IPTV Technologies and Deployment Challenges

Swarup Acharya (acharya@bell-labs.com)

Anurag Srivastava (anurag1@bell-labs.com)

Bell Laboratories, Lucent Technologies

Murray Hill, NJ, USA

Lucent Technologies
Bell Labs Innovations

Outline

What is IPTV?

Market Drivers

Triple Play/IPTV – A Quick Introduction

Technology Enablers

Network Transport Architectures

Challenges

Competitive Threat

IPTV Vendors and Service Provider Strategies

Conclusion

Challenges

Content Acquisition

Content acquisition not a familiar territory for service providers

1. Acquiring rights
2. Transport of the content

Extensive channel lineup important for a competitive offering

Content Provider Type	Content	Transport
Direct	✓	X
Co-op (e.g. NCTC)	✓	X
Aggregator (AT&T HITS)	X	✓
Wholesaler	✓	✓

How much bandwidth is enough?

Number of TV sets per household *2-3 (Avg: 2.7, source: Yankee Group)*

HSIA, online gaming bandwidth requirements

Type of Service	Bandwidth Needed
3 HDTV channels	3 x 6Mbps = 18
HSIA (download, online gaming,VoIP, video telephony)	3-5Mbps
	21-23Mbps

Demonstrates the need for at least ***ADSL2+*** and ***MPEG4-AVC*** compression for a comprehensive offering

DSL Impairments

Noise sources:

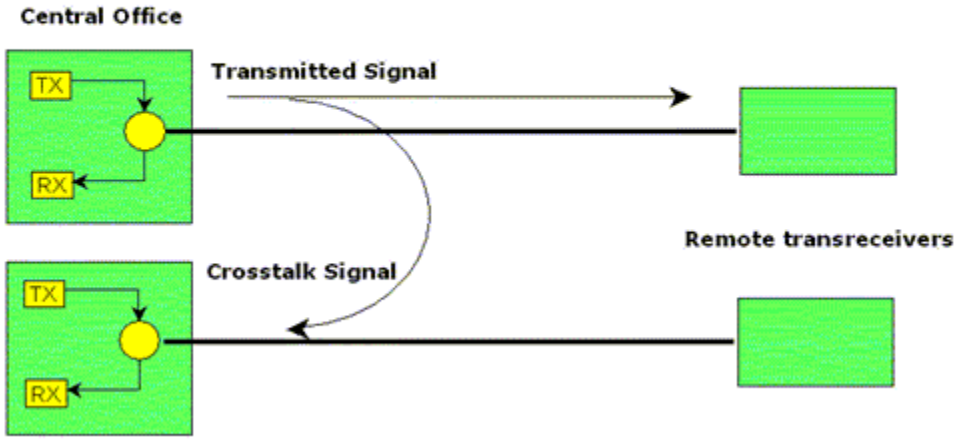
1. Capacity limiting e.g. *cross-talk*, thermal noise
   - Predictable and easy to account
2. Performance limiting e.g impulses, RFI
   - Unpredictable and geographically variable

ADSL avoided most of the crosstalk by transmitting upstream and downstream signals in different frequency band (FDD)

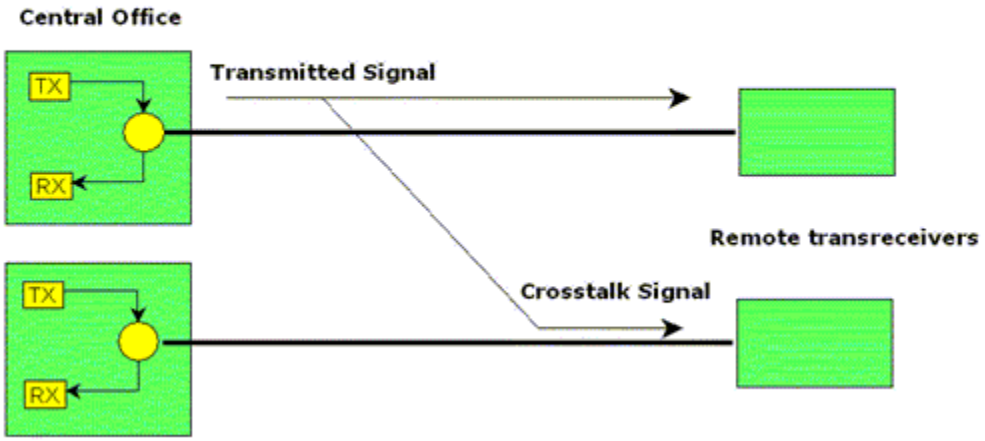
Cross-talk among different flavors (*spectrally incompatible*) of DSL becoming significant

- Higher take rates are producing more interference
- Unbundling of local loops to CLECs complicates the problem

Near End Crosstalk (NEXT)



Far End Crosstalk (FEXT)



Remedies

DSL spectrum management: Process of ensuring spectral compatibility while optimizing the loop plant

- Requires knowledge of all DSL systems in the network and how their crosstalk effects other systems

DSL Bonding effectively addresses the problem of declining speeds at longer distances

- Uses inverse multiplexing to split data on multiple DSL lines

Push fiber closer to the home (FTTN, FTTC)

Dynamic spectrum management

- Increases capacity utilization by adapting the transmit spectra of DSL lines to the actual time-variable crosstalk interference.

