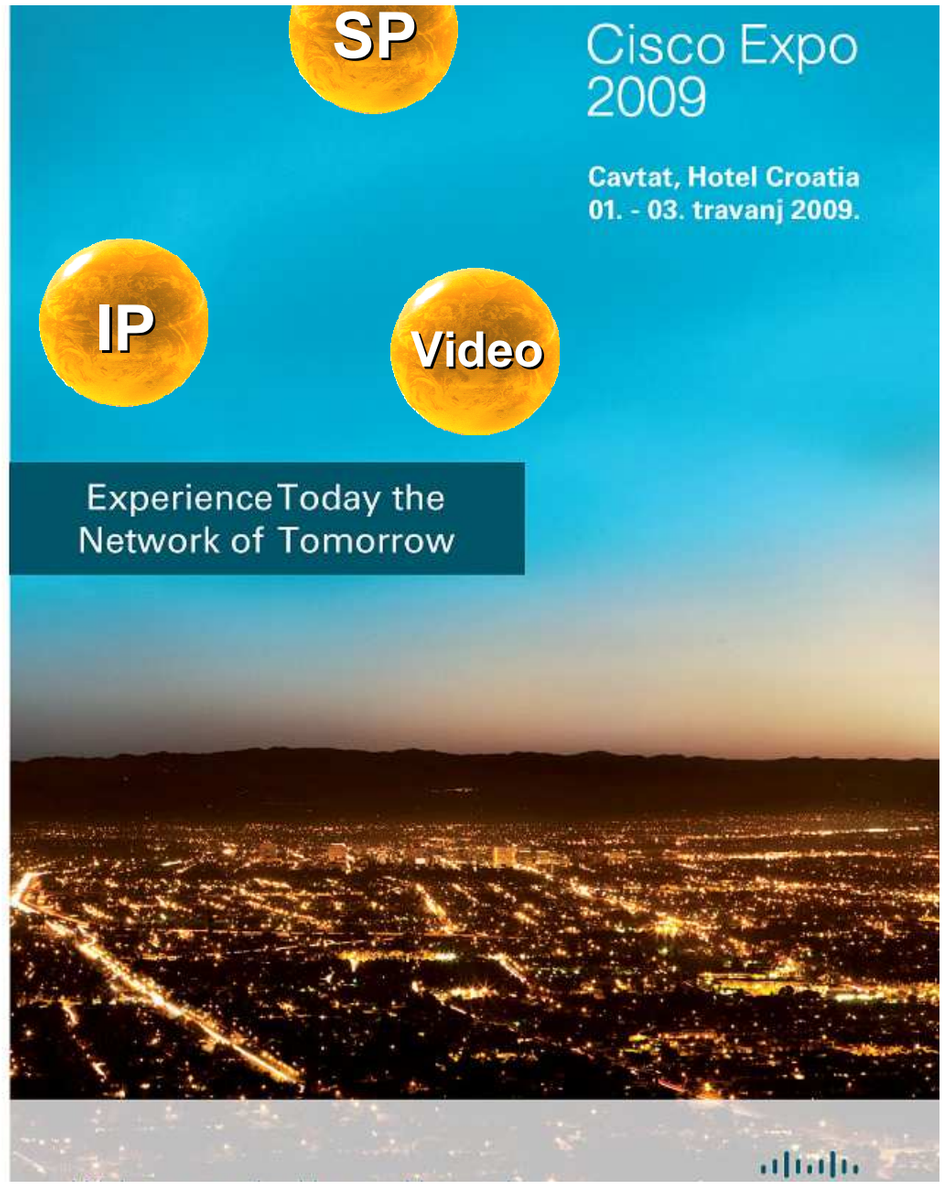
Video over IP for Service Providers

Jarosław Grabowski



Sponzor konferencije

T · · Com ·

Partner digitalnog oglašavanja

RECRO net

Partneri konferencije

COMPUTECH · computer systems · IBM · KING ICT · RECRO net · STORM · Sedam IT · verso

Pokrovitelji konferencije

AMERICAN COLLEGE OF MANAGEMENT AND TECHNOLOGY · Microsoft · SAP

Tehnološki sponzori

ComTel Corp. · EMC² · mack it · Panduit · vmware

Medijski sponzori

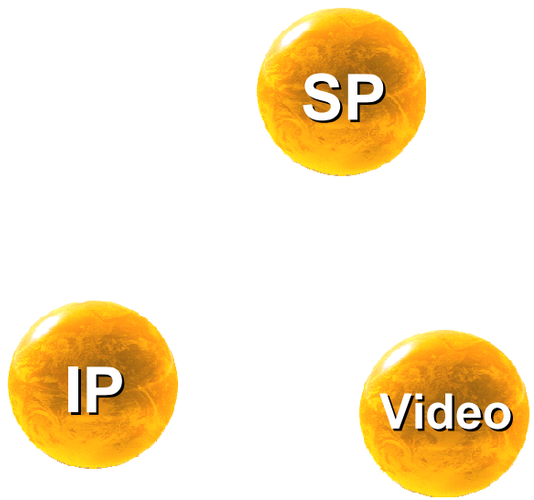
FORUM.HR · InfoTrend · MONITOR · MREŽA · PC chip · poslovni vjesnik

Cisco Expo 2009

Cavtat, Hotel Croatia
01. - 03. travanj 2009.

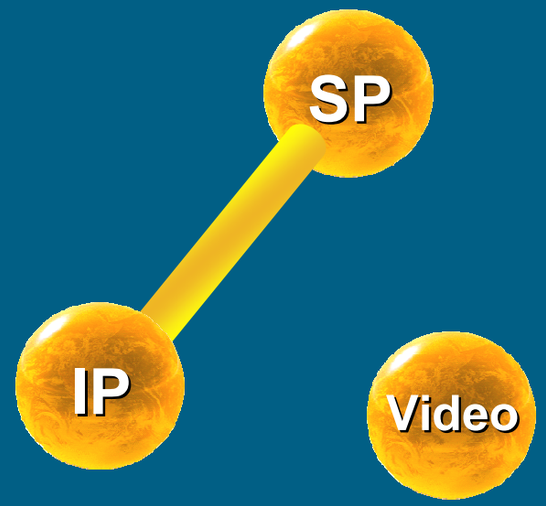
Experience Today the Network of Tomorrow

Agenda

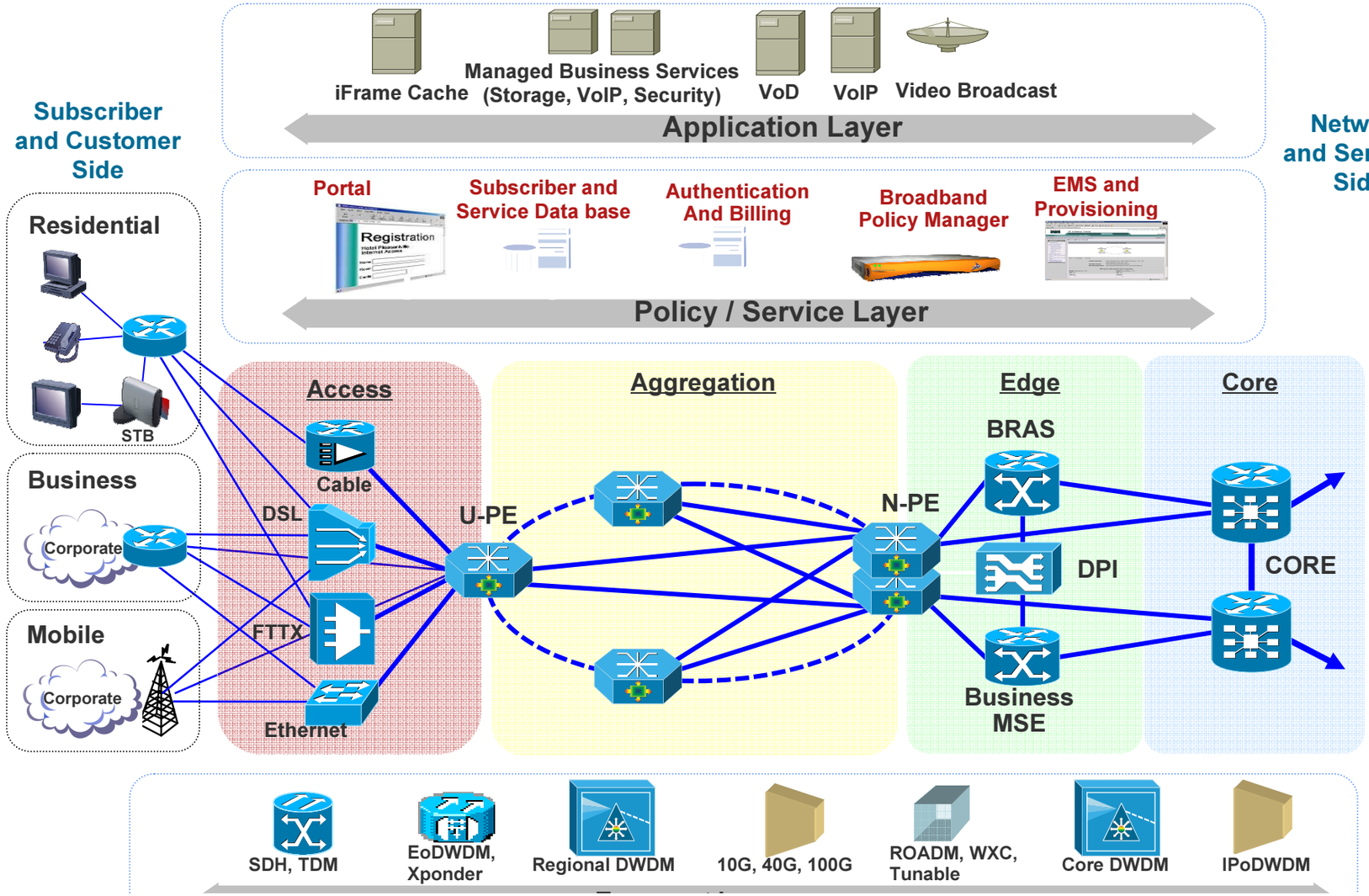


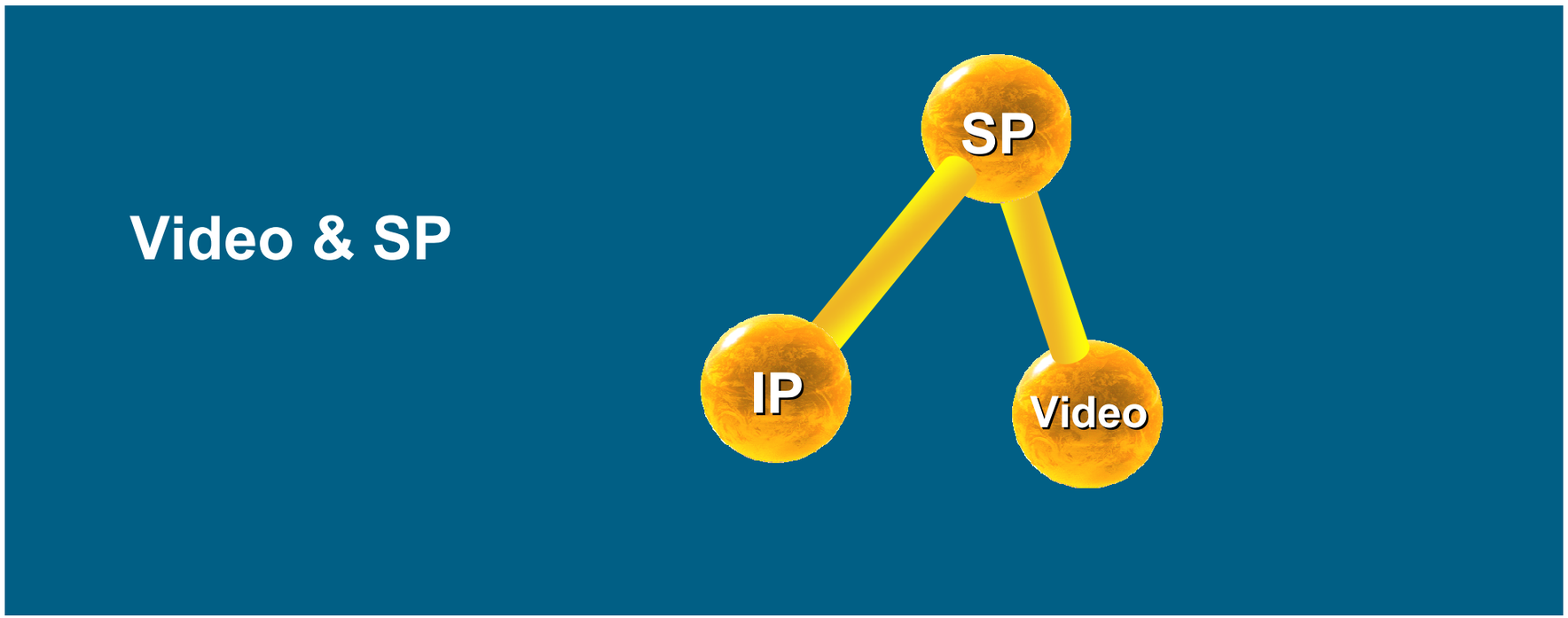
- Three main dots
  - Video
  - SP - Service Providers
  - IP
- Cisco solutions
  - Broadcasters DVB-T
  - Cable TV
  - IPTV

Service
Providers
&
IP

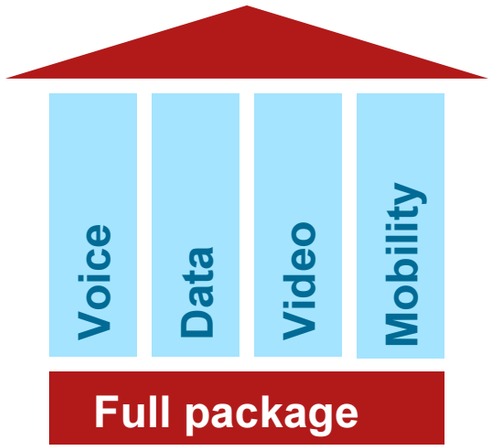


IP NGN architecture : single network - all services




Video & SP
SP
IP
Video

Service Providers & Video
Why?



- Full package
  - Voice
  - Data
  - Video (High Quality HD, VoD)
- Makes SP offer ‘complete’ with additional mobility
- Converts Service Provider to Experience Provider

Why?

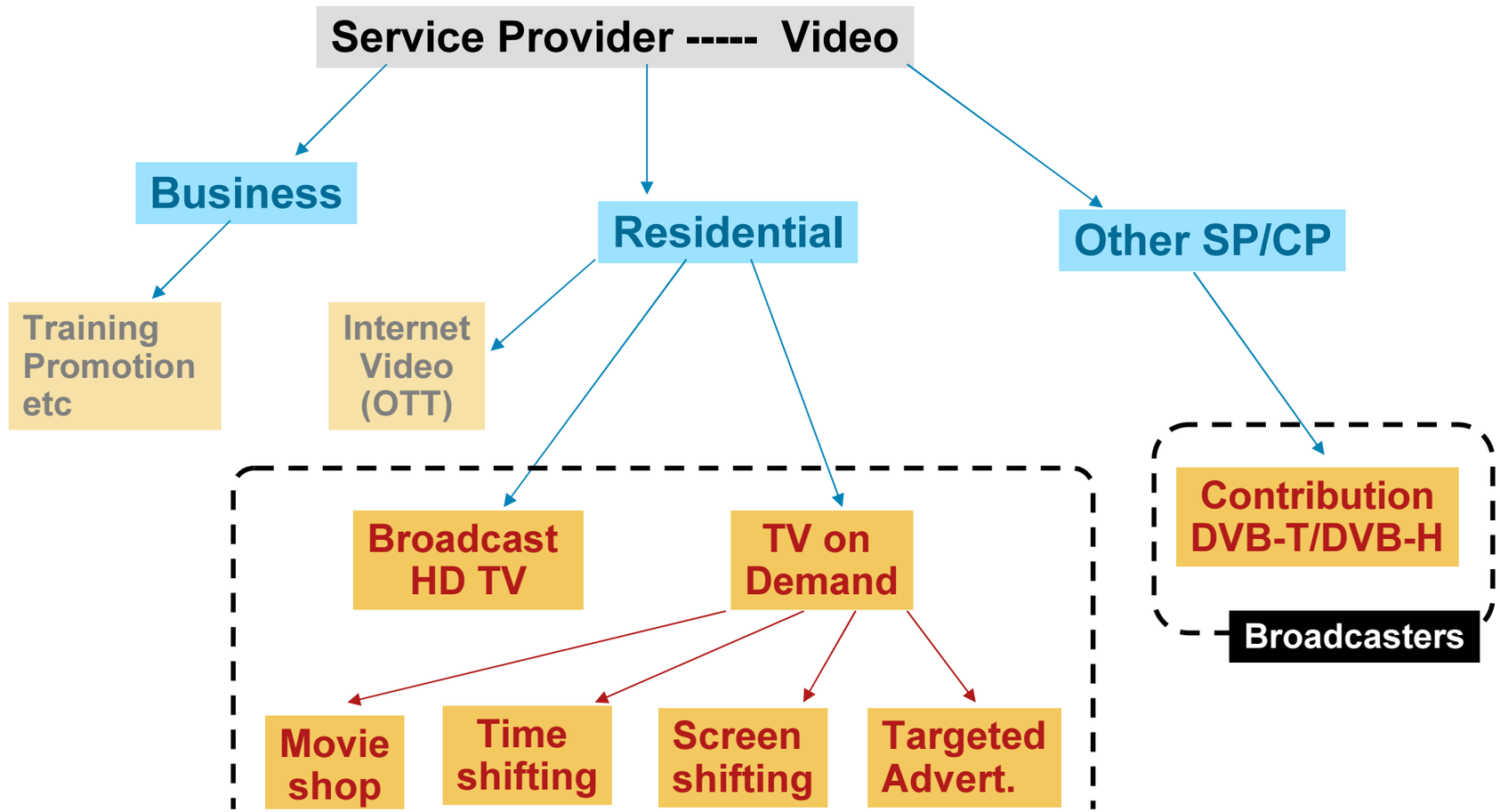
$$$$~~€€€€€~~...
keep customers,
conquer new markets
increase ARPU……..

