



# GTER23

## Arquiteturas de Redes IPTV



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# Agenda

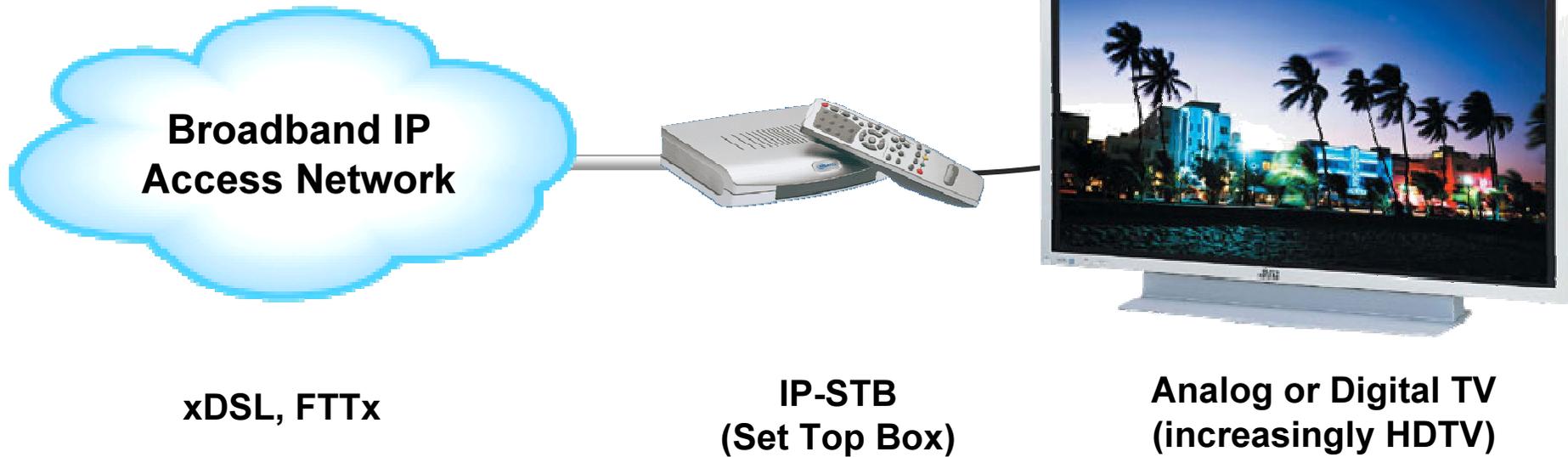
- IPTV Basics
- Headend Architecture and Components
- IPTV Distribution Networks
- IPTV Access Networks

# Introduction to IPTV



# What is IPTV?

IPTV = Broadcast Quality TeleVision delivered through an IP network



What is not IPTV:

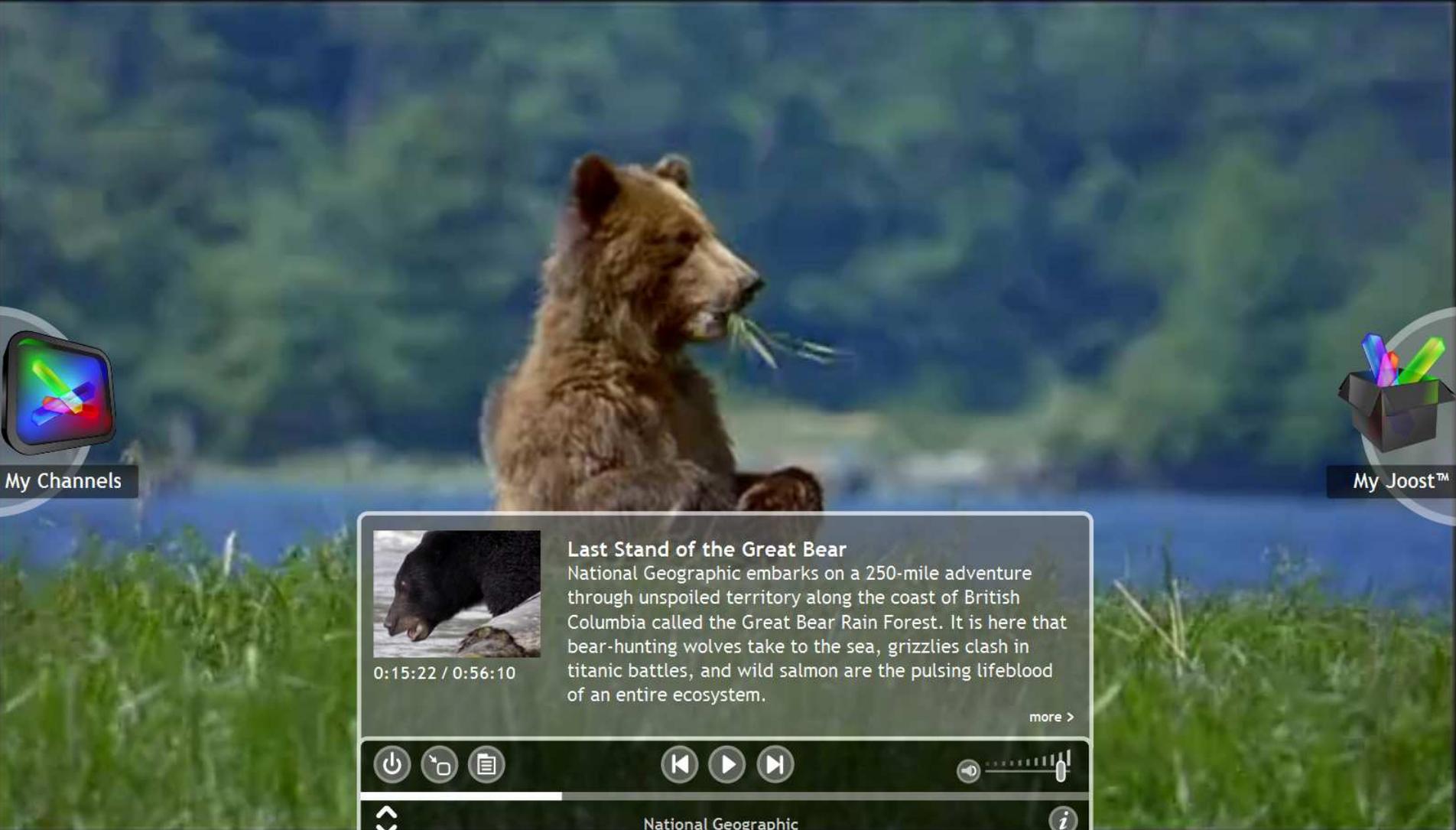




My Channels



My Joost™



0:15:22 / 0:56:10

### Last Stand of the Great Bear

National Geographic embarks on a 250-mile adventure through unspoiled territory along the coast of British Columbia called the Great Bear Rain Forest. It is here that bear-hunting wolves take to the sea, grizzlies clash in titanic battles, and wild salmon are the pulsing lifeblood of an entire ecosystem.