Headend/Transport Network Design

Headend design

- National vs. Regional vs. Local
  - Tradeoff between transport and equipment costs
- Encoding vs. Rate Shaping

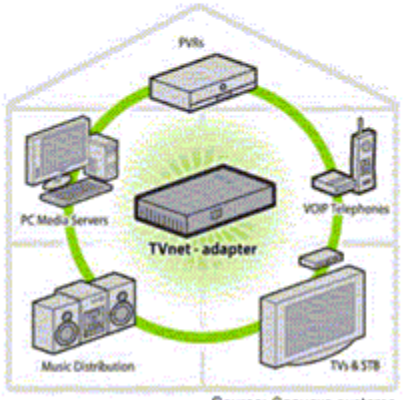
Transport network design

- ***Multicasting:*** Single Stage vs. Multi-Stage
- Number of Broadcast Channels, Bandwidth per video channel
  - MPEG-2: – 3.5 Mbps SDTV; 16-19 Mbps HDTV
  - MPEG-4/WM 9 : 1.5 – 2 Mbps SDTV; 6 - 8 Mbps HDTV
- Take rate, Over-subscription rate
- DSLAM uplink capacity

Home Networking

DSL terminates at the master STB

- How to deliver content to multiple TVs?



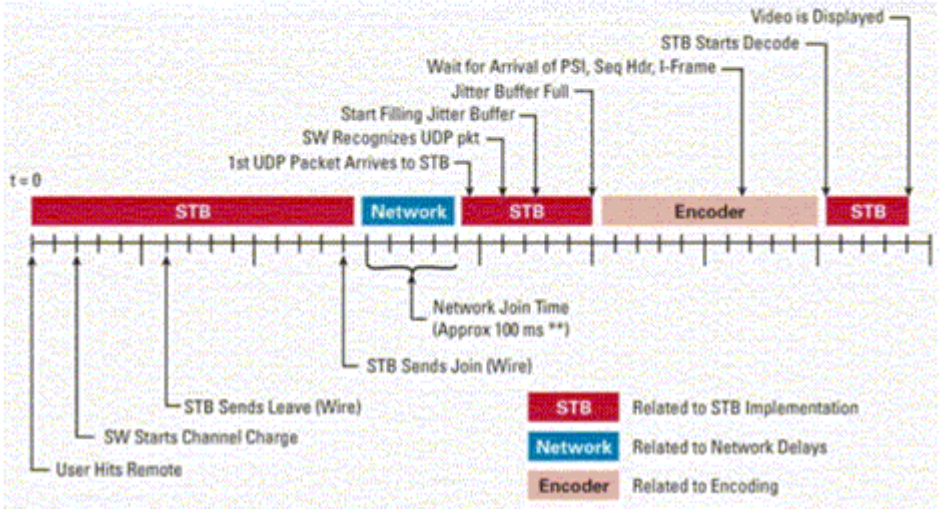
Source: Coaxsys systems

Technology	Pros	Cons
Home Phone Networking Alliance(HPNA V3)	100+Mbps	Must co-exist with DSL
100 Base-T Ethernet	100Mbps, in-expensive	Rare Ethernet wiring inside homes
HomePlug(AV) Power Alliance	250+Mbps	Still in development
Multimedia over Coax Alliance (MoCA)	High bandwidth, 250+Mbps, pervasive	Still in development

Channel Switching Issues

Small channel change latency key to user experience. Three main contributors to channel change timing

- MPEG coding structure (GOP size)
- IGMP join time (network dependent)
- Buffering delays



Network PVR (N-PVR)

Telcos considering mix approach of PVR and N-PVR

- Choice of PVR vs. N-PVR involves trade-offs

PVR: Requires a STB with disk and PVR software. A simple system from operations view.

Cable operators PVR systems offer ability to watch and record different channels using dual-tuner STBs

- Difficult to match the offering with disk based PVR. Limited DSL loop bandwidth may prevent simultaneous transmission of two channels

Disk based STB with PVR software also increases the cost per subscriber

N-PVR: Remote recording at a N-PVR system addresses the loop bandwidth issue for dual recording

Amortizes storage by keeping a single copy of programs recorded by multiple subscribers

Playing the recorded video is delivered as unicast stream (VoD)

- Large number of subscribers playing recorded video can seriously strain DSLAM Trunk capacity

Choice of PVR or N-PVR will be determined largely by network bottlenecks

Security – Content Theft vs. Service Theft

Content owners (Hollywood studios) require an end-to-end protection from source to STB. Do not want a *video napster*

- All digital content, VoD, PPV ➡ Higher Paranoia

Multicast in DSLAM exposes service theft, fraud

- Failure to reliably block secure channels (e.g. adult programming) => Lost service revenue and unhappy customers (e.g. parents).

Legacy CA system *(DVB's Simulcrypt)* designed for broadcast content

- Security provided only at the transport level. Does not address theft of content from Vod servers and PVR devices

Distributing content to multiple TVs can again expose the content (Ethernet/Coax)

- Integrated gateways, point-to-point DSL lines, port level protection lower the likelihood of service theft
- Frequent key exchanges between headend and STB makes it harder to penetrate

Service Monitoring

Service monitoring and troubleshooting capability key to business

- Unlike voice, customers have low tolerance for disruption in TV service
  - Cable operators have set the bar high for service downtime and quality
- Technologies and standards involved are complex and sometimes interpreted differently by hardware vendors
- Operator may need to comply with SLAs from content owners

Where to monitor?

- Errors in video can be introduced at several places:
  - Original video stream from broadcaster, Receivers in the head-end
  - Transcoders, Transraters IP streamers, Routers/switches/DSLAMs, Content protection systems, Set-top boxes
- End result of the error is always the same in form of *jerky playback, frozen picture.*

What to monitor?

- Monitoring all channels may be expensive in a big lineup
  - A *ratings based system* to monitor different channels at different times is more appropriate