SP 4Play readines

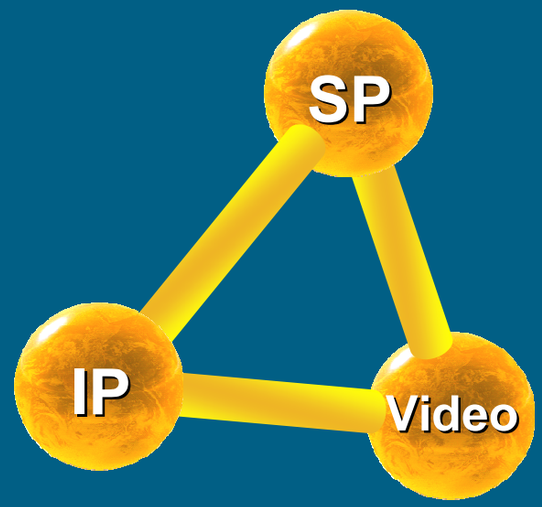
Service / SP	Voice	Data	Video	Mobility	Point of focus
Cable					Most advanced. Infrastructure needs to be digitized. HFC range is the biggest issue
Wireline					Access systems capacity. IPTV services deployment. Mobility?
Wireless GSM					Saturation is close. Radio network capacity. New services needed DVB-H?
Wireless Broadcasters					Analog TV systems switch-off. Introduction of DVB-T. Maybe DVB-H?

Service Providers & Video
Video Services

High Quality
Video
=
Carrier Class Video



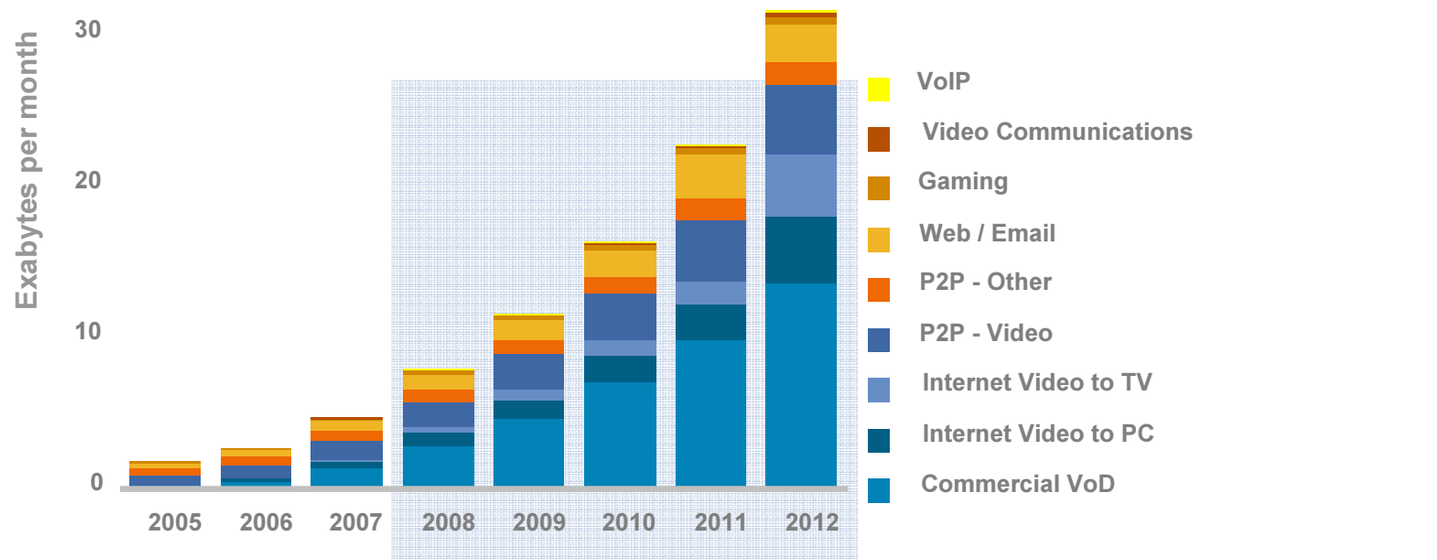
Video & IP



Video Apps Approach the Zettabyte Era

Global Consumer IP Traffic Growth

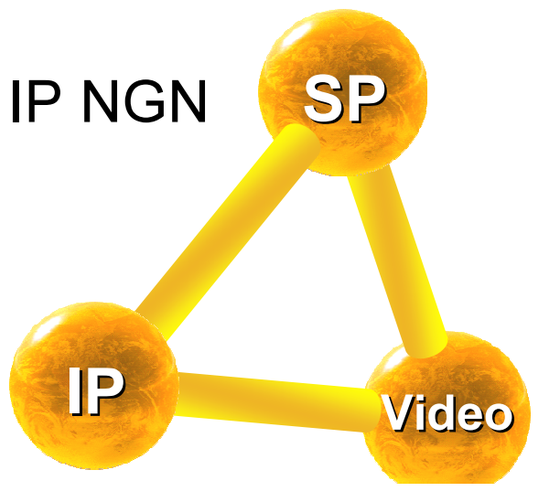
Without Video, Consumer IP doubles by 2012
With Video, Consumer IP quadruples by 2012



Video reaches 87% of Consumer IP in 2012

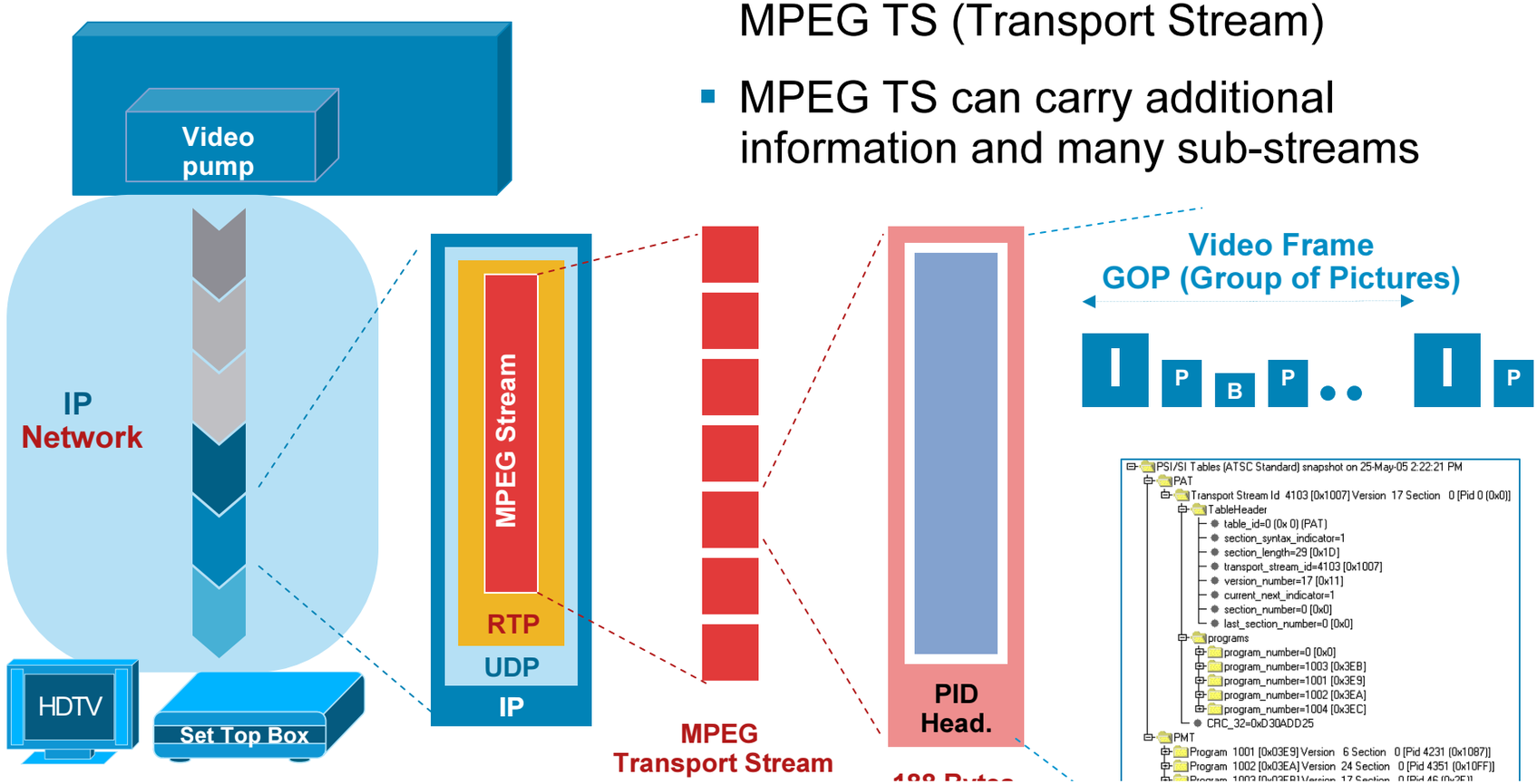
IP is almost ideal for Video distribution

- IP enables Ethernet
  - Scalable 10/100/1000/10 000/ …..
  - Price for bandwidth!! No other technology could match
- Easy to distribute (IP routing)
- MULTICAST!!!
  - Build in mechanisms for replication
- OPEX/CAPEX savings when running on IP NGN
- Almost ….

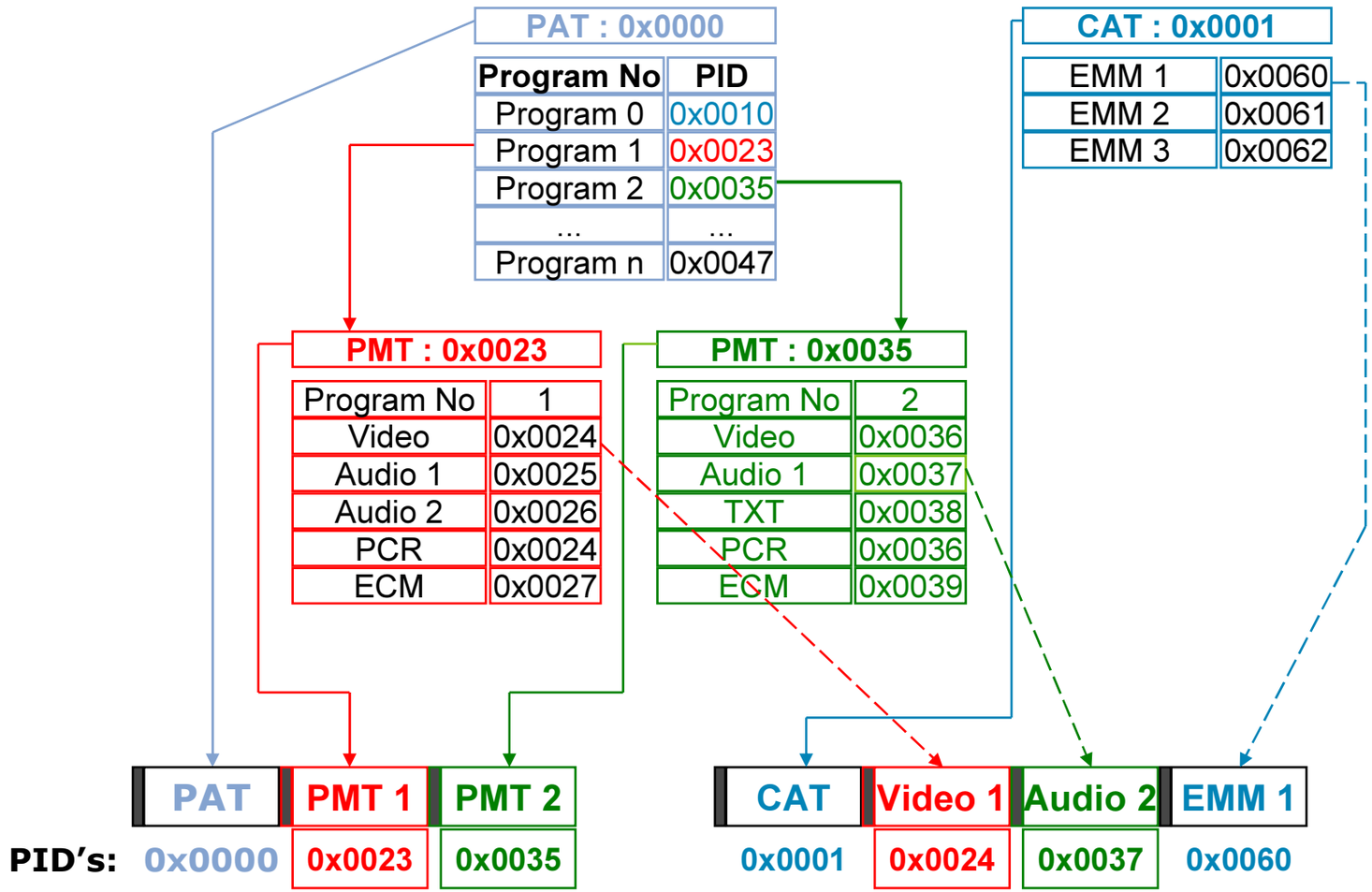


Transporting video
MPEG TS

- IP/UDP/RTP packets caring MPEG TS. RTP is optional.
- Compressed video is send using MPEG TS (Transport Stream)
- MPEG TS can carry additional information and many sub-streams

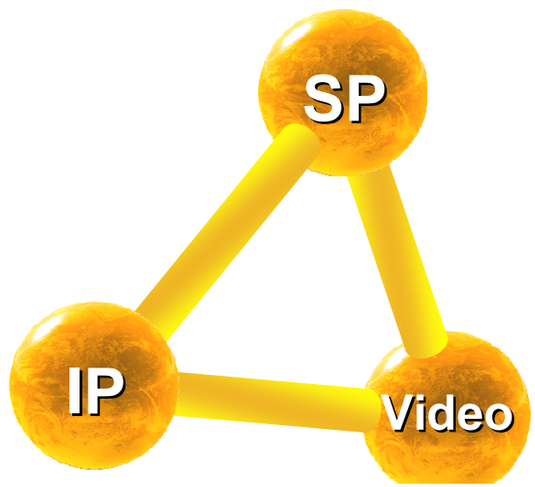


Transport Streams:
Components - Table Sequence

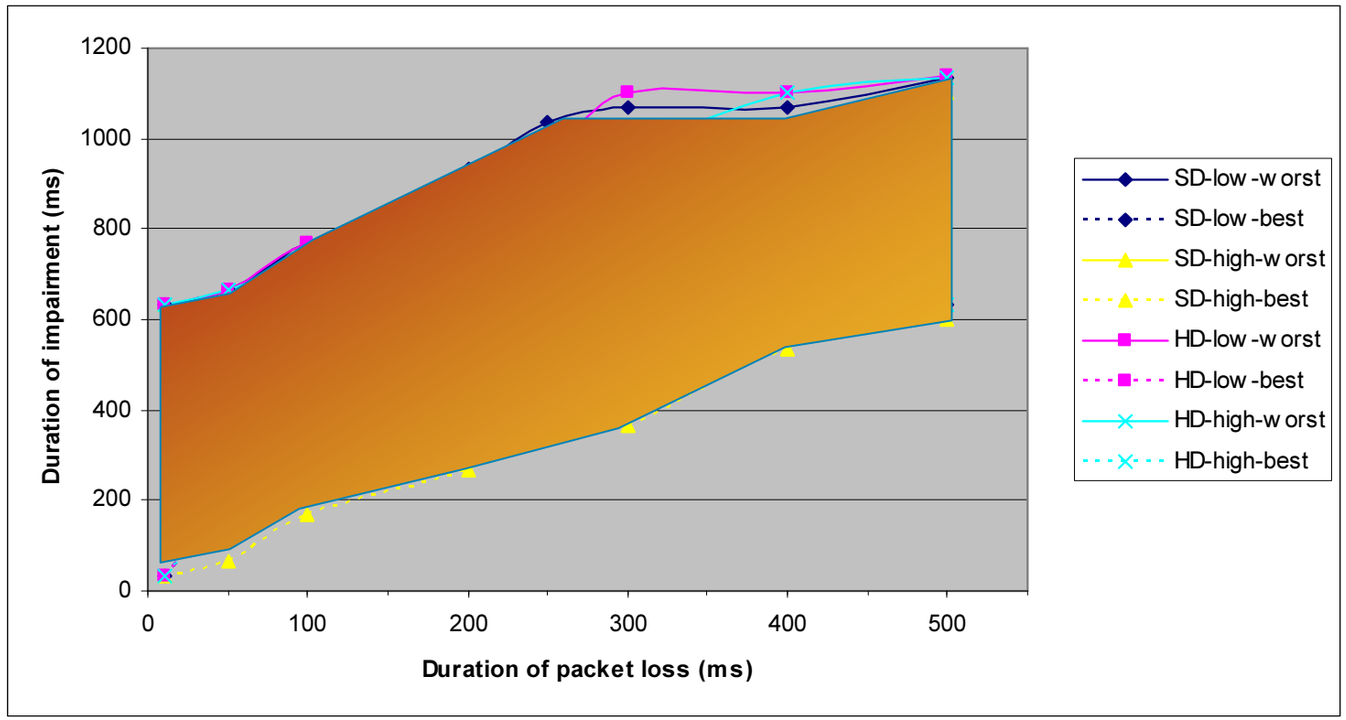


Video & IP (Ethernet)
Almost perfect marriage

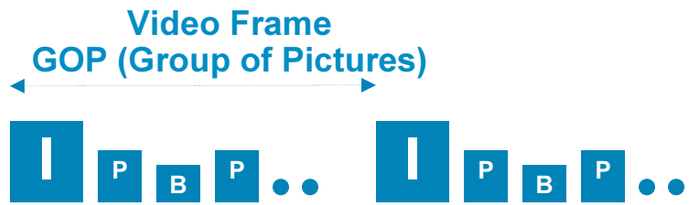
- The most important thing is to bring **all** video packets to the destination on time.
- Lost of single packet is visible on the screen
- IP and Ethernet networks are not design to be “Zero Loss”
- Packet loss reasons
  - Delay/Congestion (buffering/drops)
  - PHY-Layer Errors (noise)
  - Network Reconvergence Events
- How to manage the losses?