[more >](#)

⏪ National Geographic ⓘ

⏩ Last Stand of the Great Bear ⓘ

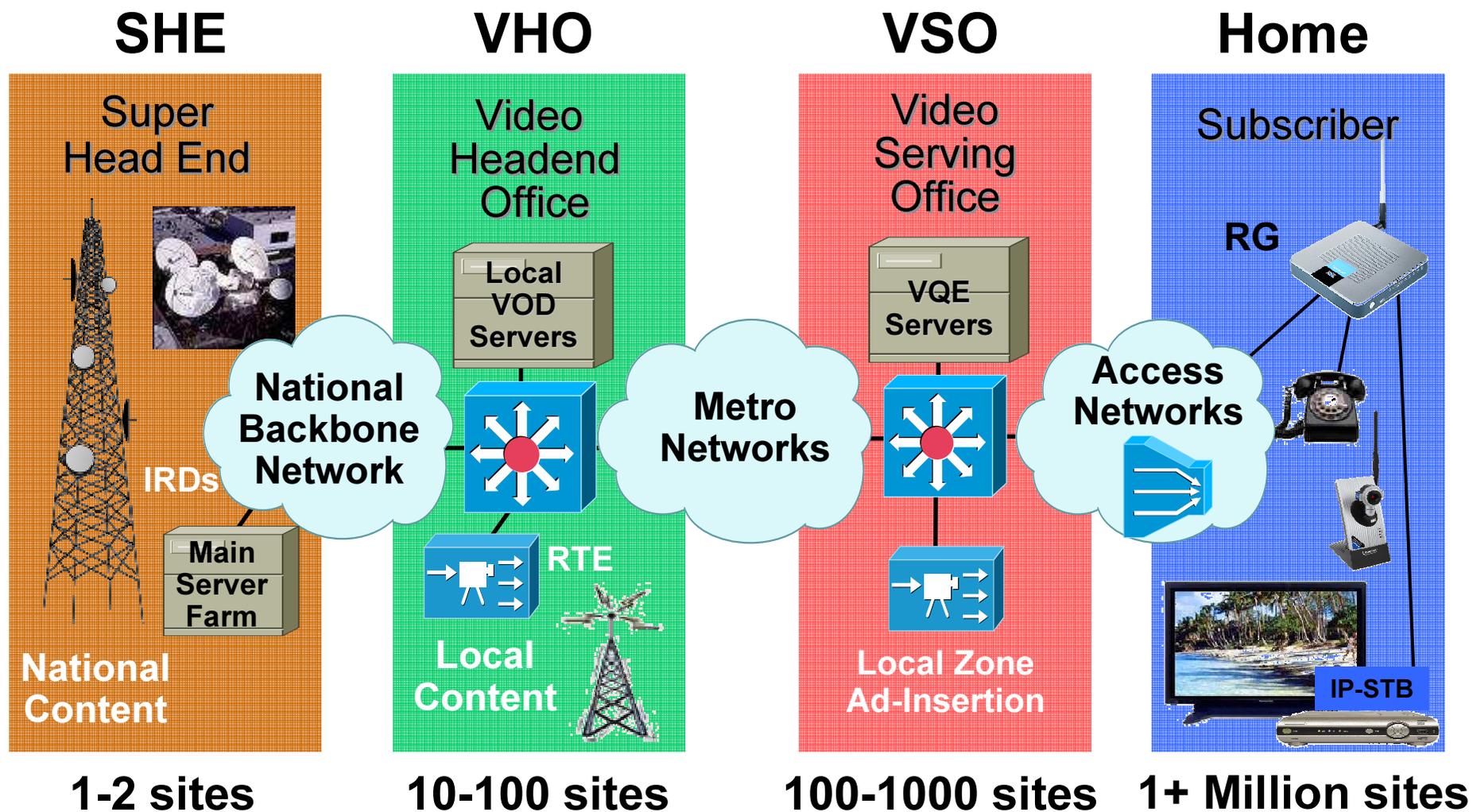
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# Typical IPTV Services

- Broadcast TV (*IP Multicast*)
- Video On Demand (*IP Unicast*)
  - Movies on Demand (MoD)
  - Subscription Video on Demand (SVoD)
  - Advertising on Demand
- Pay Per View (*IP Multicast*)
- Interactive TV (*IP Unicast*)
- Personal Video Recorder
  - Set-top Based
  - Network Based



