Internet access, voice, and video conferencing

New customized video data services

Personalized video services

Wide variety of webcast video

Tight integration of video and Internet

- Leverage existing standards, make new ones
- Keep it open



Upgraded Cable Plant

• Cable plants are upgraded for:

More reliable topology

Increased bandwidth/smaller servering areas

Increased availability

More reliable signal

Advanced network management

Two way operation

Advanced services



Key Drivers of Change

 Acceptance and penetration of the Internet

> Huge content source to be mined Huge opportunity for p ersonalization

 Data bandwidth/cost beating Moore sLaw

Backbone data bandwidth can handle 100s of MPEG-II channels

MCNS enables huge increase in access bandwidth

 Open standards for MCNS and digital TV

Economics due to standards





Cisco sView of Cable Data Standards

- Strong supporter of MCNS
 - A. We like the spec, we like the process
 - B. We want it cheap, ubiquitous, and taken for granted
 - C. We will help drive it to success
- 802.14: wait and see





Services

| • | Analog broadcast video Digital broadcast video | Existing Services |
|---|--|-------------------|
| | Internet access: Web, e-mail | New Services |
| | IP-based services Voice H.323 Webcast video Lower-bandwidth video over IP Video on demand Video conferencing and collaborative ap Radio/music Push services Personalized video and data | plications |





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Video As Data: Bandwidth

- Assume 100 video channels
- Assume 5 Mbps each
- Total bandwidth only 500 Mbps
- Less than one OC-12!
- High end routers and switches have a dozen or more OC-12 ports







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Separate Infrastructures

Benefits

Uses existing equipment

Problems

Duplicate networks Costly Unwieldy, complex Video is not networked, only point-to-point links





IP Transport Infrastructure

• Benefits

Unified network infrastructure IP brings scale and security IP is ubiquitous QoS w/ RSVP, L3 services Lower cost of ownership Leverage the Internet growth Applications/content/services Cost/performance curve Interoperability

• Problems

Backbone-class devices only emerging now SONET integration New IP-based telephony





Final Backbone Architecture

 Retains current digital video transmission

> Simple broadcast It works and it scheap

- Uses IP transport for:
 - Switched video Two-way video Complex routes: studios, post production, ad houses, local sources







Digital Video Transport + SONET++ Ring



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Mining the Web Cache

- Caching is technically necessary and valuable
 Edge bandwidth far exceeds backbone and server bandwidth
 Backbone and server bandwidth expensive, edge bandwidth cheap
- Solution is to cache the content at the edges, close to the bandwidth

Cache gives the MSO an excellent window into the viewing patterns Promote content that viewers have discovered and claim share of advertising revenue

 Caching hides the amount of content distribution from the source

1000 hits look like 1

Content owner is unaware of viewers, looses Ad revenue

Content creators driven to ache busting?in desperation



Access Network: HFC

- Analog video on RF
- Digital video MPEG/64QAM
- Voice, Web, webcast video IP/MCNS/64QAM









Typical Bandwidth per Data User

• Assumptions:

50% of homes passed are subscribers

10% of subscribers are active

One downstream at 64-QAM per 4 fiber nodes

One upstream at 2560 Mbps per fiber node

| HP Per Node | HP Per Downstream | Peak Data Rate (D/U) | Average Data Rate (D/U) |
|----------------|----------------------|-------------------------|----------------------------|
| 500 | 2000 | 27 Mbps/ 4 Mbps | 270 Kbps/ 102 Kbps |
| 1000 | 4000 | 27 Mbps/ 4 Mbps | 135 Kbps/ 51 Kbps |

Typical Cost at Head End/Hub Is \$5/Home Passed More Bandwidth is Available with More HE Gear



Residence Network Diagram



Voice Service Deployment



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Voice Requirement: QoS Solution: MCNS Extension

• Traffic differentiation

Interface, subscriber, traffic type, etc CMTS must maintain per-CM state (it already does a lot of this)

Bandwidth policies and mechanisms

Preferential queuing, drops, allocations in backbone Weighted Random Early Discard (WRED) Controlled Admission Rate (CAR) QoS in MCNS

Easy to do e e done it in our uBR Standardization underway in MCNS



Delivering Voice Over IP: Playout Buffers Smooth Jitter





Question: What Do the Following Applications Have in Common?

- Voice gateway
- Dial access server
- Circuit video gateway
- Internet FAX gateway
- Net VoiceMail







Service with Voice Over IP

- H.323 VoIP local loop bypass
- Integrated messaging: E-mail, voice mail, FaxMail
- VoIP GW also Telco-return dial server



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New Video Service Deployment



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Transition From Legacy STBs

 Leave the old STBs and old head ends in service

No cut-over, no service disruption

- Simulcast scrambled analog channels in digital
- Simulcast electronic program guide and conditional access in IP

EPG and CA total ~300 kbps (1% of MCNS BW) New STBs receive EPG and CA on MCNS IP path

 New STBs don tneed to support legacy scrambling and EPG: simpler, cheaper



Integrated Video/Data Network



Personalized TV: One Example

- 30?20 sec video clips cached, assembled, and pushed based on predefined or user-defined profile
- Mixed with live broadcast TV
- Non-interactive prsonal?TV providing video and data clips



Interactive TV Is back!