MPEG –Packet Loss impact



- Jason Greengrass, John Evans, Ali C. Begen, *"Not All Packets Are Equal: The Impact of Network Packet Loss on Video Transport"* – to be published in IEEE Internet Computing, Nov 08



Video & IP (Ethernet)
Tools to improve QoE (Quality of Experience)

- Network Layer

  Fast IP Convergence (sub second) — **Simplest method.**

  MPLS Traffic Engineering with Fast Reroute (pre-calculated back up TE tunnels, 100ms). — **More complex to manage. Bandwidth reservation**

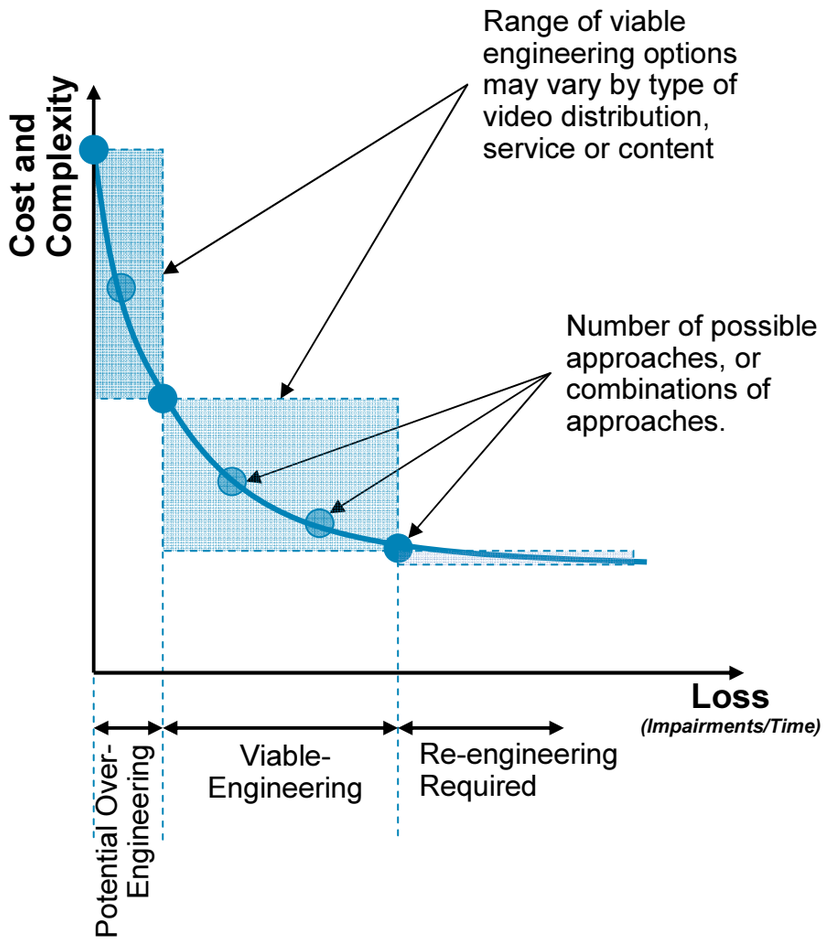
- Application Layer

  FEC (Forward Error Correction). — **Added by Cisco DCM9900**

  Retransmission of missing packets — **Available on Cisco VQE-S**

  Active/Active. Two simultaneous streams.

Video SLA Requirements:
Managing Loss



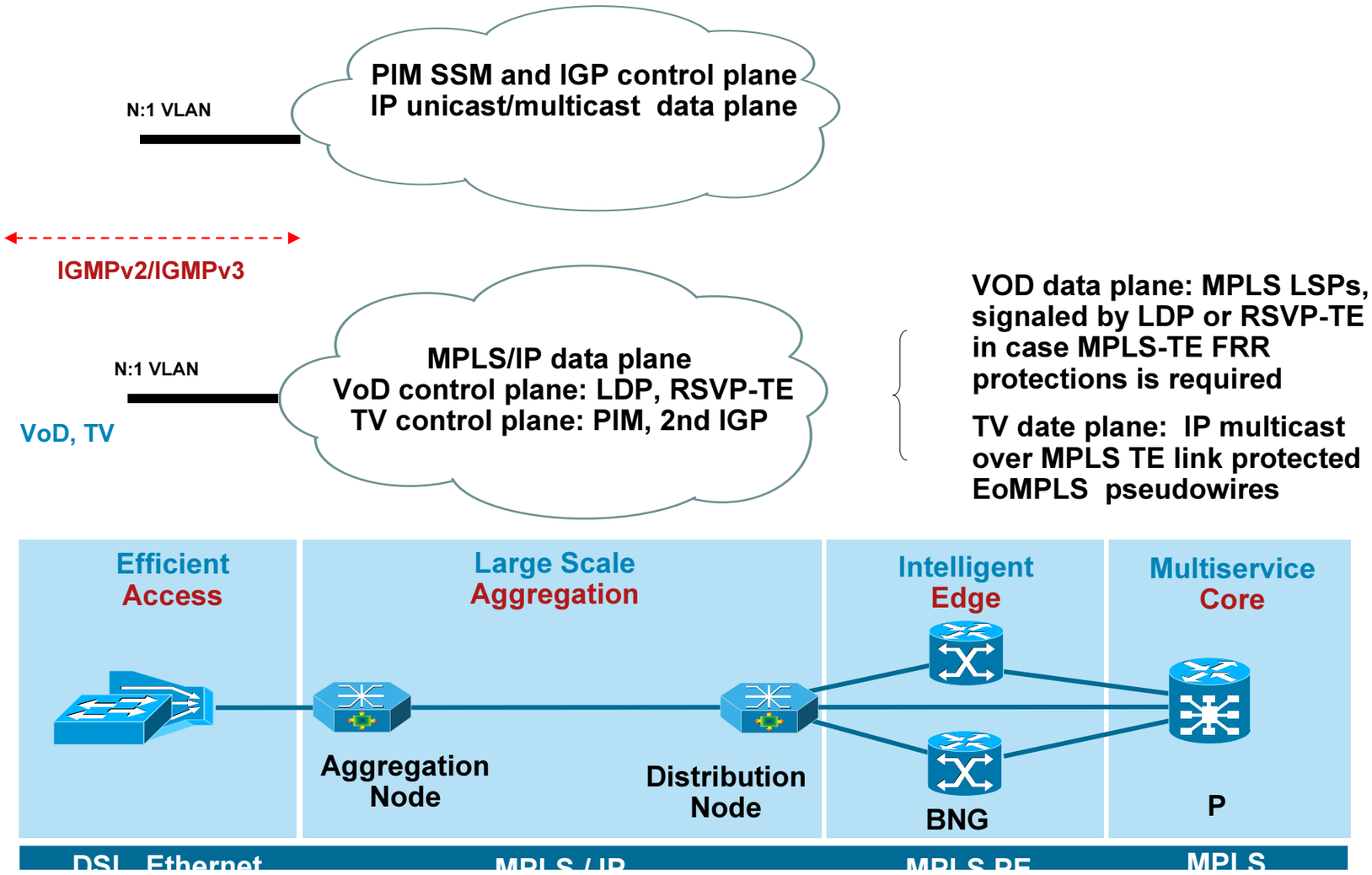
- A number of technological approaches to achieve required SLA

  Recommendation for IPTV is to have single artefact per 1hour

- Number of network deployment models to support each approach
- Application level approaches may also impose requirements on the network
- Different combinations of models and approaches have different pros / cons and cost vs. complexity trade-offs

Multimedia Services Architecture

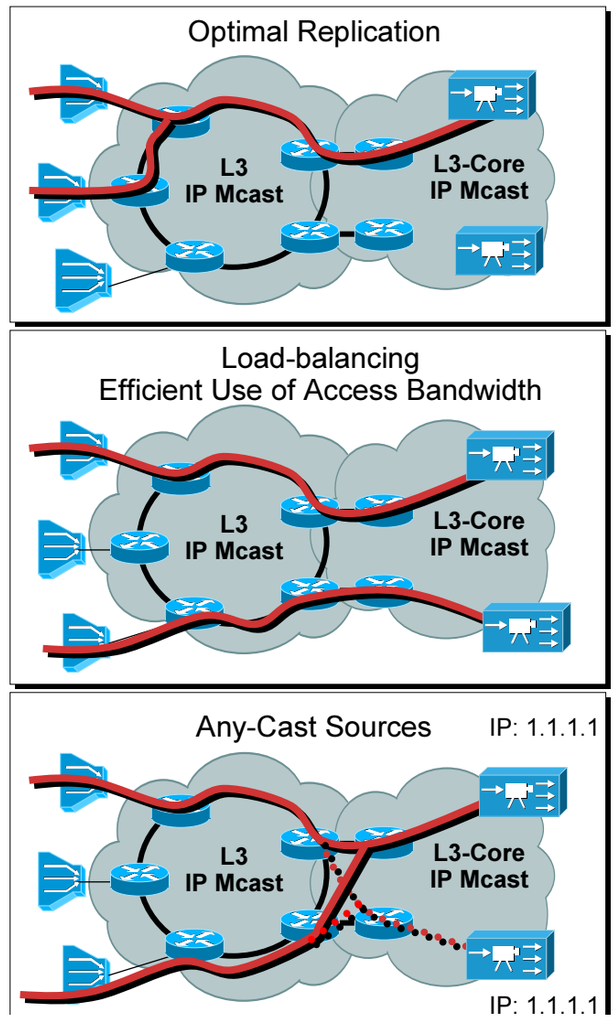
Options: “Native IP” transport or MPLS transport



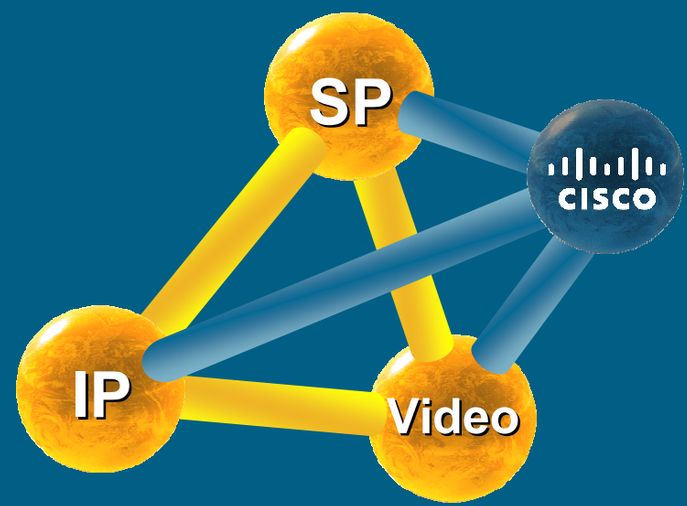
IP for Video and IPTV Service Delivery

Key Characteristics and Benefits

- **Simplified Operations**
  - IGMP/PIM only required, no snooping necessary in Aggregation network; snooping contained in DSLAM
  - Single point of L3 termination for IPTV (no VRRP required)
- **Optimal and Scalable forwarding**
  - SSM multicast distribution model for optimal tree creation under all conditions
  - Dynamic load balancing on equal cost paths(!!)
  - Optimized ARP and IGMP tables through distribution
  - Flexible content injection, including localized content
  - Scales in terms of network nodes and subscribers in any topology due to distributed L3
  - Allows for on-path CAC
- **Resiliency**
  - Consistent convergence in all failure cases: Source-, Node-, Link-Failure.
  - Anycast-Source model for enhanced redundancy
  - SSM security & address-space efficiency proven architecture in many 3Play production networks today
- **Future Ready**
  - Possibility to add/distribute video monitoring and error concealment techniques easily



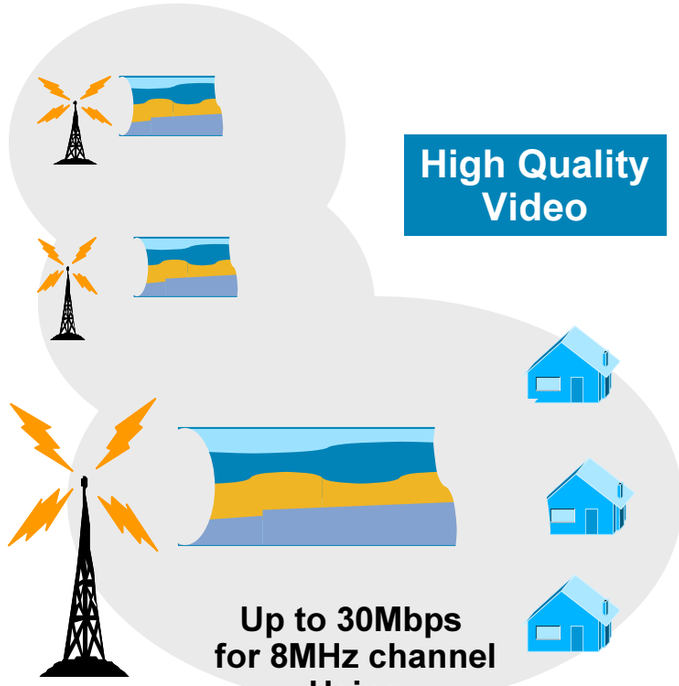
Video
& IP
& SP
& Cisco architectures

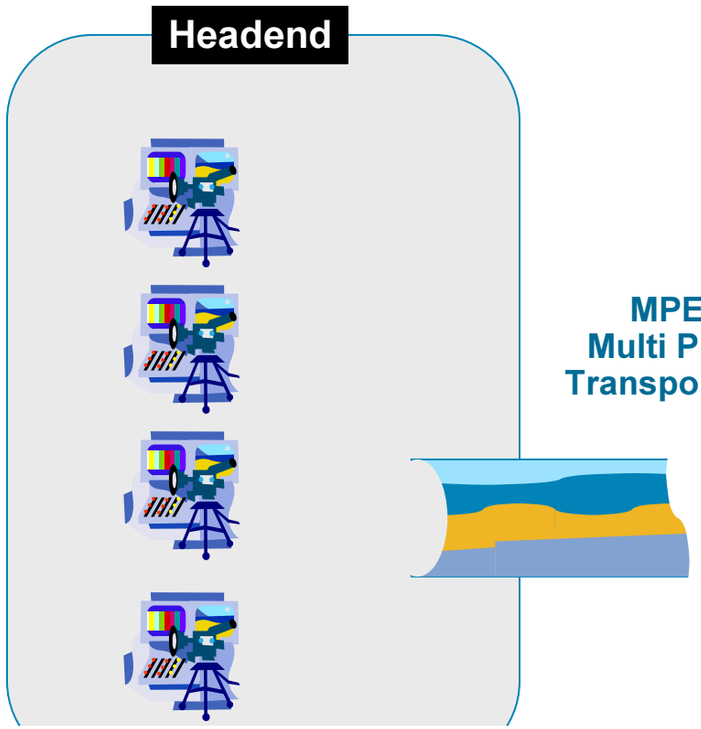


SP video architectures

- Video Broadcast transport
- Video on Demand introduction (cable)
- IPTV systems for wireline/cable
- IPTV super unification with Wireless