# Typical IPTV High Level Architecture



# Headend Architectures and Components



# IPTV Headend Architecture Overview

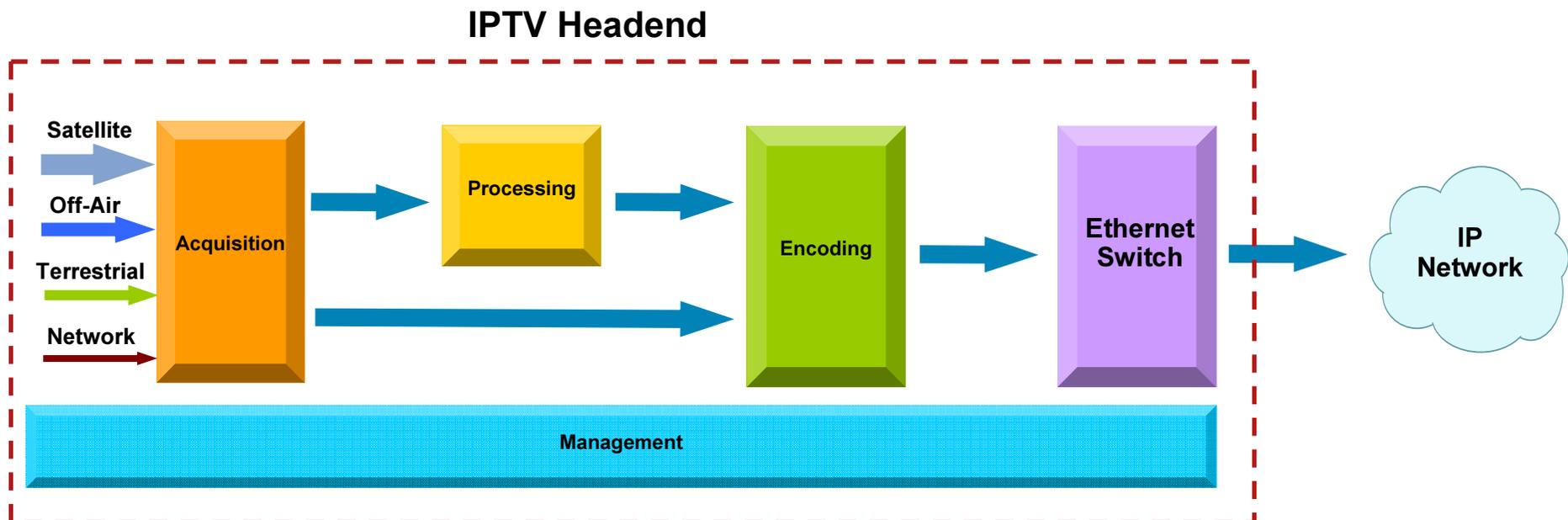
## ■ IPTV Headend Building Blocks

Video Acquisition

Video Processing

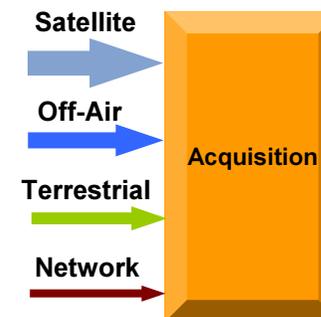
Video Encoding

Management

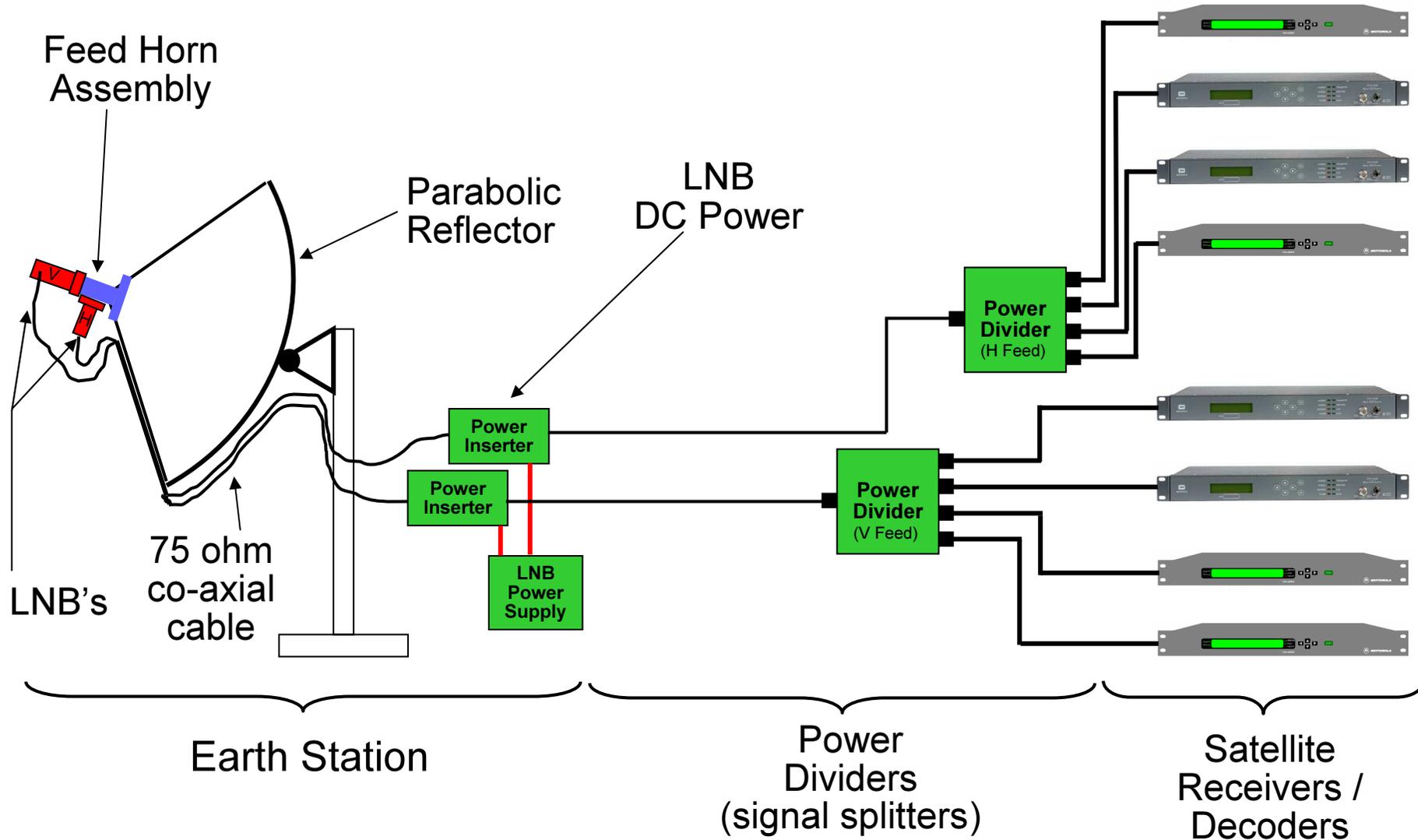


# Headend: Video Acquisition Block

- Satellite Antennas (C or Ku Band)
  - Digital Satellite Receivers
  - Analog Satellite Receivers
- Off-Air Antennas (UHF, VHF, DVB-T)
  - Digital Receivers (DTH)
  - Analog Receivers
- Terrestrial (Dark Fiber)
  - Digital (DWDM)
- Network (IP Network)
  - Digital (IP Multicast or Unicast)



# Satellite Reception Components



# Satellite Transponders

- One analog or multiple digital programs per transponder
- Multiple Transponders on a satellite

Transponders

**Hot Bird 6 at 13.0°E**

Hot Bird 6 © Lyngemark Satellite, last updated 2006-08-23 - <http://www.lyngsat.com/hb6.html>

Freq. Tp	Provider Name Channel Name	Video Encryption	SR-FEC SID-VPID	NID-TID Audio	Beam	Source Updated
10813 H tp 115	 <a href="#">Duna TV</a> [A] [T] [N] PAL			6.50 Hu	Europe	A Kardos 051004
	<a href="#">Kossuth Rádió AM</a> [A] [N]			7.02:7.20		
	<a href="#">Rádió Budapest</a> [A]			7.38 Hu		
	<a href="#">Petöfi Rádió</a> [A] [N]			7.56		
	<a href="#">Regionális és Nemzetiségi Adások</a> [A]			7.74 Hu		
				7.92 Hu		
10830 H tp 115U	 <a href="#">Autonómia TV</a> [A] [N]	DVB	3333-3/4 1 - 80	318-11500 81 Hu	Europe	DX Bozóth 060413
10834 V tp 116	 <a href="#">TPS</a> [A] [P]	DVB Mediaguard 2 Viaccess 2.3 Viaccess 2.5	27500-3/4	176-11600	Europe	N Schlammer 060802

<http://www.lyngsat.com>

# Satellite Receivers: IRDs and MRDs

- Satellite receivers used in commercial video acquisition today are actually a combination of a **receiver** and **decoder** also known as **Integrated Receiver Decoder (IRD)**.
- An **IRD** executes the following actions on a received signal:
  - Demodulate**: separates the video signal from the modulated carrier
  - Decrypt**: descrambles, if the signal is encrypted
- The other type of satellite receiver is called a **Multiple Decryption Receiver (MDR)**. While the IRD can only process a single service on a transponder a MDR can process all the services on the same transponder.

# Digital Video Broadcast (Satellite) Standards

- **DVB-S** is an open satellite transmission standard. It does NOT specify any particular conditional access (CA) system; programmers are free to choose the CA system which best fits its particular needs.
- **DigiCipher® II**, is a Motorola proprietary standard that requires Motorola CA system on the up-link and the down-link.
- **PowerVu**, is a Scientific Atlanta proprietary standard that requires Scientific Atlanta CA system on the up-link and the down link.
- **ISDB-S**, is used sparingly; predominantly in Japan.

\* Does not include DBS

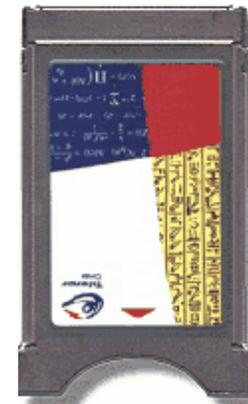
# DVB-S Conditional Access Vendors



**Viaccess**



**Cryptoworks**



**Conax**



**NagraVision**



**Irdeto**



**Aston**

# Headend: Video Processing Block

- Incoming Content needs “Processing” before

Decoding of compressed signals

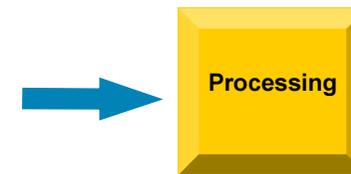
Format Conversion

PAL<->NTSC

Analog/ASI -> SDI

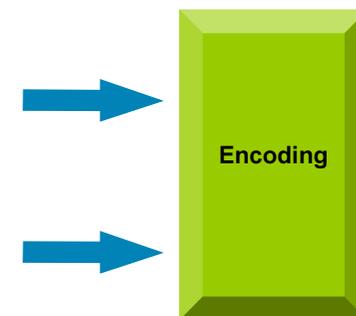
Equalization of Audio

Frame Synchronization



# Headend: Encoding Block

- IPTV deployments must use MPEG4 Part 10 (AVC/H.264) to save bandwidth
- Encoders need SDI or Analog input signals
- Output is a Single Program Transport Stream over IP/UDP



# Uncompressed Digital Video - SDI

SDI signal is an uncompressed digital baseband video format

There are three distinct channels (same as component video)