Data bandwidth supports Webcast video services

Distance learning, video conferencing, streaming video

- Integrated digital set-top and Web browser
- TV watching and Web browsing merged

Not just TV on PCs, not just Web on TV

URLs hidden inside commercials, movies, sports, EPG

Single button push to follow links

Enhanced TV experience with smooth continuum of interactivity

Web content can overlay broadcast video



Tying It All Together: Directory Enabled Networks

- Knowledge of the customer demographics is extremely valuable
- Store everything about the network in one unified directory
 - LDAP access
 - **Provisioning: customer service level**
 - Customer preferences: specified and observed
 - Favorite sports teams, location (drives custom traffic reports)
- Drive fine-grained ad insertion of Web advertisements
 - On EPG, on Web pages
- Intelligent network creates value



Summary

- Integrated architecture for video, voice, and data
- Backbone carries all traffic in IP over SONET
- Access (HFC) has some video directly on RF, leaves some on IP
- Voice carried on IP H.323 into home Gateways to PSTN in head ends
- Webcast video on IP for greater content selection
- Digital set-top box with Web browser is the killer app! PC-98 PCs can participate with MCNS cable modem
- Web cache critical for managing content distribution
- Service differentiation creates intelligent network





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Cable Multiservice Network





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Cisco Product Strategy

• Subscriber cable modems

Enable the rapid development of the subscriber cable modem market by engaging consumer electronics giants

Not compete directly in the residential cable modem market

Provide reference hardware design and **Oble** IOS?software and compete indirectly through partners

Design and build product and compete directly in the higher-end telecommuter and SOHO markets

Headend router and cable modem shelf

Design and build product and compete directly Universal Broadband Router launched at ?7 Western Show













Interoperability Plans

Cisco will interoperate with all MCNS compliant modems and head ends

We are open to partnering with anyone with an MCNS product or who is developing an MCNS product

We do not have an exclusive amp

Cisco was the first vendor (along with Broadcom) to participate in CableLabs?formal interoperability testing in January

• Cisco will also interoperate with pre-MCNS head ends from GI, Terayon and Com21

The uBR interoperates with GI sexisting Surfboard Telco return modem, and their new MCNS Telco return and two-way modems, all on the same downstream channel



Universal Broadband Router

- Combination router and head end modem
- Utilizes standard Cisco 7200
 router elements
- Can be deployed as router only, with modem cards added later
- Interchangeable modem cards support future upgrades
- Initial product will contain MCNS modem cards







First Release Port Adapters: 10BaseT, Fast Ethernet, ATM-OC-3, HSSI





Front View





Modem Card Types

• Two-way modem cards, also support Telco return on same channel:

MC-11: MCNS with one downstream, one upstream (64-QAM @ 27 Mbps downstream, QPSK @ 2.5 Mbps upstream)

MC-14: MCNS with one downstream, four upstream (64-QAM @ 27 Mbps downstream, QPSK @ 2.5 Mbps upstream, or

256-QAM @ 40 Mbps downstream, 16-QAM @ 5 Mbps upstream)

MC-26: MCNS with two downstream, six upstream

(64-QAM @ 27 Mbps downstream, QPSK @ 2.5 Mbps upstream, or

256-QAM @ 40 Mbps downstream, 16-QAM @ 5 Mbps upstream)

Other modem cards will be developed as needed



Planned Product Ramp

- Limited field trials started December 1997
- uBR chassis, 7200 router functionality shipped January 29, 1998
- MCNS two-way 1:1 modem card ships April 1998
- MCNS two-way telecommuter modem shipped June 1998
- MCNS two-way 1:4 modem card ships August 1998
- Telco return software ships August 1998
- Second product release planned for 2H 1998
 Higher density modem cards (e.g., 2x6)
 Full QoS, enhanced security
 Clsco
 Clsco













Modems Supported: 1x1 Card



Modems Supported: 1x4 Card **Usage Rate Per User**



Modems Supported: 2x6 Card



uBR Benefits

Integrated routing

Combines two products in one package Maximizes network efficiency and privacy

Universal product design

Interchangeable modem cards optimize bandwidth usage

Provides maximum capacity, minimum rack space

Assured interoperability

First to market with MCNS-compliant product

Other major competitors are also in the retail modem space

Networking expertise plus partners insures **CISCO SYSTEMS** interoperability





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- Cable overview
- Applications

Data, voice, video, etc

- The future
- Questions and discussion



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