TV Broadcast DVB-T
Everything digital



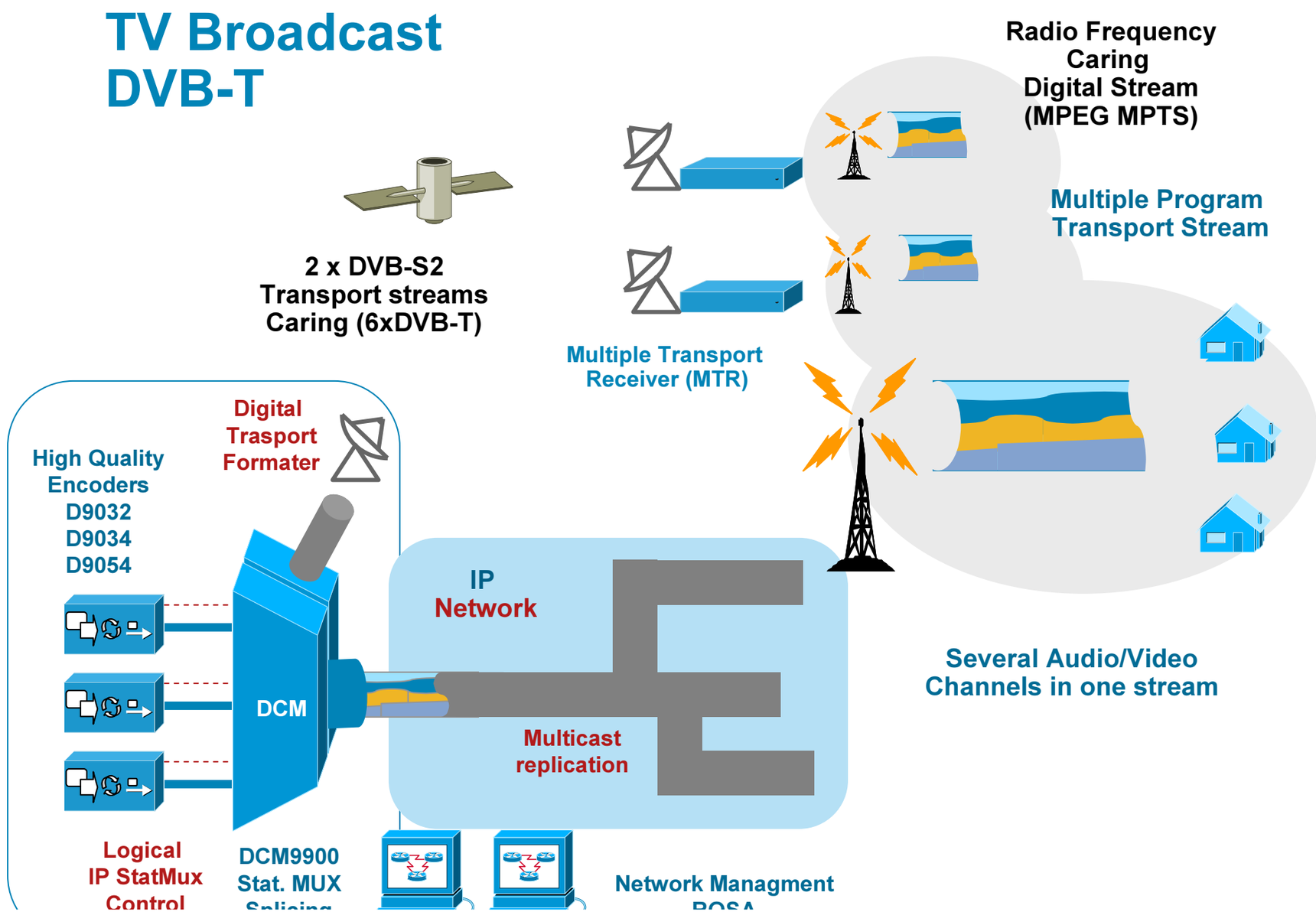


MPEG TS
Multi Program
Transport Stream

Several Audio/Video
Channels in one stream

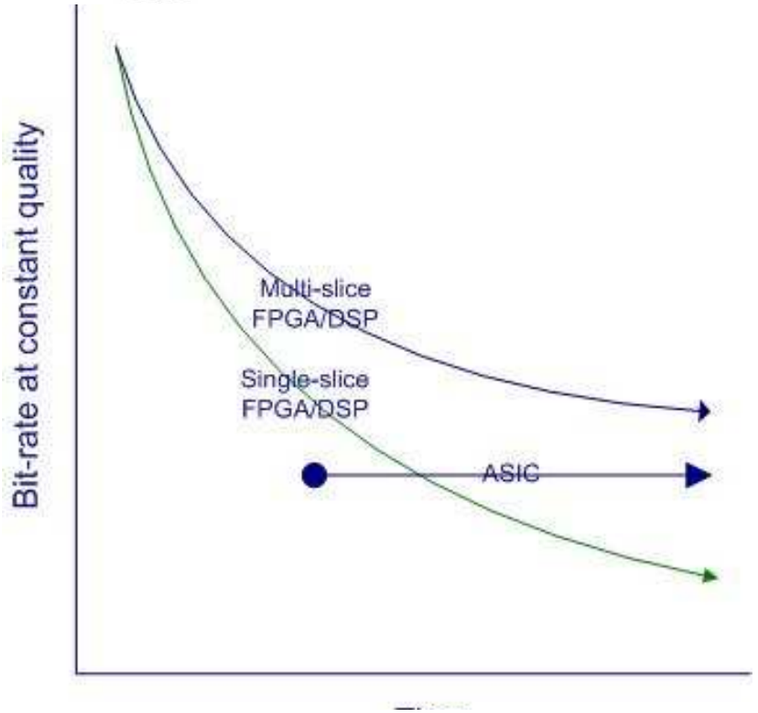
Options: MPEG2, MPEG4, SD, HD
Limitation: Bandwidth

TV Broadcast
DVB-T



IPTV Define

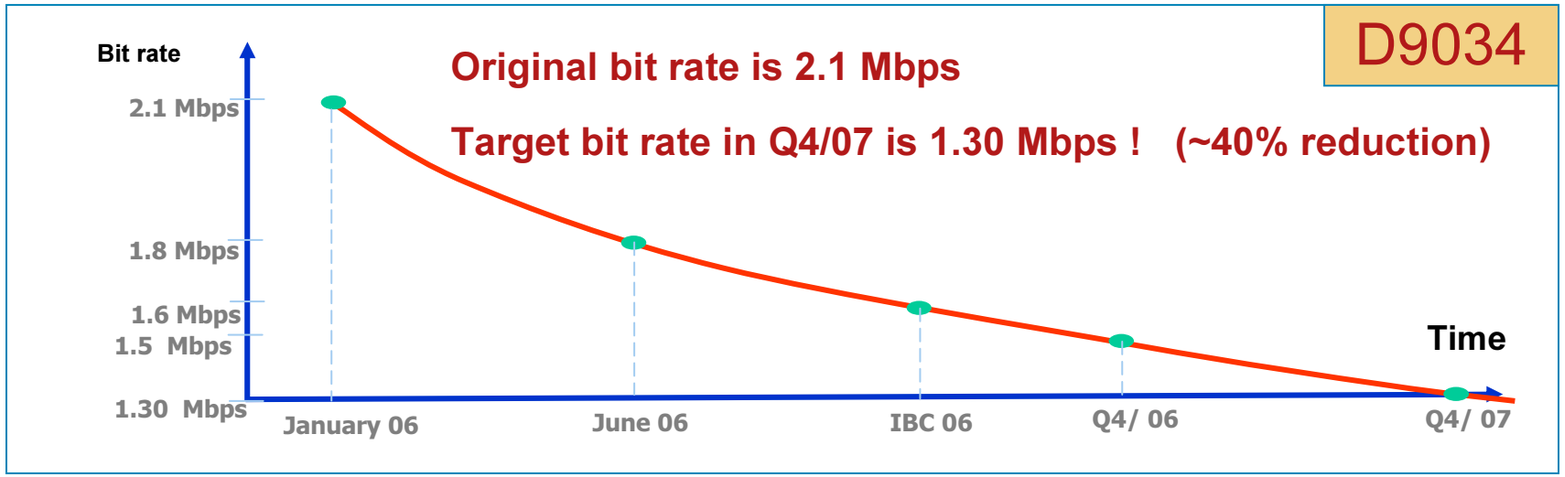
Encoders in Headend

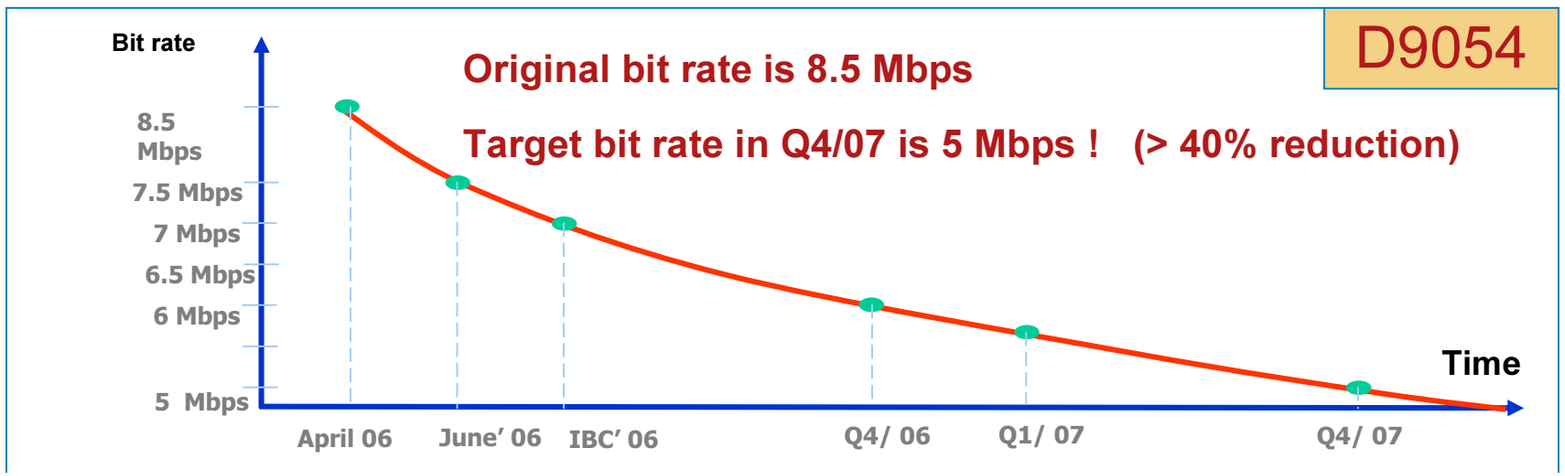


- The D9054 provides unparalleled horsepower required for:
  - Single-slice HD encoding
  - **AND**
  - Future video quality improvements
  - Many H.264-tools are still to be implemented
- **Full flexibility** into every corner of the encoding implementation:
  - Improve already implemented tools
  - Add all remaining tools
  - Adapt to eventual lack of interoperability

AVC Encoding

H.264 Encoder Video Quality Improvements (MPEG stram)

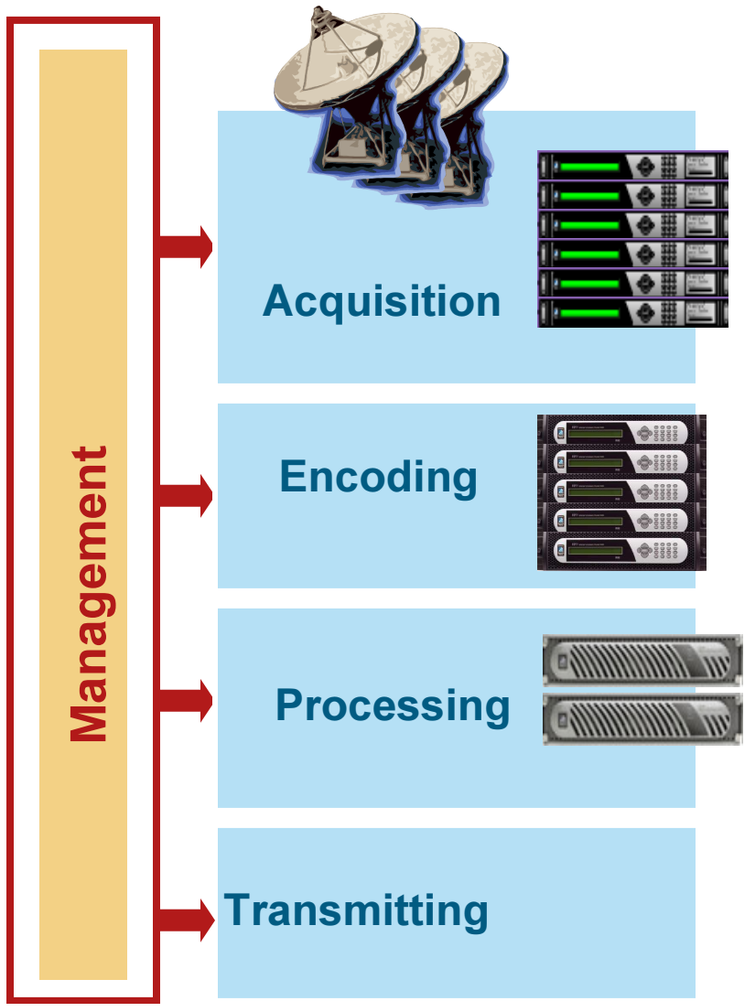




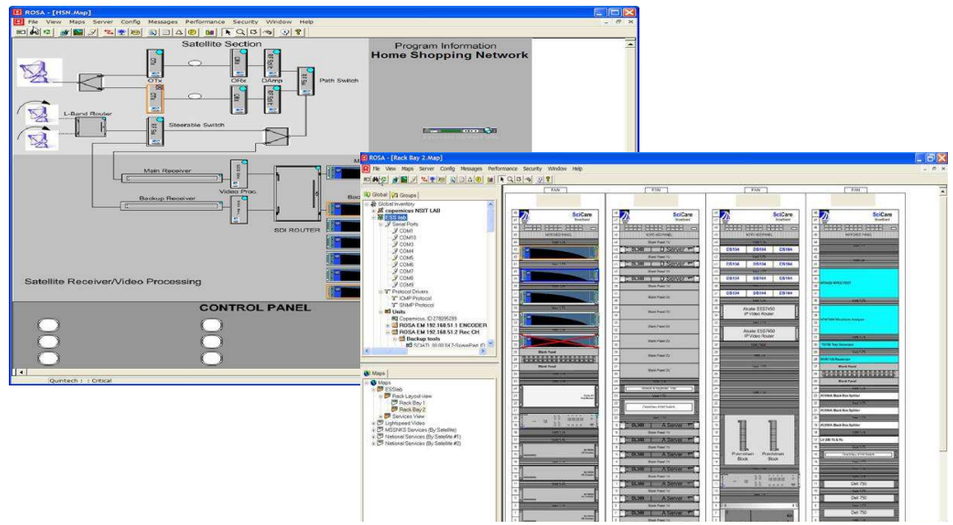
IPTV Define

Headend Reliability

99.999 Uptime
5 minutes
Downtime per year

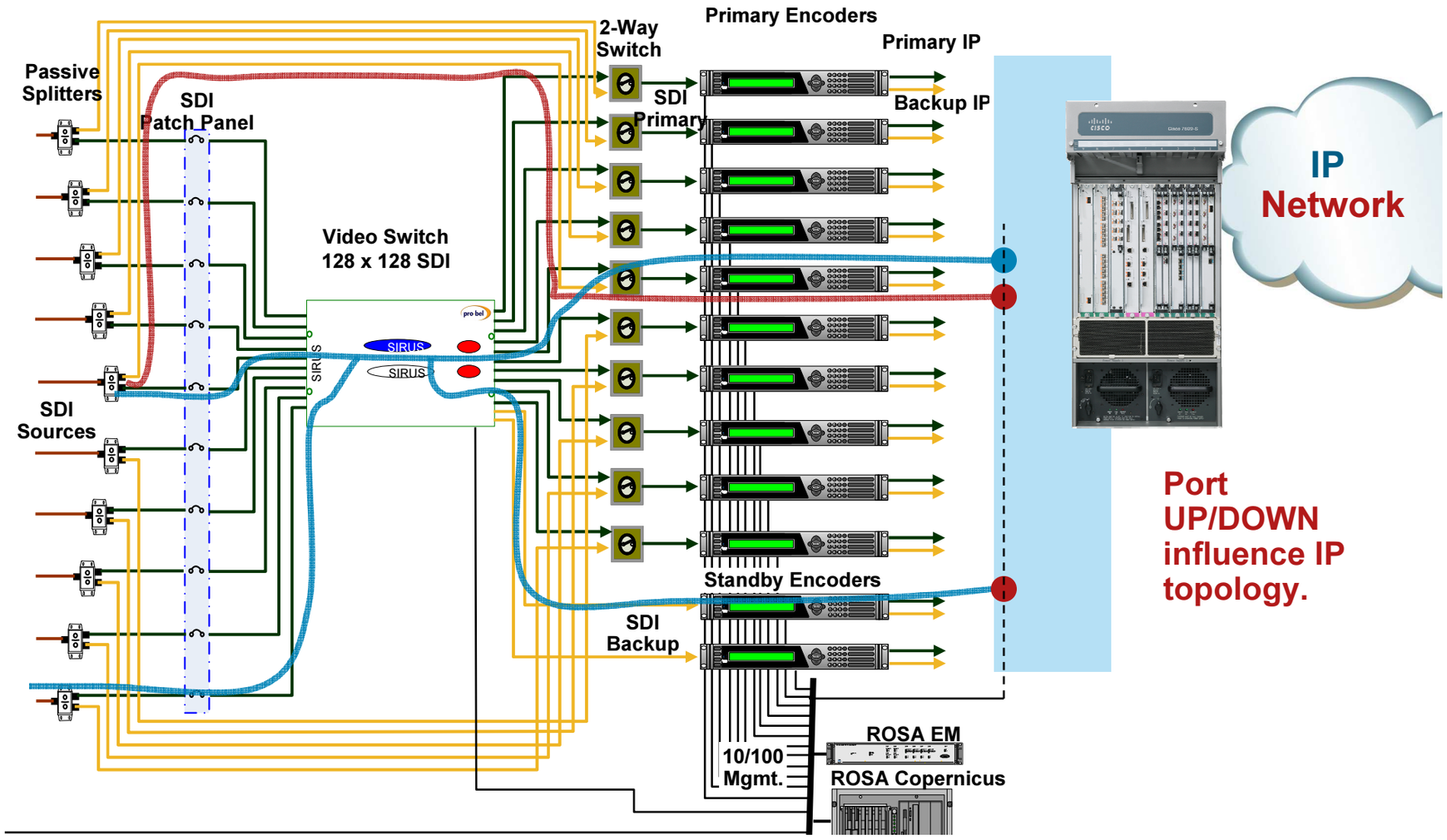


- Finding & Fixing Error/Failure – critical for 99.999
- ROSA management system offers full control over video path
- Different failure scenarios can be programmed