Y or Luminous

Pb or Luminous-blue

Pr or Luminous-red

## **Data Rates:**

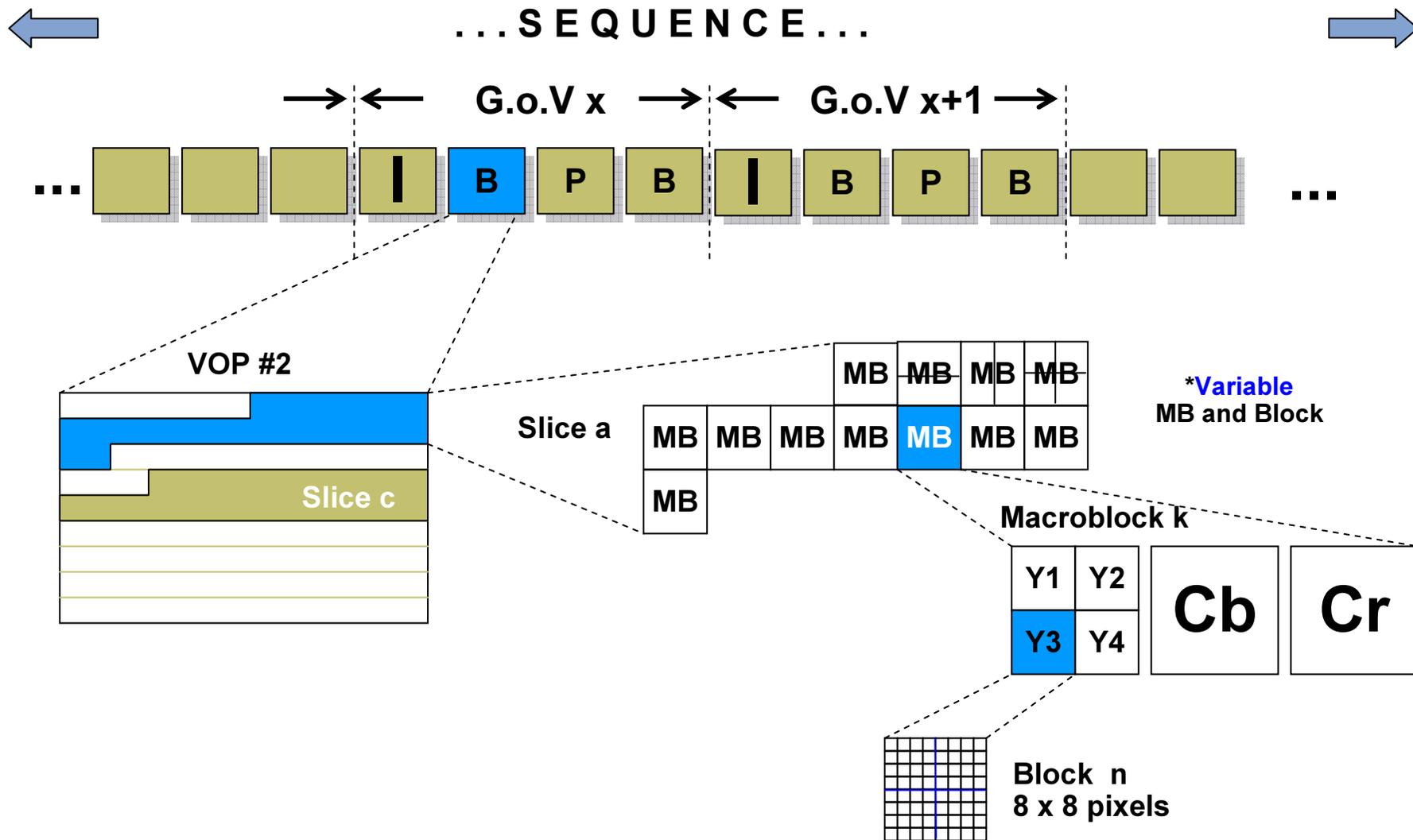
270Mbps for SDTV

1.485Mbps for HDTV

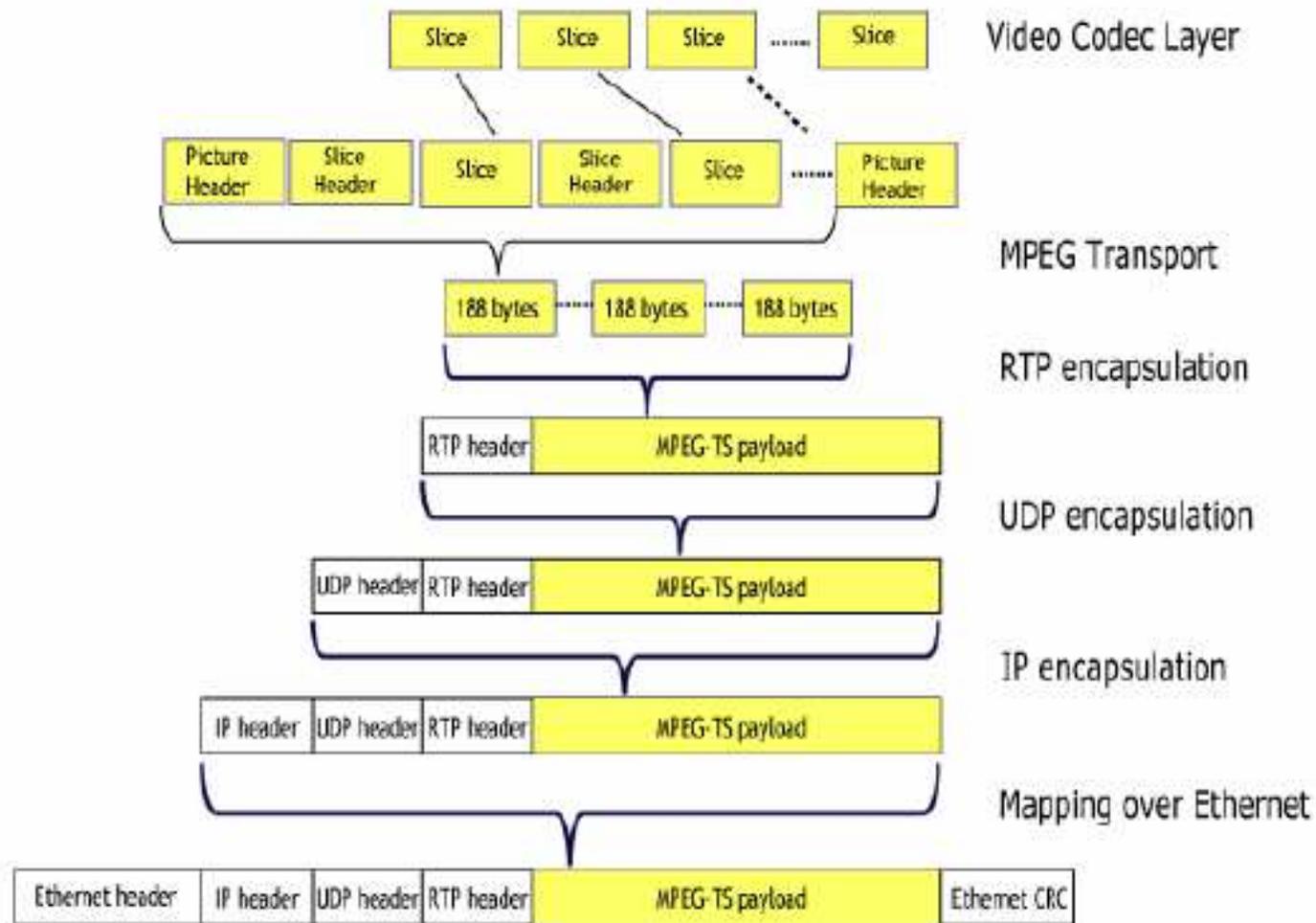


# H.264: MPEG Video Hierarchy

## Sequence, GoP, Picture, Slice, MB, Block



# From Video to IP



# Headend: Middleware Servers

*“In computing, middleware consists of software agents acting as an intermediary between different application components. It is used most often to support complex, distributed applications. The software agents involved may be one or many “ – Wikipedia definition*

- IPTV Middleware is responsible for, but not limited to:

User Interface (EPG, Portal, etc)

Subscriber Management

Billing

Digital Rights Management (DRM)



# Headend: VoD Systems

- Typical Video On Demand systems employ a distributed architecture to better serve the subscribers
- The Headend contains the central content servers and storage
- Typical VoD Vendors:



# Headend: Management Block

- All Headend Equipment must be Managed

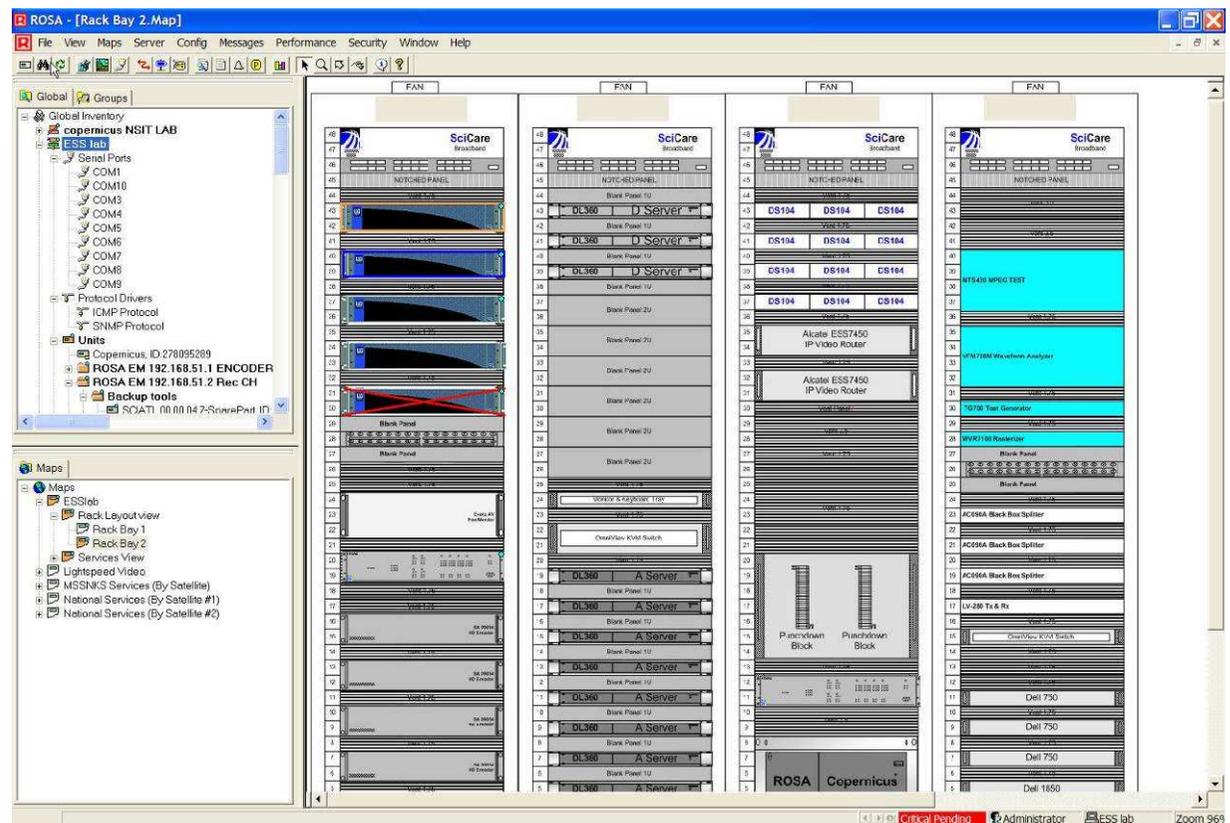
Configuration

Fault

Alarms

Redundancy

Status



# IPTV Distribution Networks



# Broadcast TV: IP Multicast Routing

- Native IP Multicast Routing using PIM-SSM and Anycast

- Multicast Routing Advantages:

**Bandwidth Efficiency**

**Shortest Path to Source**

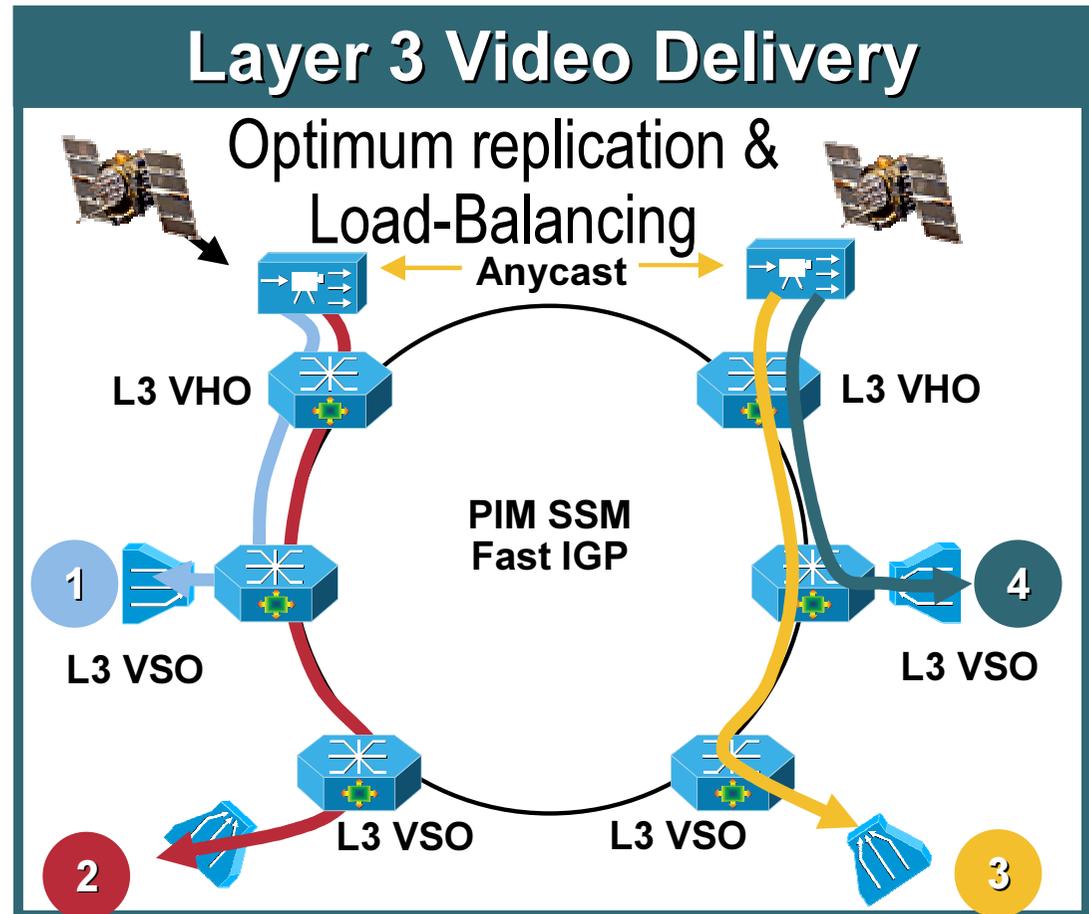
**Load Balancing**

**Improved End-to-End Service Resiliency**

**Anycast for Designated Router Redundancy**

**Source Security via SSM**

**Scalability (no RPs)**



# VoD Transport

## How much bandwidth is required ?

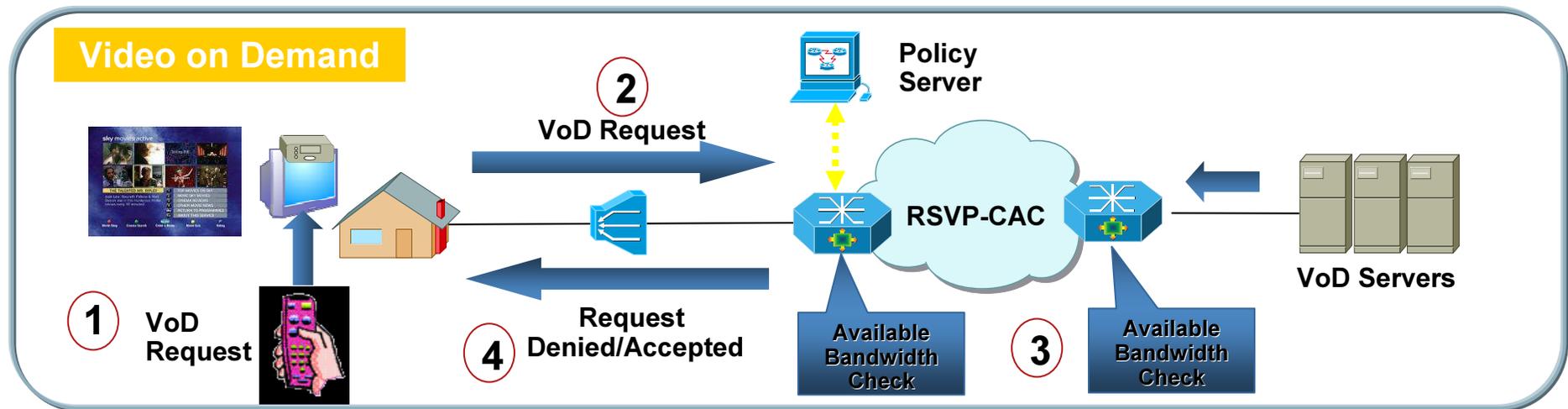
### Broadcast

- **Scale** with the number of **channels**
- $BW = Nbr(SD) * BW(SD) + Nbr(HD) * BW(HD)$
- Oversubscription possible
  - *Dynamic Multicast (SDV) + CAC*

### VoD

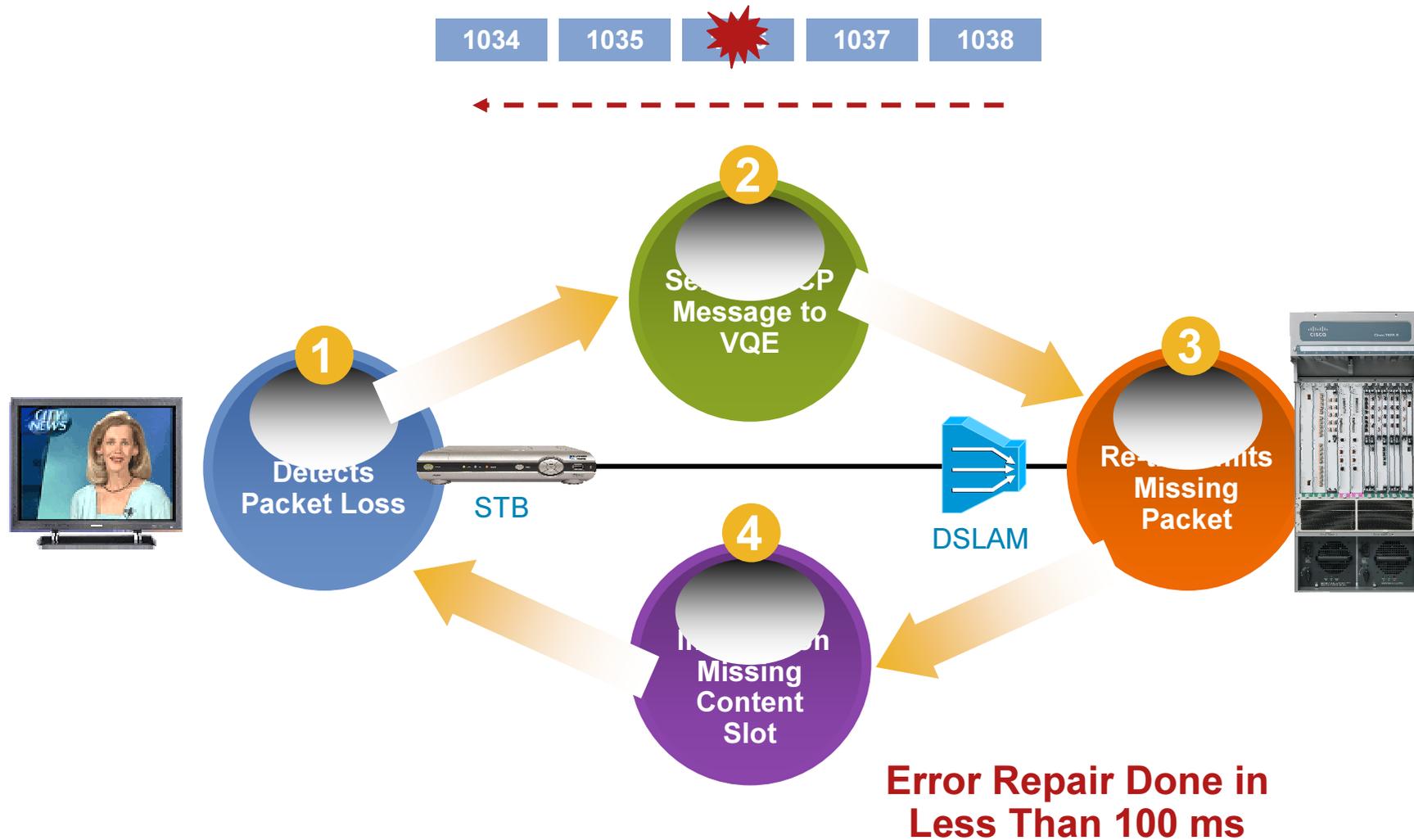
- **Scale** with the number of **subscribers**
- **Scale** with the service **popularity**
- Main factors in BW computations are
  - *Video Subscribers Served Per Link*
  - *Peak Usage Rate*
- **Erlang Analysis** can be used
  - *Independent of Movie Length (VoD)*
  - *Assumes Random Subscriber Behavior*
  - *Busy Hour Traffic (BHT) = f(peak rate)*
  - *Blocking Factor = 10-5 typical*
- Oversubscription possible
  - CAC

# VoD Connection Admission Control



Provides a "Busy Signal" for subscribers of Video on Demand services using standard-based protocols (RSVP)

# VQE: DSL Line Packet Loss Repair



# Typical IPTV Channel Change Delay

- Key Contributors to channel change delay

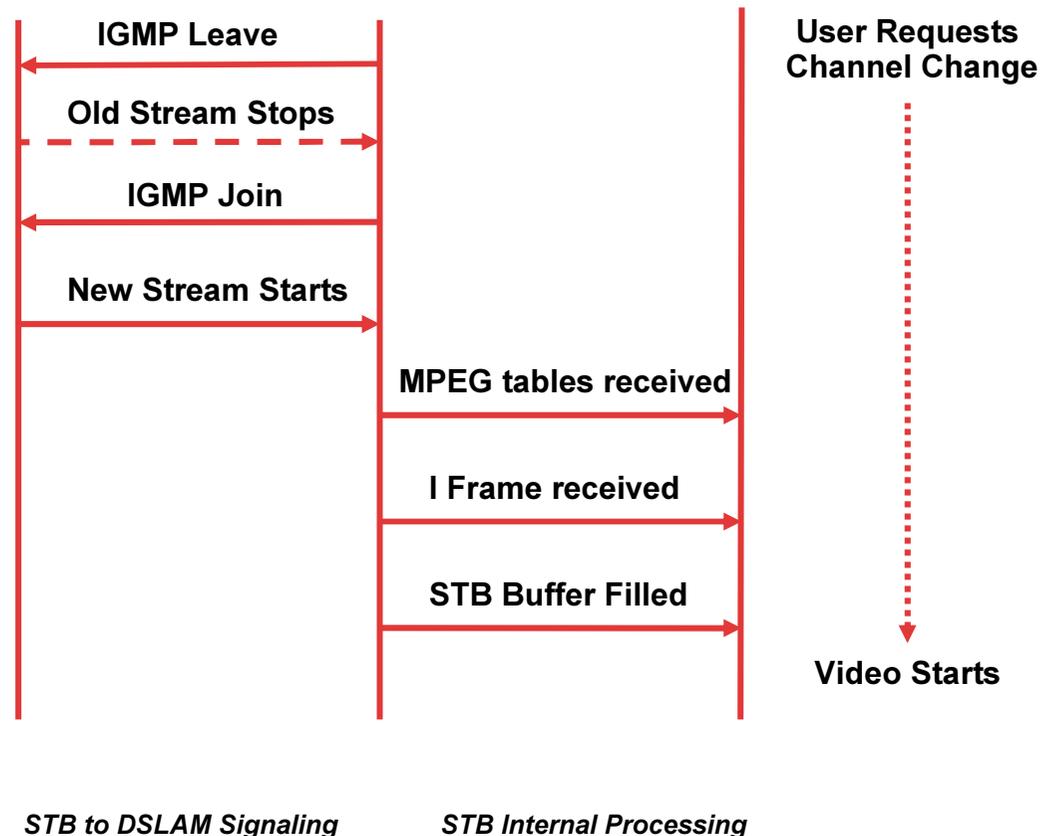
IGMP Leave/Join latency

Historical MPEG stream info—Program Address Table, Encryption Control Messages, ...