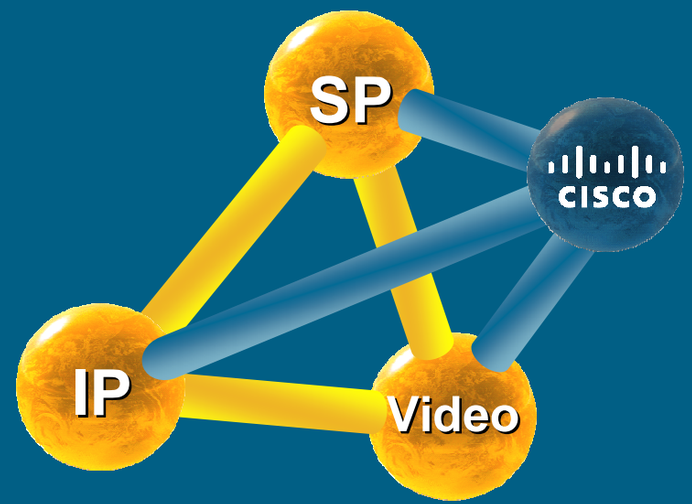
Headend

ROSA - Managing Video Path

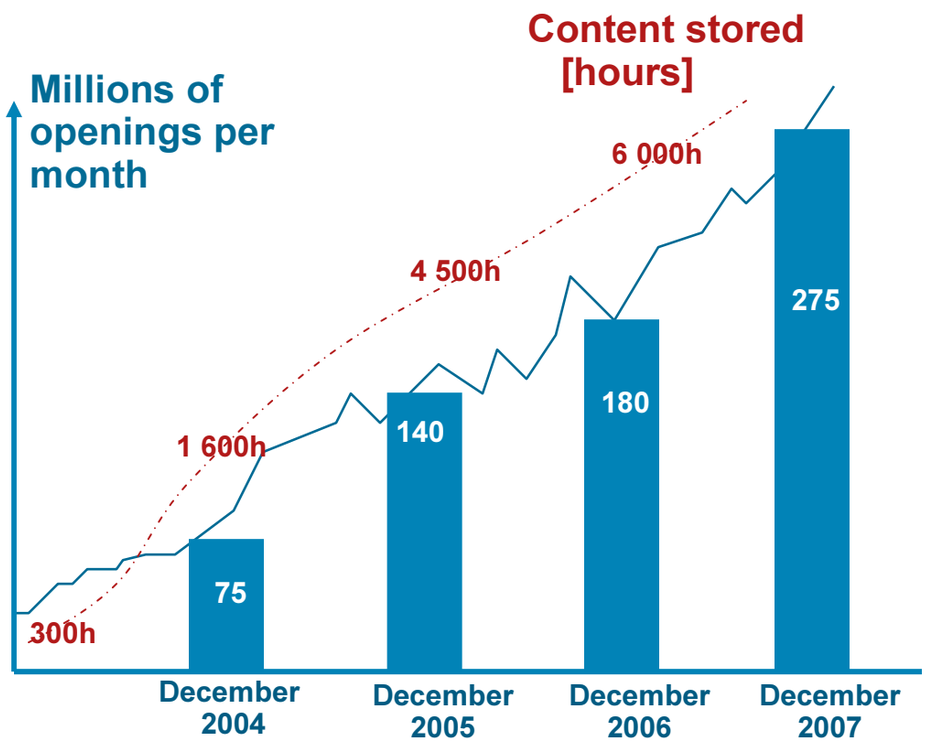


Video & IP & SP architectures

Video On Demand Introduction



VoD in production network
One of the biggest Cable operator in US



- In average single subscriber is using VoD service 27 times per month.

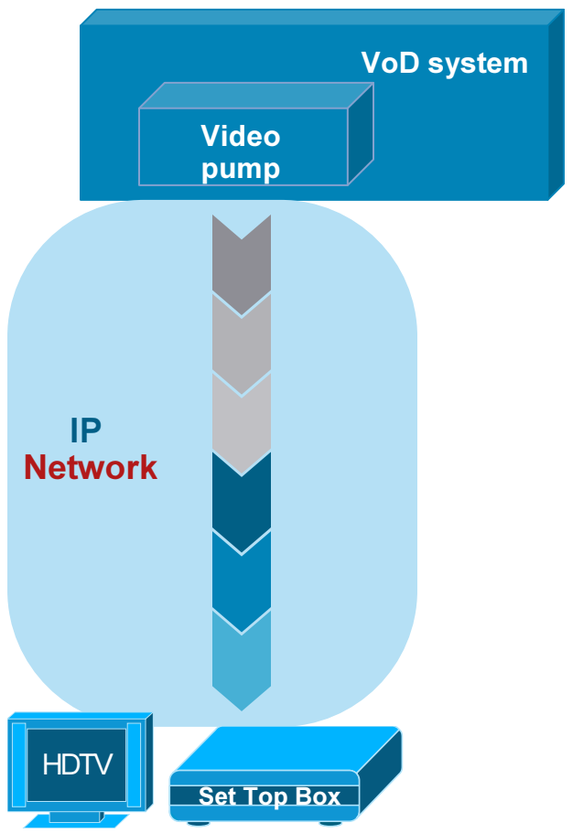
What services we can offer using VoD
It is obvious…..

- „Video shop”
  - Flexible billing and promotions (flat rate, pay per view, special ofers, marketing department loves that)
  - Training and education materials,
  - Promotions materials
  - Special (Adults) materials…

More VoD applications

- N-PVR, (Network-Private Video Recorder).
  - Digital recording – no quality loss.
  - Content providers do not like that (skipping advertisements)
- Start-Over (TimeShifting)
  - Subscriber have couple of hours window to watch any show.
  - No fast forwarding – advertisements delivered ☺ (☹)
- Targeted Advertisement
  - System traces statistics and delivers advertisement which reflects subscriber preferences

Video on Demand
Applications

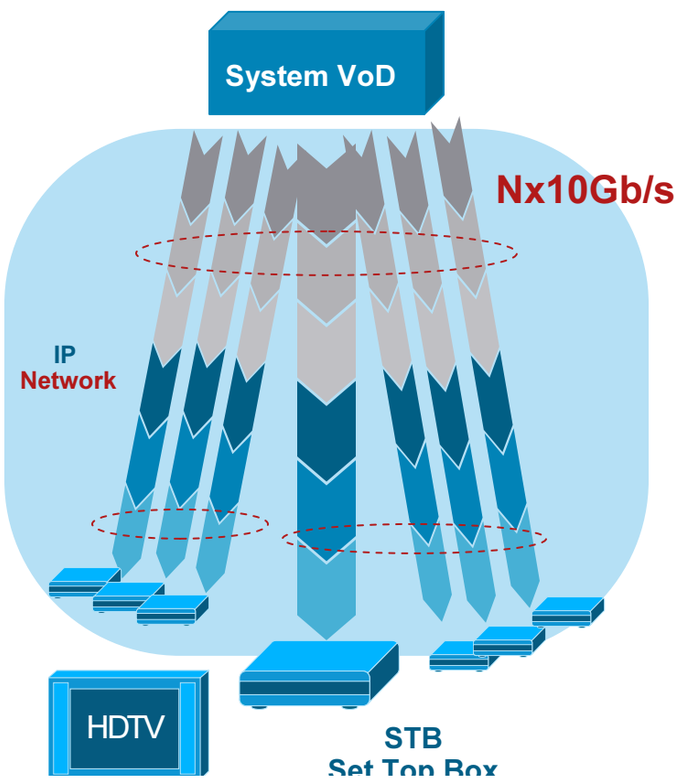


- The most distinct application of IP video.
- “On demand” will be dominant method of access to multimedia content !!
- We will chose content, time and place!!
- Basic applications:
  - Video shop (movies, trainings, promotions)
- Advanced applications
  - Network PVR
  - Other Timeshifting (StartOver)
  - Targeted advertisement

Video on Demand. Biggest problem.
Bandwidth vs redundancy. What is better?

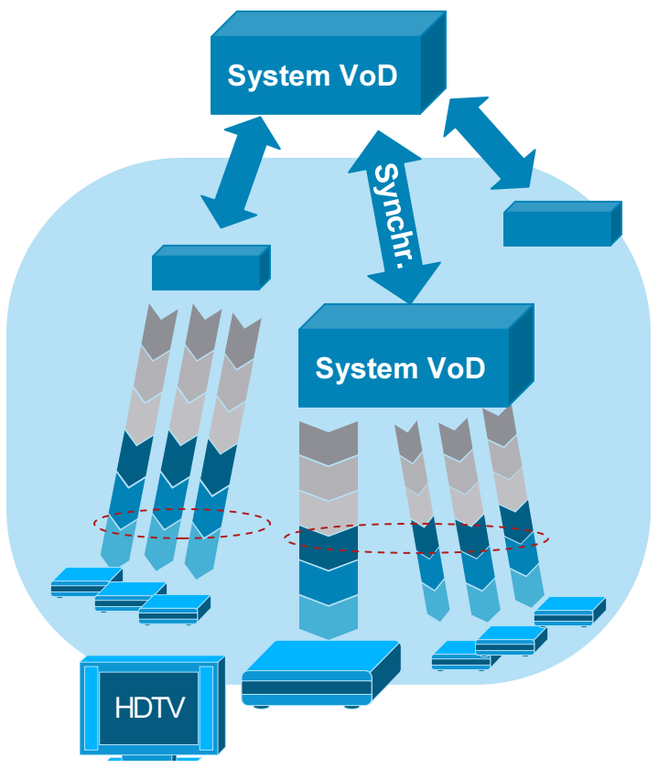
Centralized Architecture

8Mbps/ Stream
= 1200 streams /10 GE

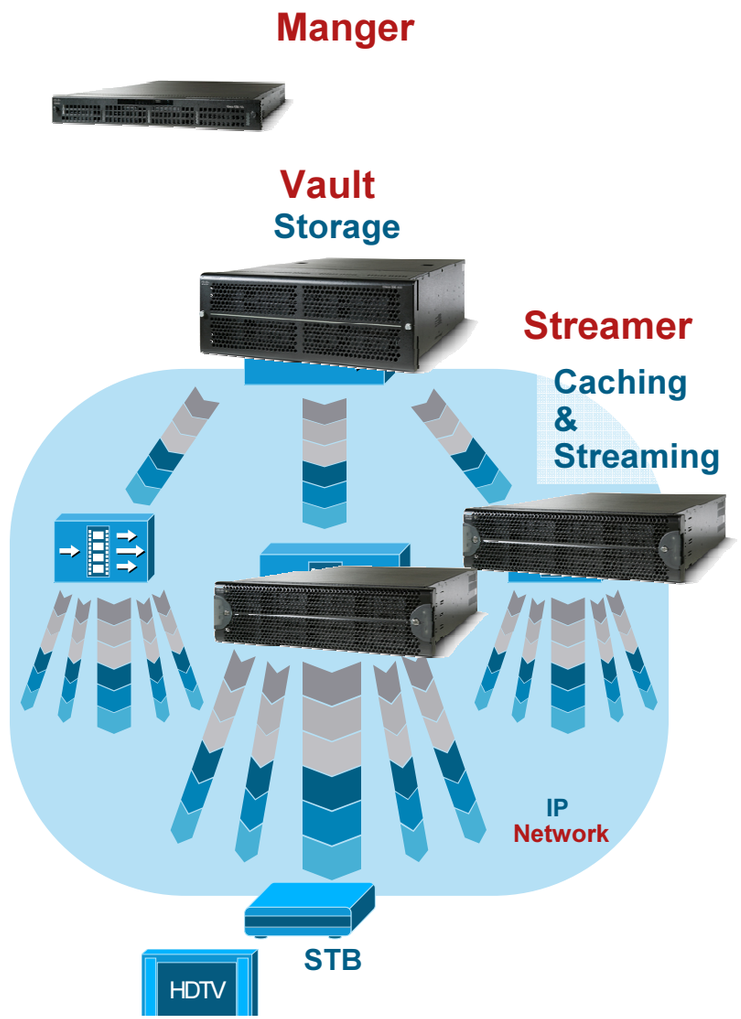


Distributed Architecture

Nx VoD system

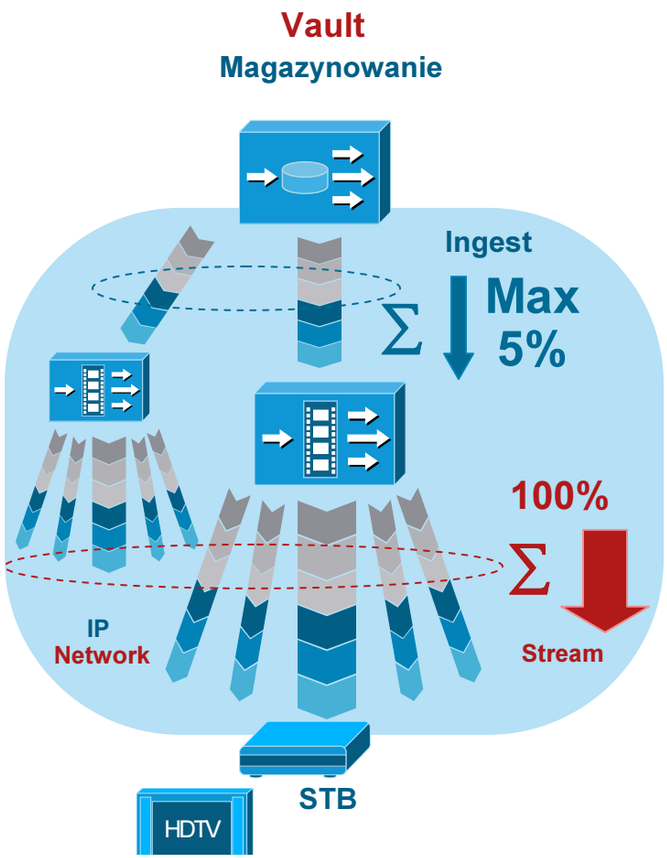


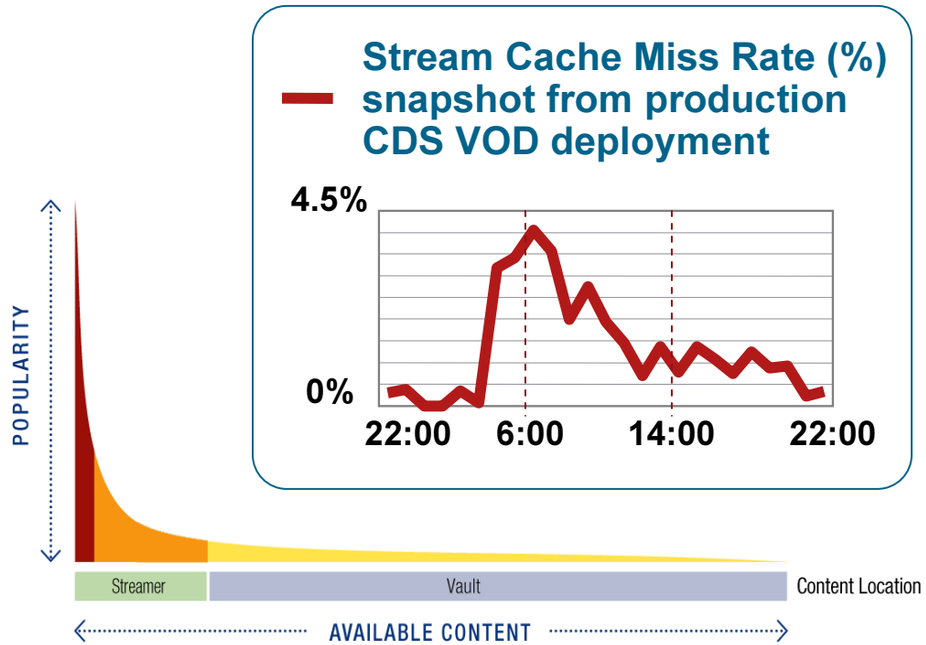
Answer is CDS (Content Delivery System)



- Vault
  - Stores content
  - Ingesting content to Streamers (when needed!!)
- Streamer
  - Streaming the content
  - Caching for later use
- Manager

Cisco CDS TV





- Bandwidth savings 95%
- Contents is automatically distributed where is needed.