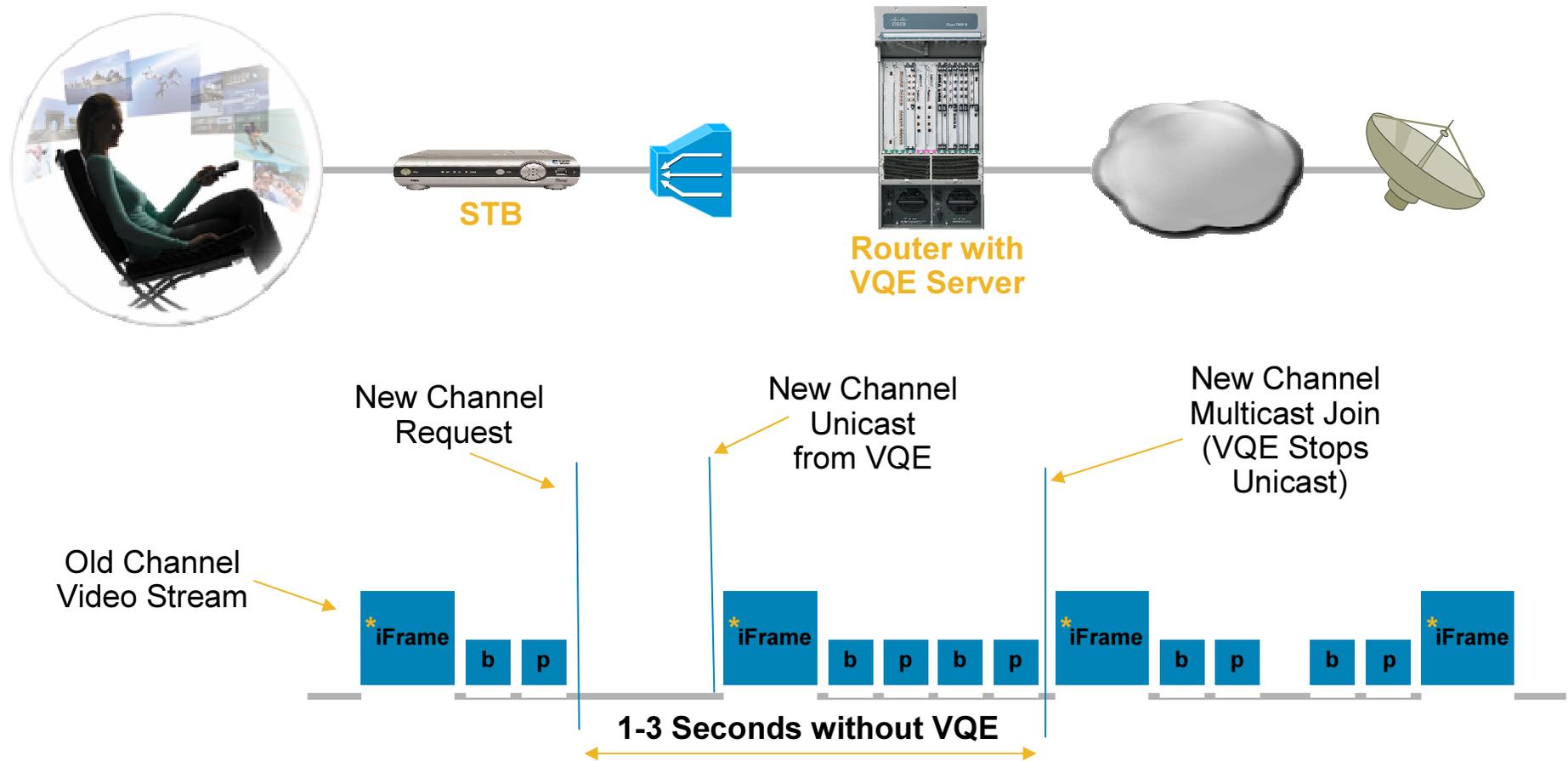
I-frame delay—highly dependent on Group of Pictures (GOP) size

Amount of burst bandwidth available

De-jitter and MPEG decoder fill



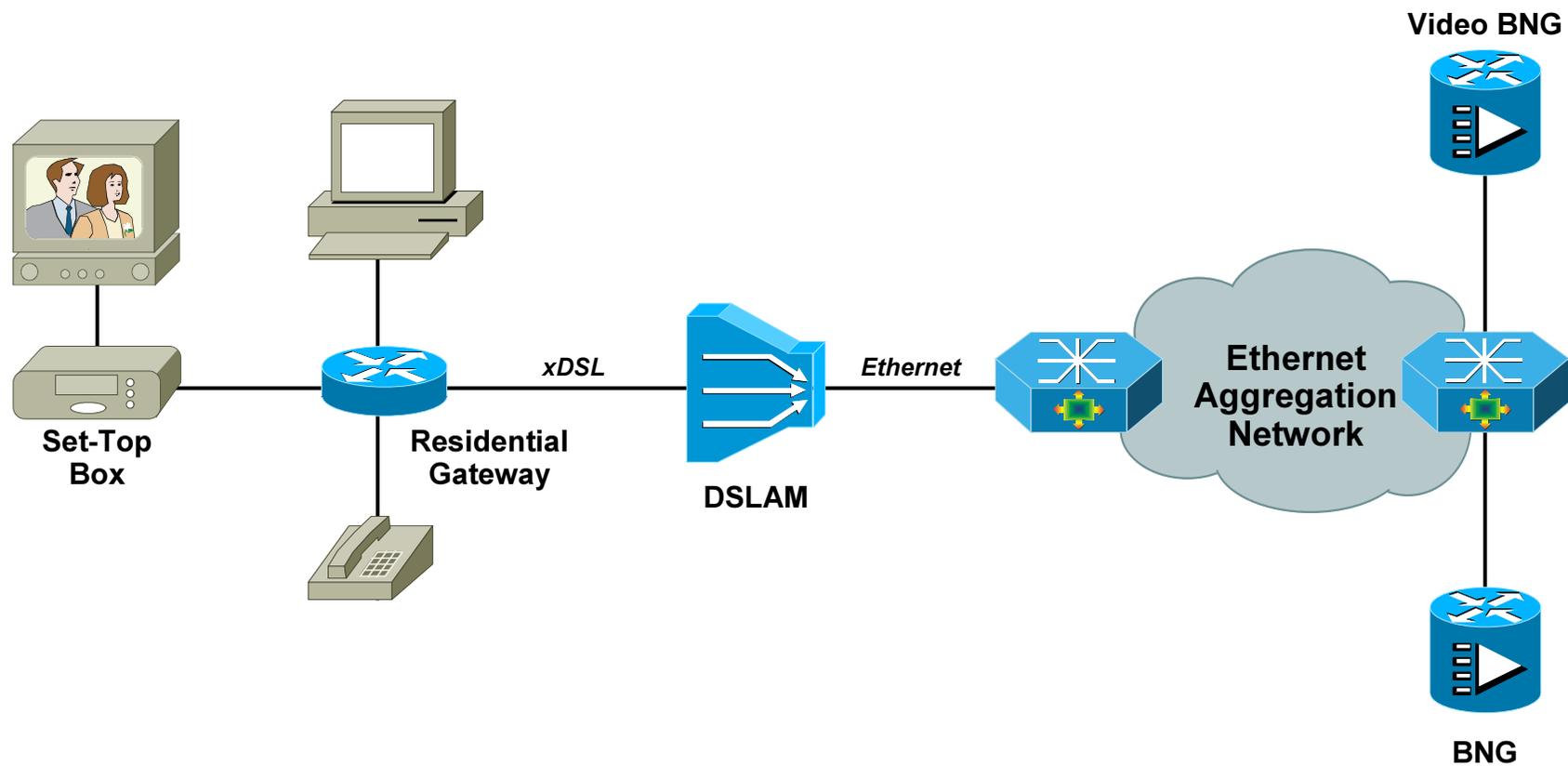
# VQE: Standards-based Rapid Channel Change



# IPTV Access Networks



# DSL Forum TR-101 Generic Architecture



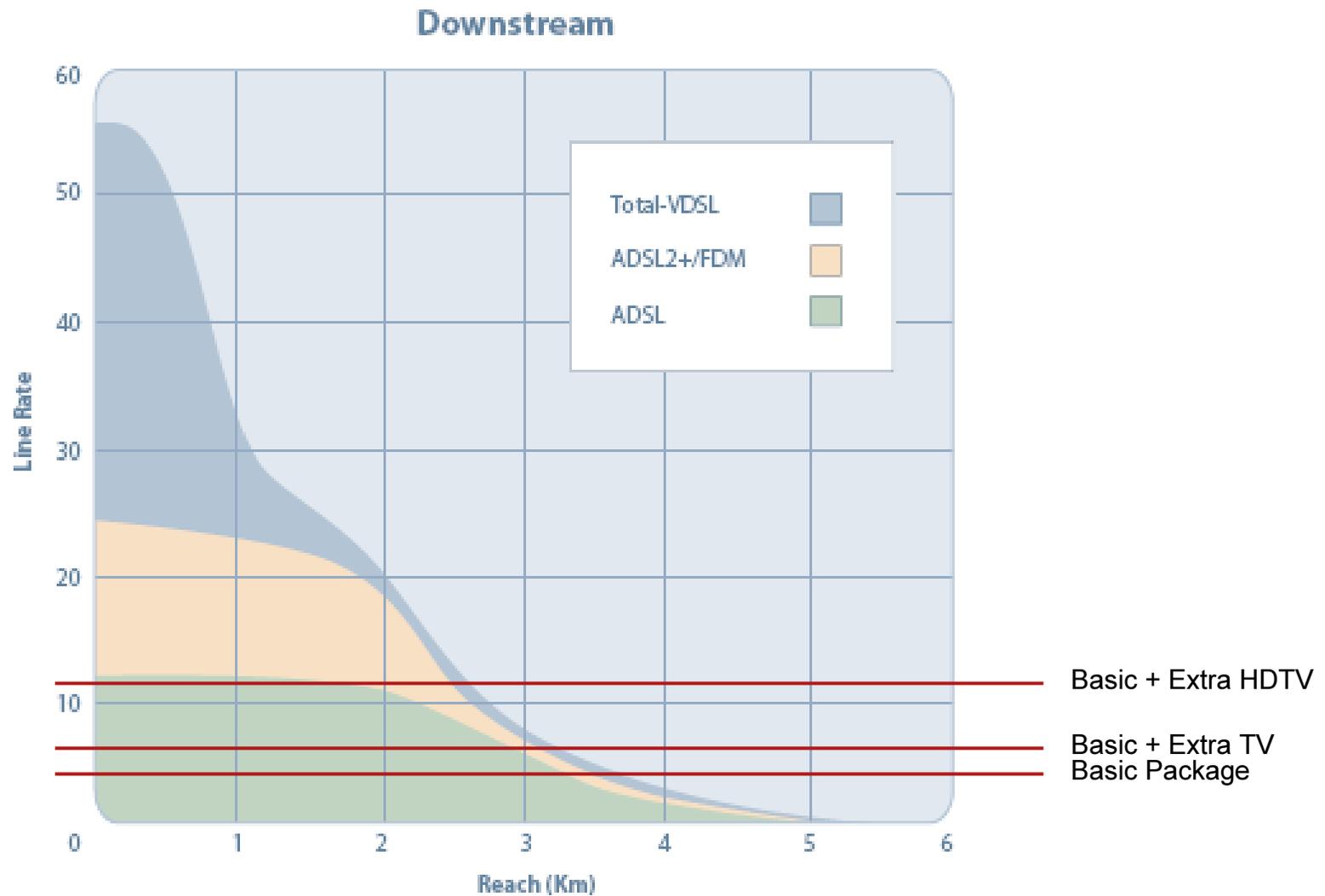
# Typical Services Mix Bandwidth

- High Speed Internet: 2Mbps
- 1 x SDTV Channel: 1.8~2Mbps
- 1 x Voice over IP Line: 0.1Mbps
- Total Bandwidth: 

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~4.0Mbps
  
- Base plus second SDTV channel: ~5.8Mbps
- Base plus one HDTV channel: ~11.5Mbps

# DSL Speeds vs Loop Length



# Competing Fiber Access Technologies

- GPON (ITU G.984)

Passive optical network using star topology

2.488Gbps Downstream / 1.244Gbps Upstream

Up to 64 users per tree

Primarily used in North America



- Ethernet (IEEE 802.3)

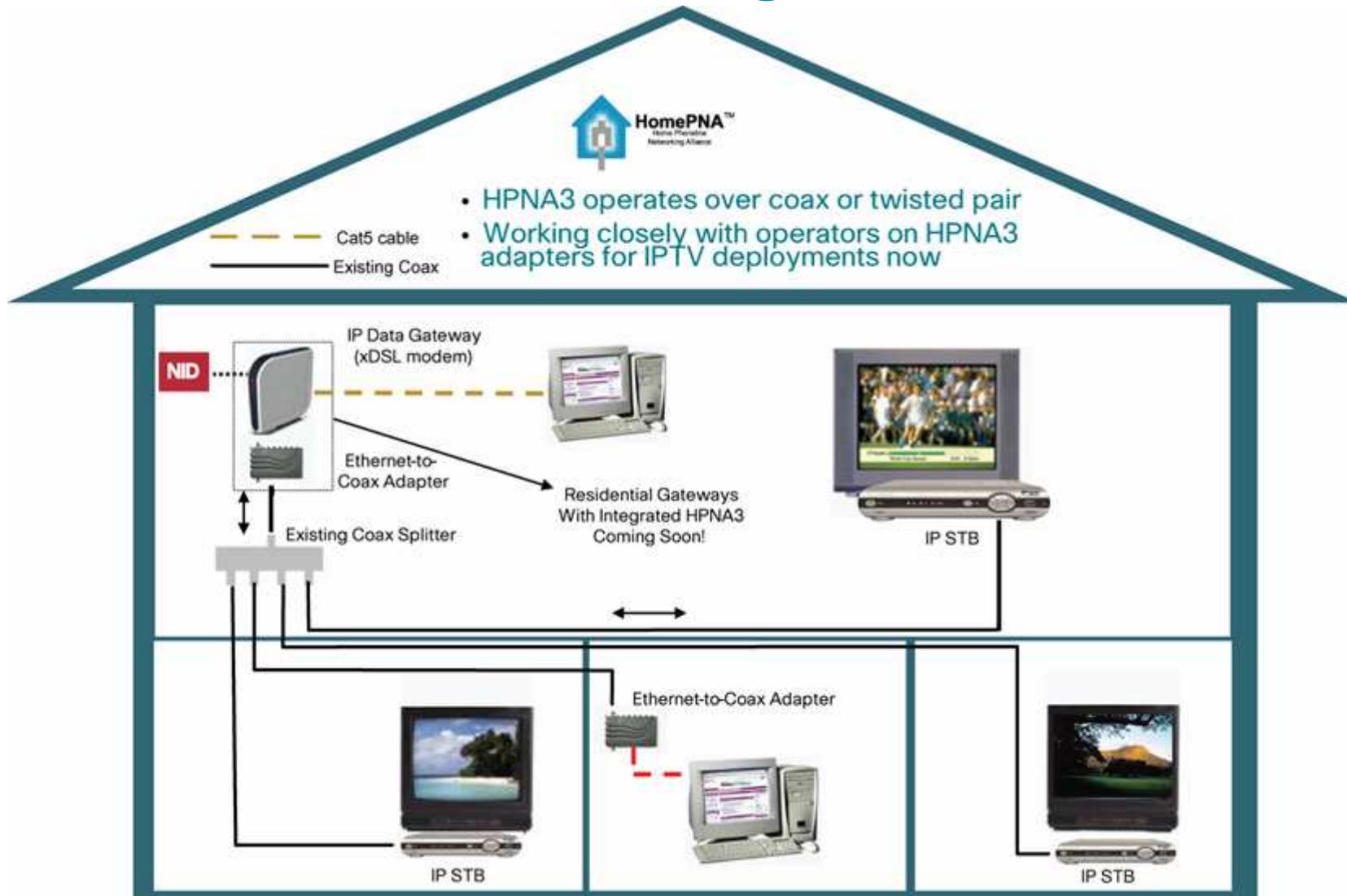
Can be Fast, Giga or 10 Gigabit in a point-to-point topology

Generally 100Base-BX (single strand of fiber)

Primarily used in Europe



# HomePNA: Networking Inside the Home



# Light Reading IPTV Testing



*“A ground-breaking test commissioned by Light Reading -- the first of its kind -- has shown that equipment from Cisco Systems Inc. (Nasdaq: CSCO - message board) can scale to 1 million IPTV customers with carrier-grade features such as quality of service (QOS) and resilience.”*

[http://www.lightreading.com/document.asp?doc\\_id=126475](http://www.lightreading.com/document.asp?doc_id=126475)



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