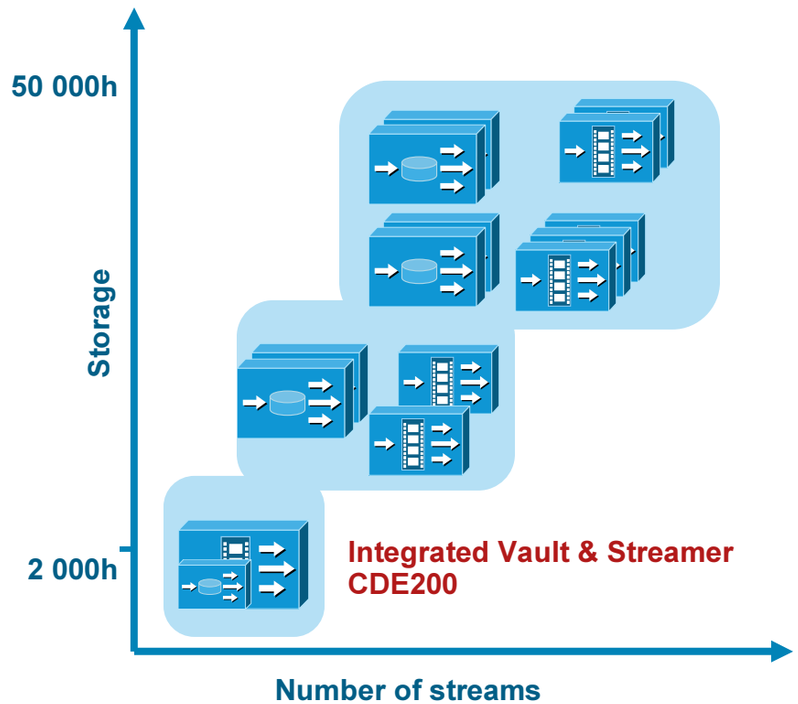
CDS - Hardware Appliances

High End Configurations for Content Delivery

	CDE100	CDE200	CDE300	CDE400
Rack Space	1RU	2RU	3RU	4RU
Processors	1x Dual Core	2x Dual Core	2x Dual Core	2x Dual Core
Storage	290GB [4x 73GB SCSI]	6TB [12x 500GB	1.15TB [16x 73GB SCSI]	12TB [24x 500GB
Memory (DRAM)	4GB	8GB	16GB	4GB
I/O	2 TX GE	Copper: 4 TX GE Fiber: 4 SX GE	Copper: 12 TX GE Fiber: 8 SX GE	Copper: 6 TX GE Fiber: 6 SX GE

Maximum Performance				
Max Streams	N/A (Manager)	750 SD	2500 SD	N/A (Vault)
Max Ingest Hrs	N/A (Manager)	3000 Hrs (SD Eq)	N/A (Streamer)	6000 Hrs (SD Eq)
Max Ingest Ch.	N/A (Manager)	200 SD Eq.	N/A (Streamer)	200 SD Eq.

Cisco CDS TV Arrays
Scalability & High Availibility



- Arrays

  CDE elements could be group in Arrays. Visible as single node

  High availability

- Vault Arrays

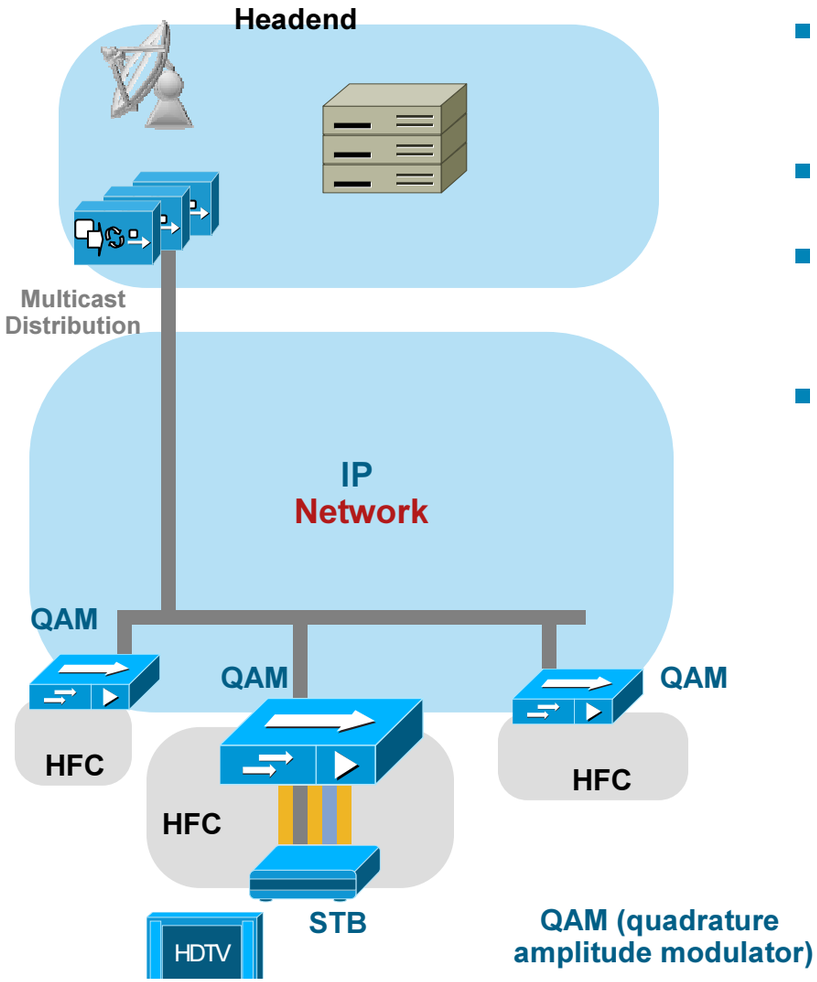
  Increase Storage

- Streamer Arrays

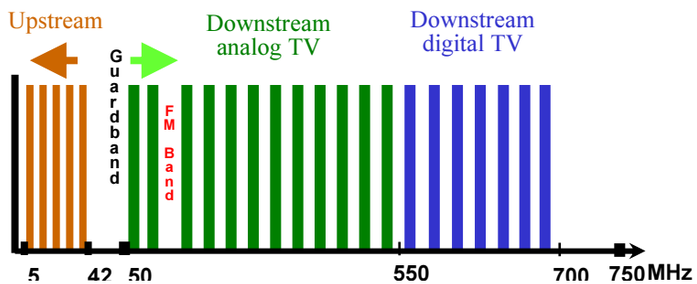
  Number of generated streams

- Adding new CDE does not required to stop the sevice.

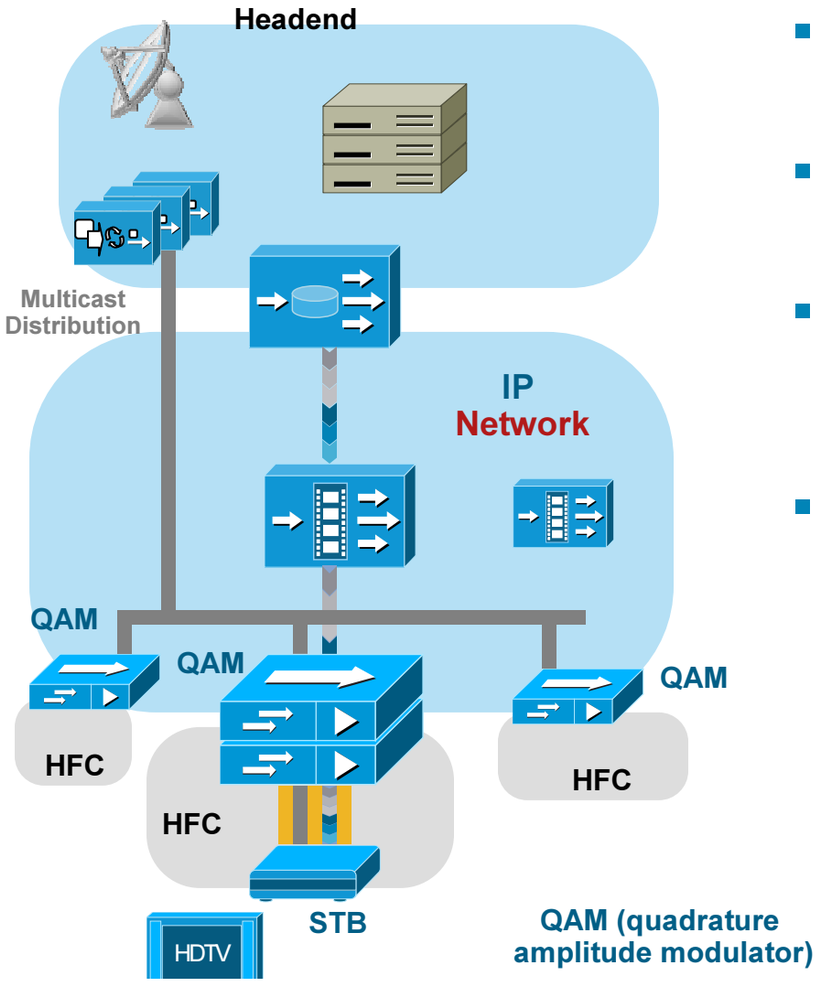
Video IP in cable environment



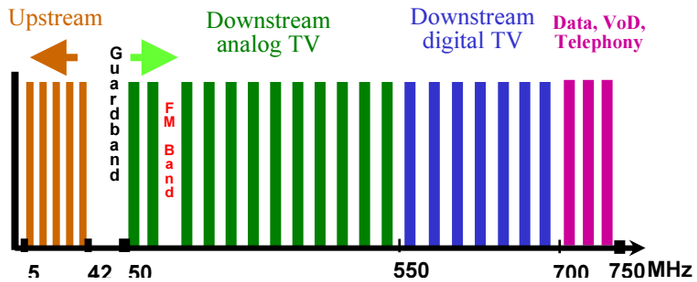
- IP for video distribution is used in cable environment since many years
- Digitization in HFC part is needed
- IP is used to transport BTV and VoD to QAM.
- QAMs are sending MPEG MPTS (look DVB-T) streams to HFC segment



Video IP in cable environment

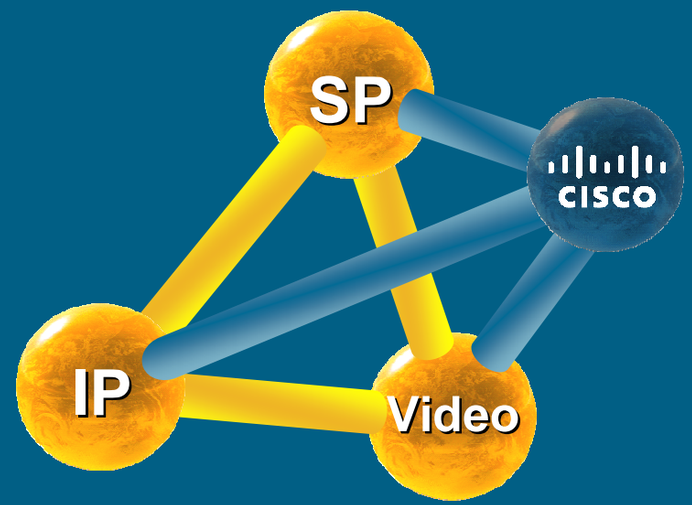


- CDS TV system could be easily added to digitized Cable environment
- Streamer is sending IP video to QAM supporting specific STB
- STB needs to interact with VoD control software to get information where to ‘tune”
- “Cisco Validated Desing”



Video & IP & SP architectures

IPTV systems



IPTV System
Why it is different?

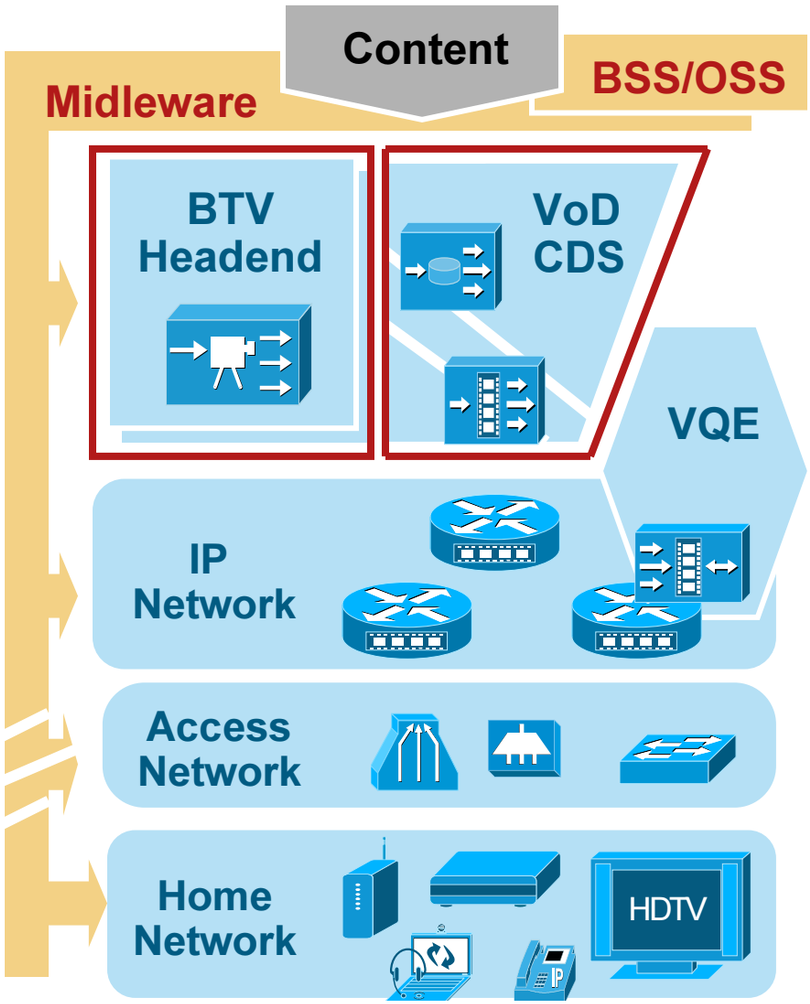
- Bidirectional communication with all subscribers over IP

  Security, customer preferences etc.

- Access technology agnostic: xDSL, FTTx, Cable-Docsis3.0, ...

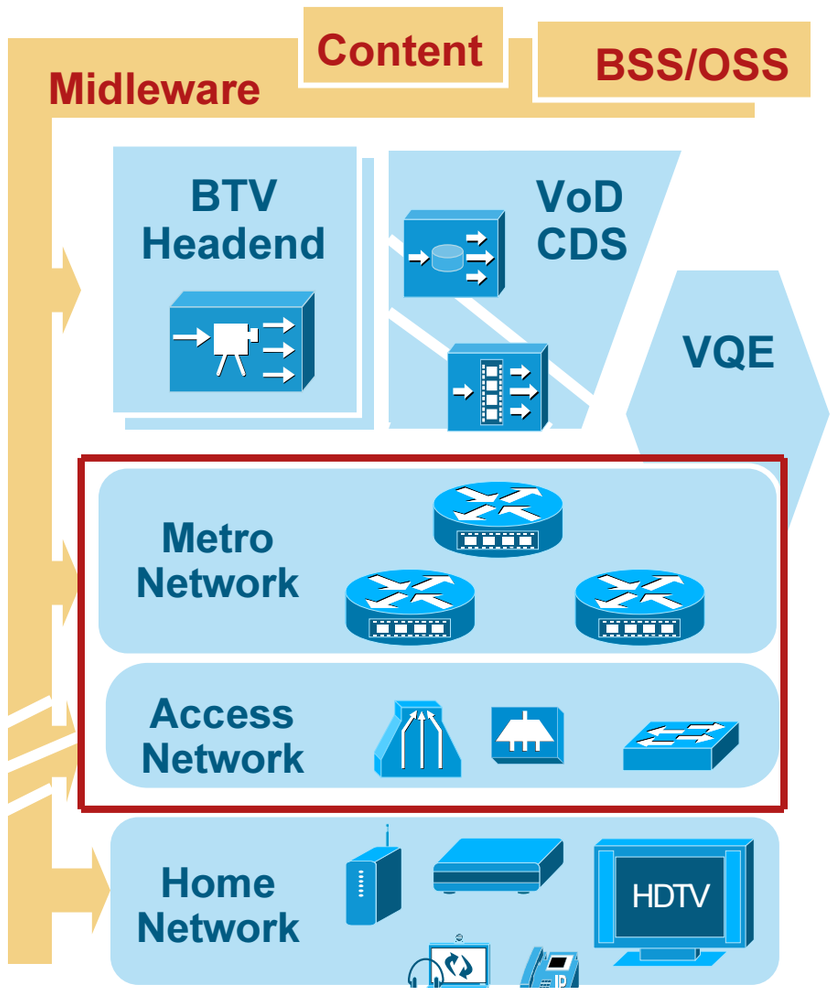
IPTV End to End

Video centric

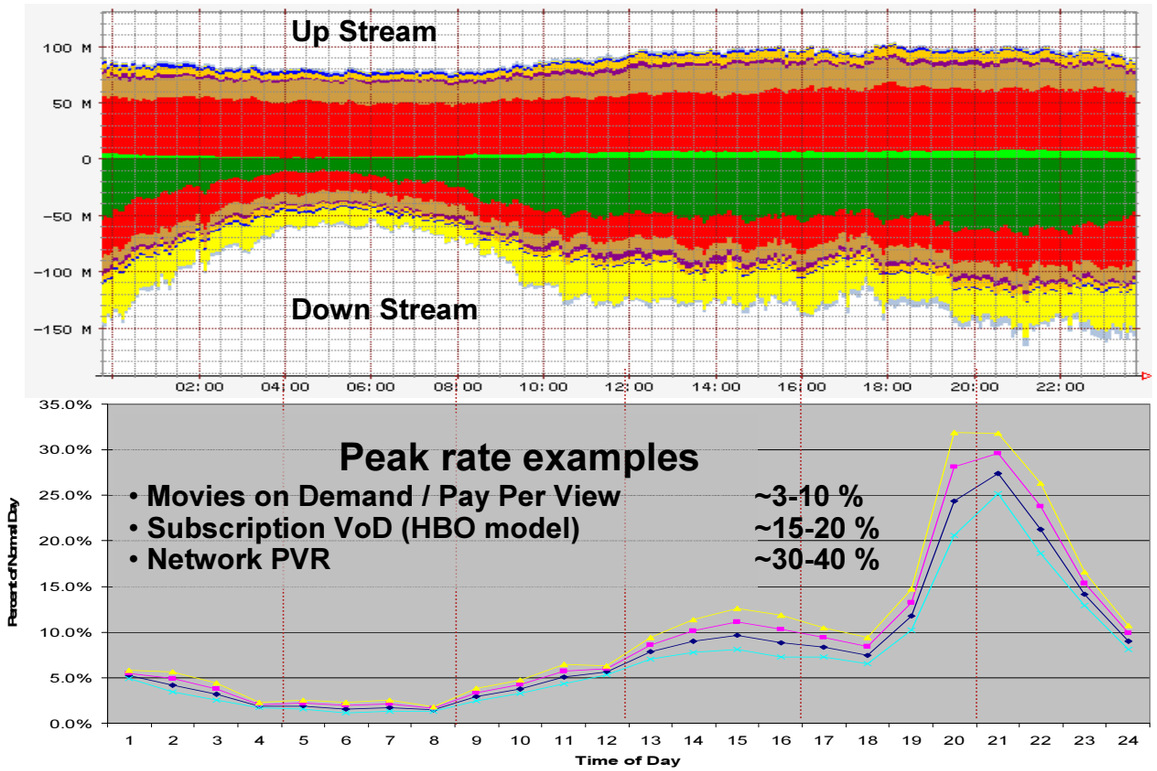


- Define
  - BTV - Headend
  - VoD – Content Delivery System
- Preserve
  - Metro and Access Network
  - VQE - Video Quality Experience
- Realize
  - Home Network
  - IP Set Top Box
- Management
  - Midleware, BSS/OSS

IPTV - THE Network



Multimedia services
Traffic patterns



On Demand services could be planed based on telephony network rules. Erlang analysis for given number of users and expected GoS.

Busy signal – very useful, we need Bandwidth Control

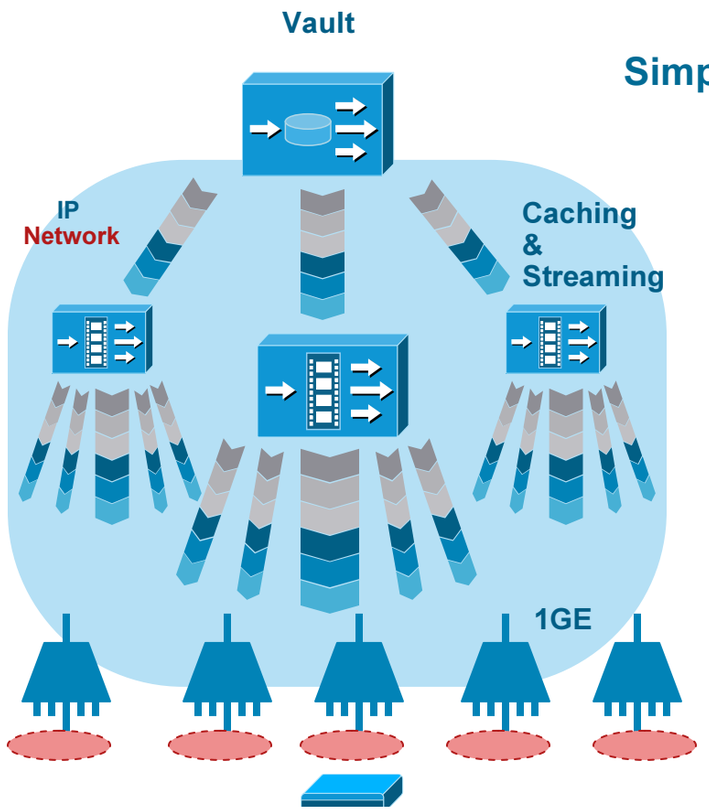
Internet Traffic

- Traditional IP networks are planned for **average usage** based on packet statistical gain
- When **congestion** occurs **packets are buffered and dropped** according to defined polices

Multimedia

- In order to keep high QoE (Quality of Experience) multimedia traffic **can NOT be dropped and buffered (jitter)**
- This requires to plan the network for the **peak utilization** in worse case scenario (e.g. Link failures)

CAC – Call Admission Control
Simple “Off Path”



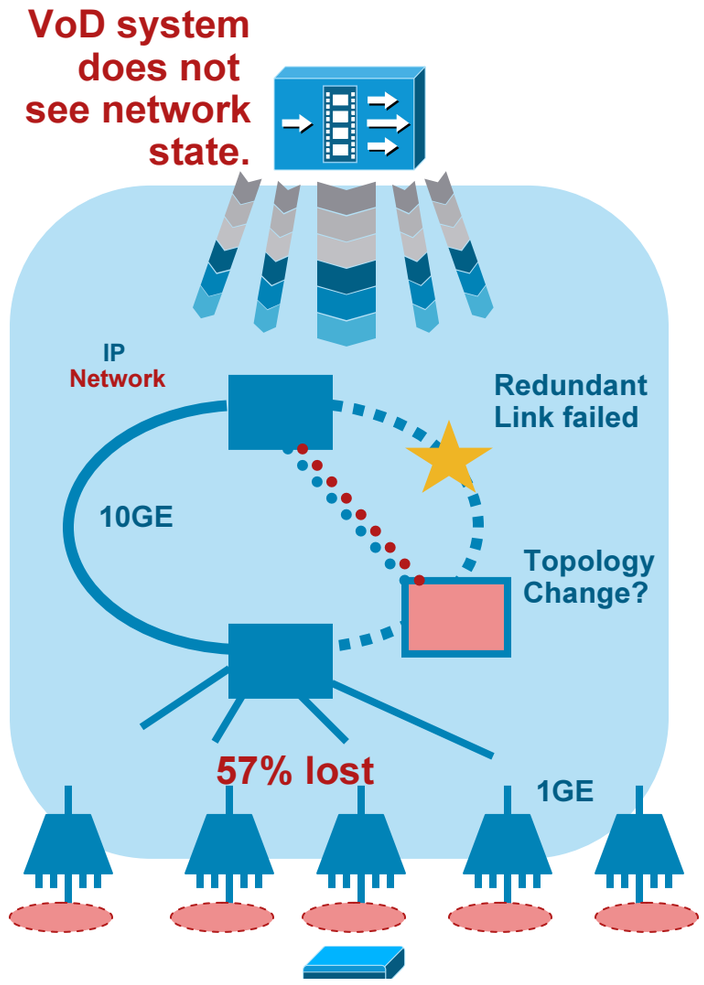
- How to protect network against congestion? Especially on Access Systems?

Simple solution without knowing network state(„off path”)

- Users are assigned to ‘Service/ Subnets groups”. There is maximum bandwidth assigned per group
- After reaching maximum no other service is admisioned

E.g. max 50 streams per group

CAC – Call Admission Control
Is “off-path” optimum?



- IP network is not cloud with unlimited capacity
- It is necessary to plan worse-case scenario.

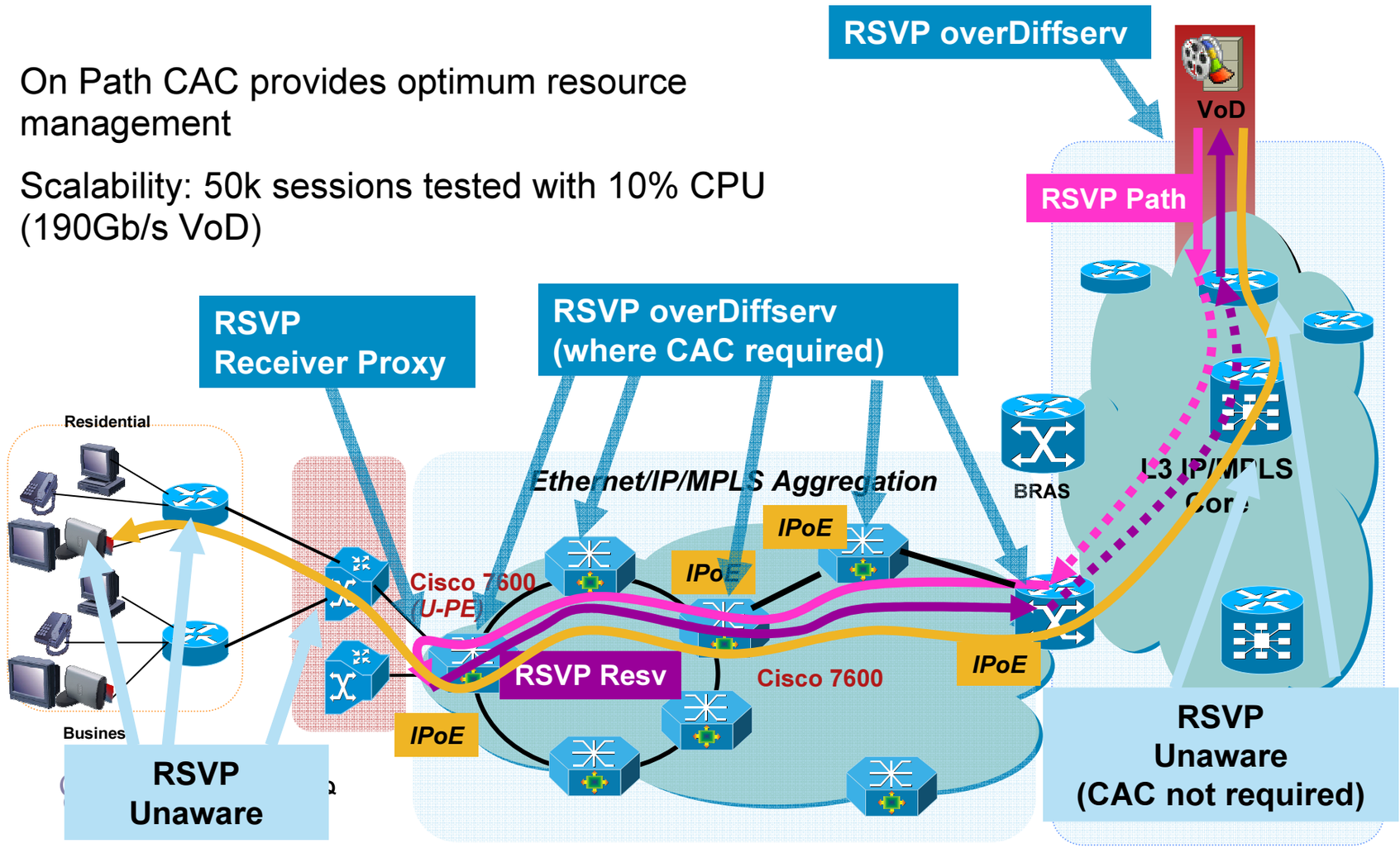
  How much bandwidth network could carry during the failure?
- Recalculate that after topology change!

In case of „Off Path”, where VoD system does not know network state - around 57% of bandwidth is usually lost

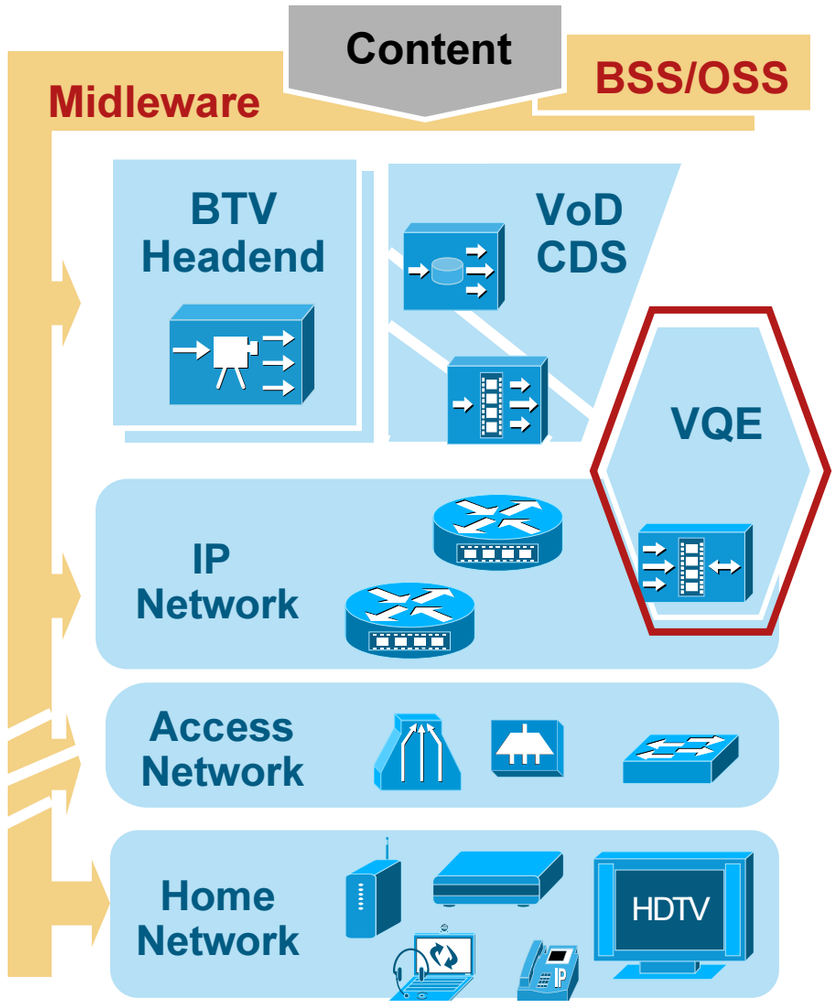
CAC for unicast (Video on Demand)

On Path CAC

- On Path CAC provides optimum resource management
- Scalability: 50k sessions tested with 10% CPU (190Gb/s VoD)



IPTV End to End
Video Quality Experience



- How to assure high quality for video users?
- Monitor Quality
- Repair Errors
- Improve service

Cisco 7600 VQE (Visual Quality Experience)

Video Error Repair

- WHY?

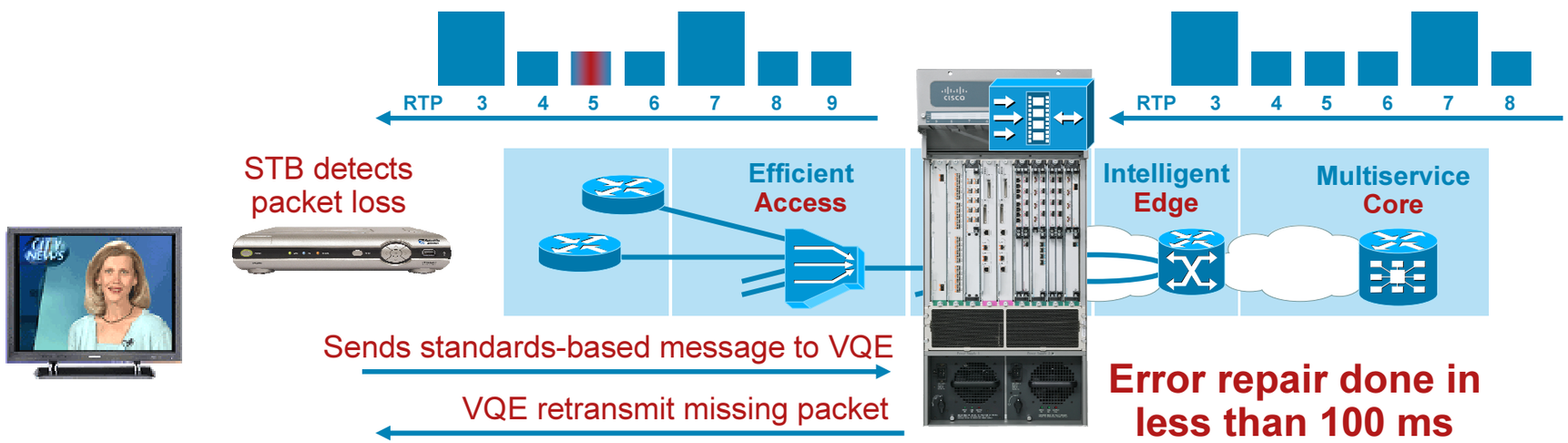
  QoE Rule: 1 artifact per movie (2 hours)- better than 10^{-6} Packet Loss Ratio

  On the way we have FO, DSLAM, CPE and DSL line.

  DSL line with BER 10^{-6} could lead to 10^{-3} PLR (1 artifact per minute)

- HOW?

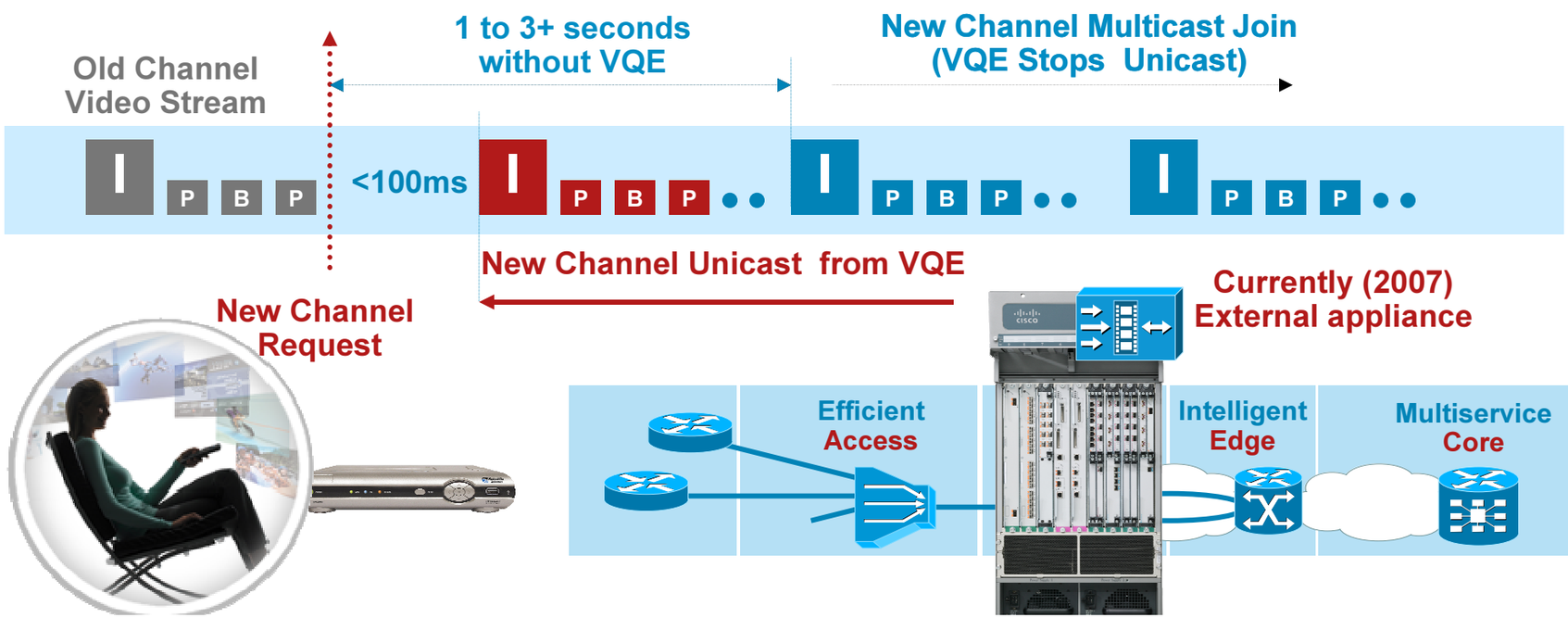
  Mechanism of retransmission for RTP



Cisco 7600 VQE (Visual Quality Experience)
Scalable Standard-based Rapid Channel Change

- WHY?

  Most of the waiting time for channel change (80%) come from next I-Frame delay (good compression) and MPEG buffering (jitter resistance)



VQE (Visual Quality Experience) technology
Summary

- Open technology

  VQE solution documented to enable integration with 3rd party CE, middleware, provisioning and management systems

- VQE-S Server

  Dedicated service module or external appliance

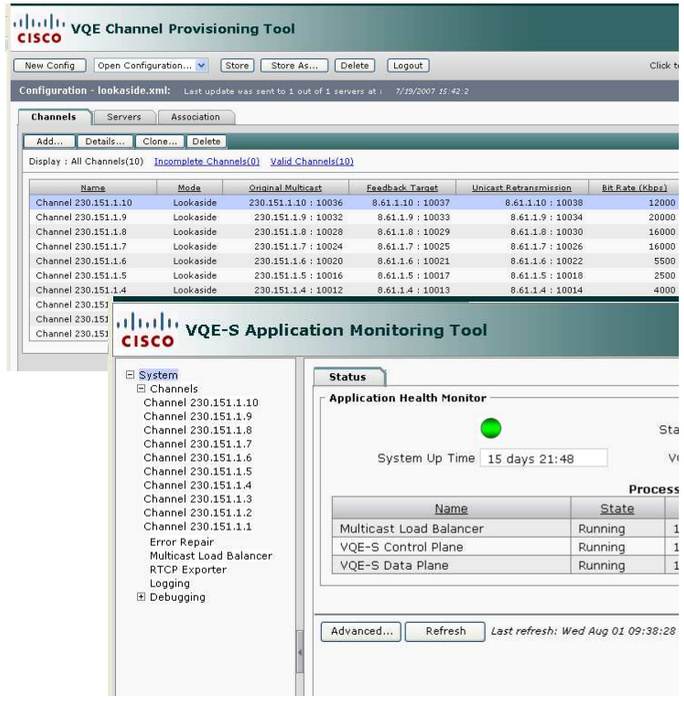
  CDE110 (Content Delivery Engine)

- VQE-C Client

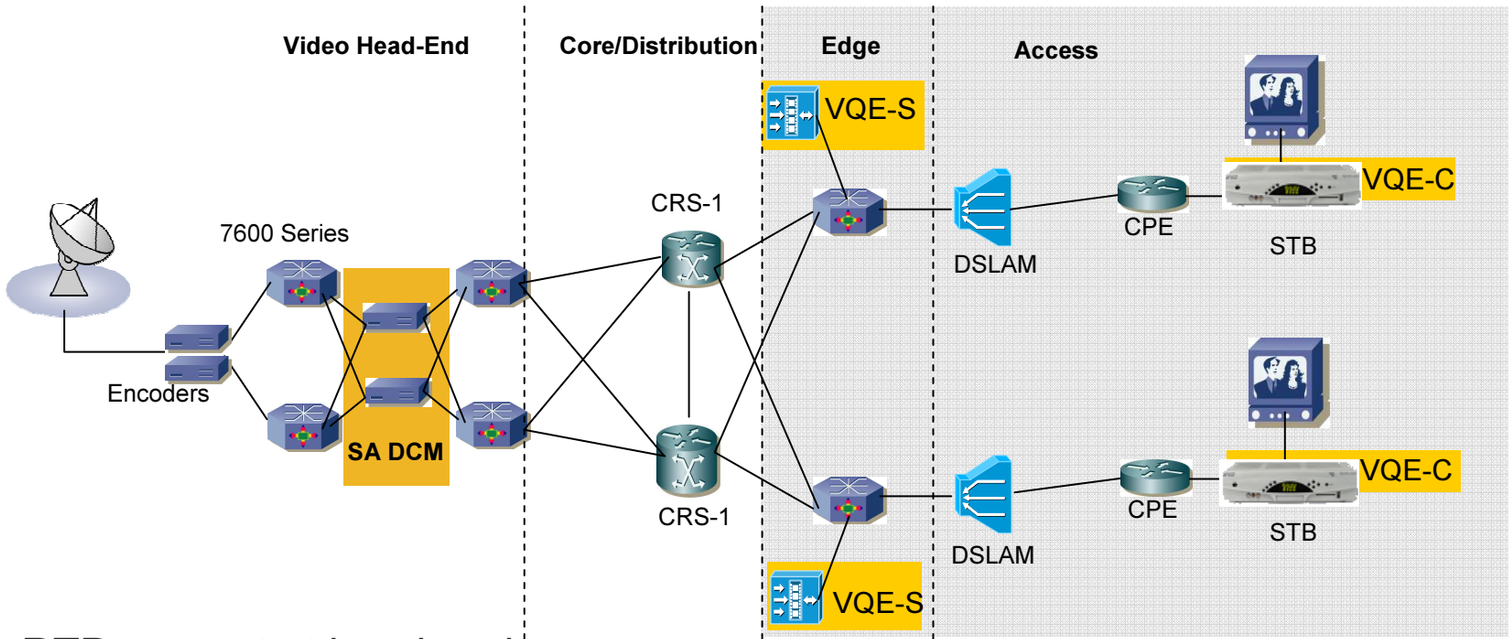
  Published via open-source program (BSD license). Available on CCO

- VQE Monitoring Tools

CDE110

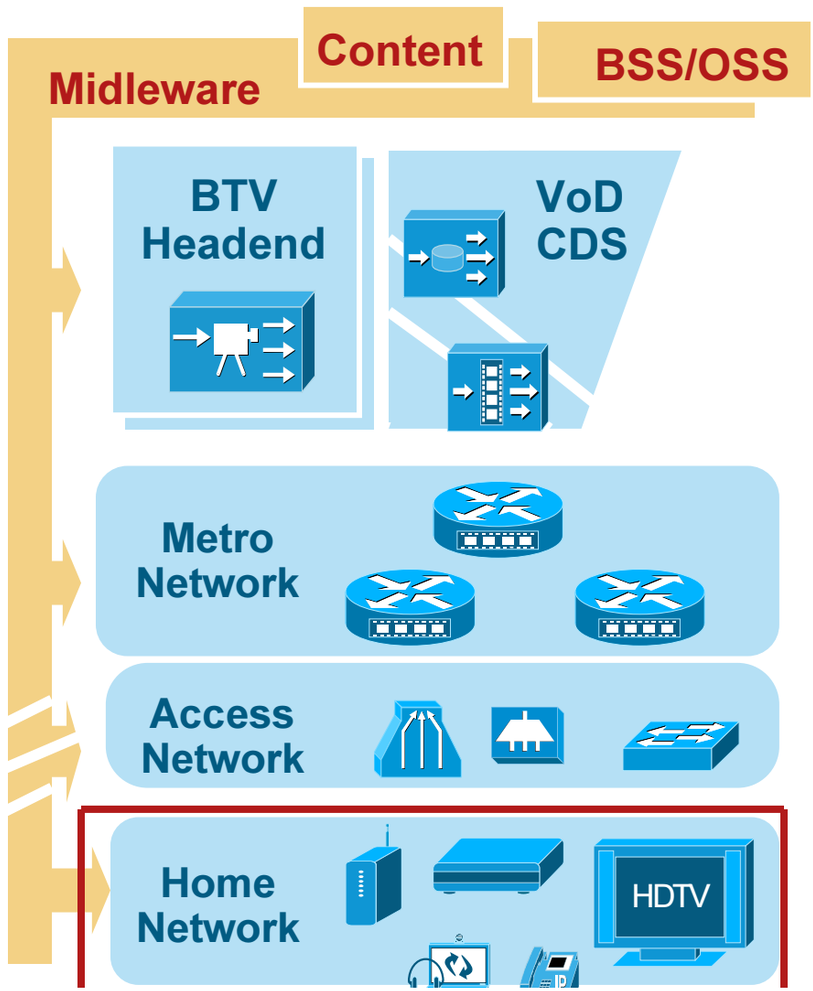


VQE – High Level Architecture



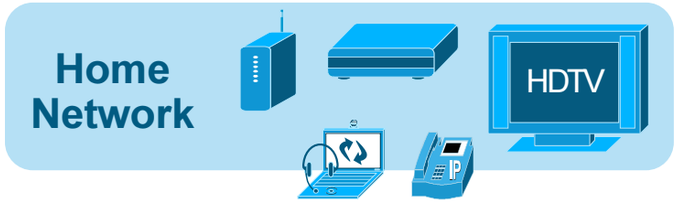
- RTP support at head-end
  - Real-Time Encoders or Cisco DCM (Digital Content Manager) – RTP encapsulation
- VQE-Server at network edge joins multicast channels
  - Primary function: Caches channel content and respond to VQE Service requests (RET, RCC) from Clients (STBs)
  - Generate per-channel real-time reception quality reports (loss, delay, jitter,…)
- VQE-Client embedded in Set-Top Box join different channels
  - Primary function: facilitate error repair and RCC requests

IPTV - At Home


Midleware
Content
BSS/OSS
BTV
Headend
VoD
CDS
Metro
Network
Access
Network
Home
Network
HDTV

IPTV Realize

Home Network



CPE

CIS 2000

Fanless
Single SD & HD

High Definition
IPP330HD

+ HD (160GB) DVR

Digital Video Recorder
IPP430MC

+ 3 decoders (3xTV)

Multi-Stream DVR Gateway
IPN603MCG

- CPE Customer Premise Equipment – connection to access network
  - Linksys, Scientific Atlanta, 3rd Party
  - Bulid in VoIP gateways and WiFi
- Set Top Box – connection to IPTV services
  - Scientific Atlanta
  - Long live time 7 years
  - 20mln digital STB delivered

Set Top Box – Silicon performance
Mosaic Capability

- Ability to decode up to 12 streams
- User-generated mosaic channels using IP-delivered video

IPTV Management

Midleware

- Midleware functions

  Security, Electronic Program Guide, billing, content management, digital rights management, subscribers management, software, configuration management ……

- Cisco works with many Midleware vendors

  Myrio

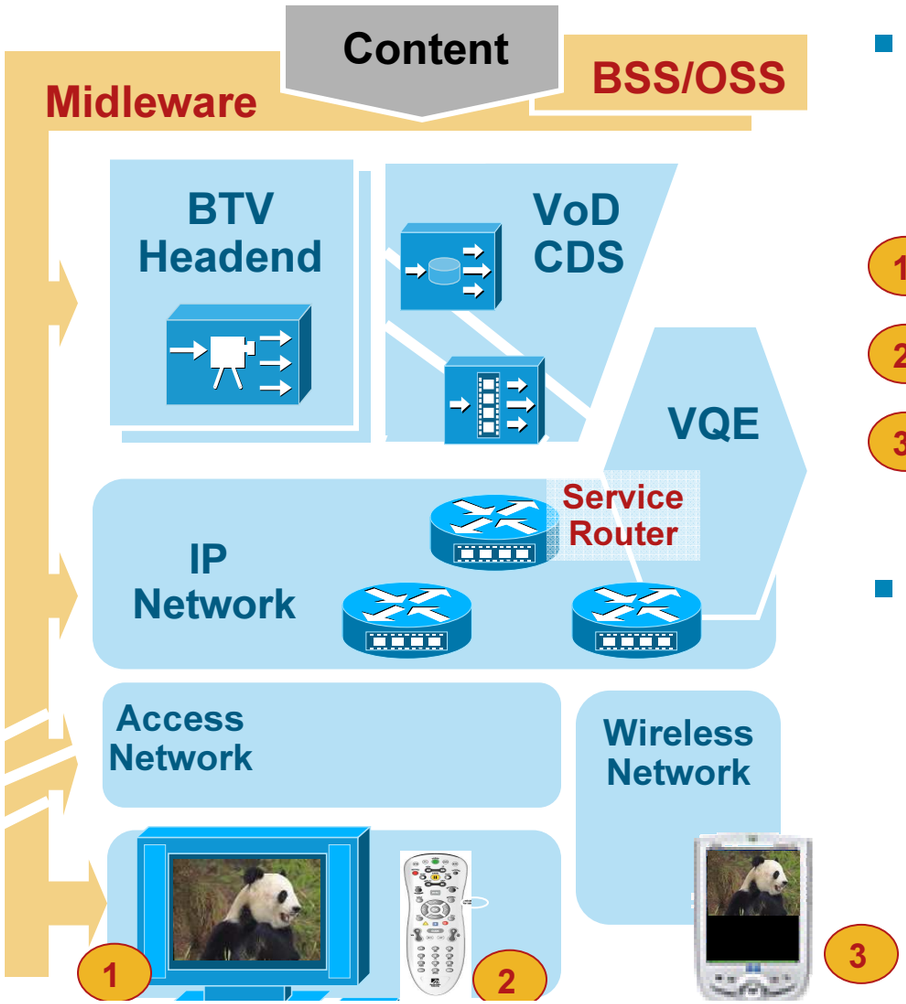
  Minerva

  MediaRoom (Microsoft)

  ..

IPTV End to End

4Play Screen shifting



- By adding CDS IS (Internet Streaming) it is possible to have true 4Play.

1. User is watching VoD show
2. User press “Pause”
3. User can Resume on any other terminal

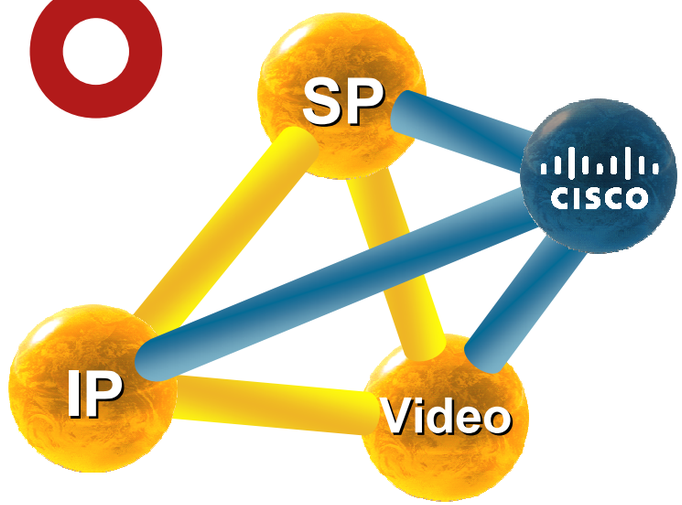
- Information about session state is stored in Service router

Building on Unmatched Experience

Cisco and Scientific-Atlanta

- The world's largest IPTV networks run on the combined company's infrastructure
- Expertise from launching 270 interactive video networks
- Implementing one of largest IPTV projects
  - Engineer-furnish-install (EF&I)
  - 2 SHEs and 40+ VHOs
  - Video Operations Centers and operations outsourcing
- 5 out of Top 6 IPTV providers use Cisco equipment
- Complementary solutions for broadcasters
- Over 30 million Explorer Digital STBs
  - Over 4 Million DVR units shipped
  - Over 3 Million HD STBs shipped
- Over 240 video head-ends deployed globally
- Over one billion IP/TV VoD streams will be carried on Cisco networks


CISCO


SP
CISCO
IP
Video