Switched Digital Video (SDV) Advantages and Theory of Operations

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BigBand Networks
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BIGBaND® *networks*

Presentation Outline

Picture This.

Agenda

» What is SDV and what are its drivers?

» SDV Components & Subsystems

» SDV Service Flows

- Cisco/SA – TWC ISA/SSP-SIS
- Moto - NGOD

» SDV Design and Deployment

» SDV Tools

» Future Applicatons

What is SDV and What are its Drivers?

What is Switched Digital Video?

» SDV is a technique for cable providers to offer more and more programming on a fixed bandwidth plant

» Historically, cable video was a pretty 'dumb' architecture
  - Broadcast nature – one source, many recipients
  - Data/CMTS/DOCSIS and VOD necessitated some signaling through a backchannel

» Works on a notion that not all viewers are watching distinct programming at the same time
  - Television viewing data analysis confirms that only few services from the offered services tier interests larger audience
  - Uses the same application of 'Service Group' in the VOD world to subdivide the general subscriber population into smaller groups

» Technology borrows heavily from VOD
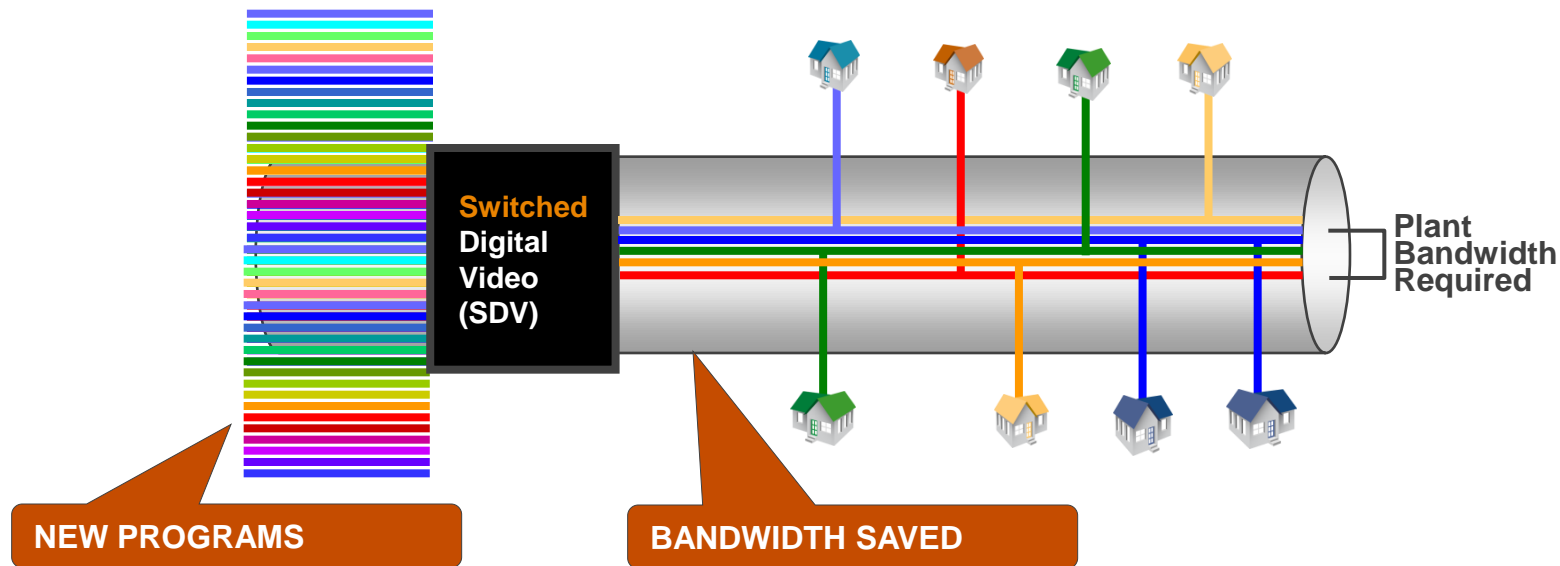
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What is SDV? (2)

» Typical switched broadcast system requires a thin client to be loaded on the STB

- Modern STB OSs and EPG clients are integrating an embedded switching client

» System receives channel change requests from STBs and only put the services on the plant if viewer demands it

- These dynamic QAMs must be described by a Dynamic Channel Map or mini-carousel that constantly updates the STB of these dynamically allocated channels

- Optionally, broadcast channels can be placed into the SDV lineup in order to get viewership statistics about it

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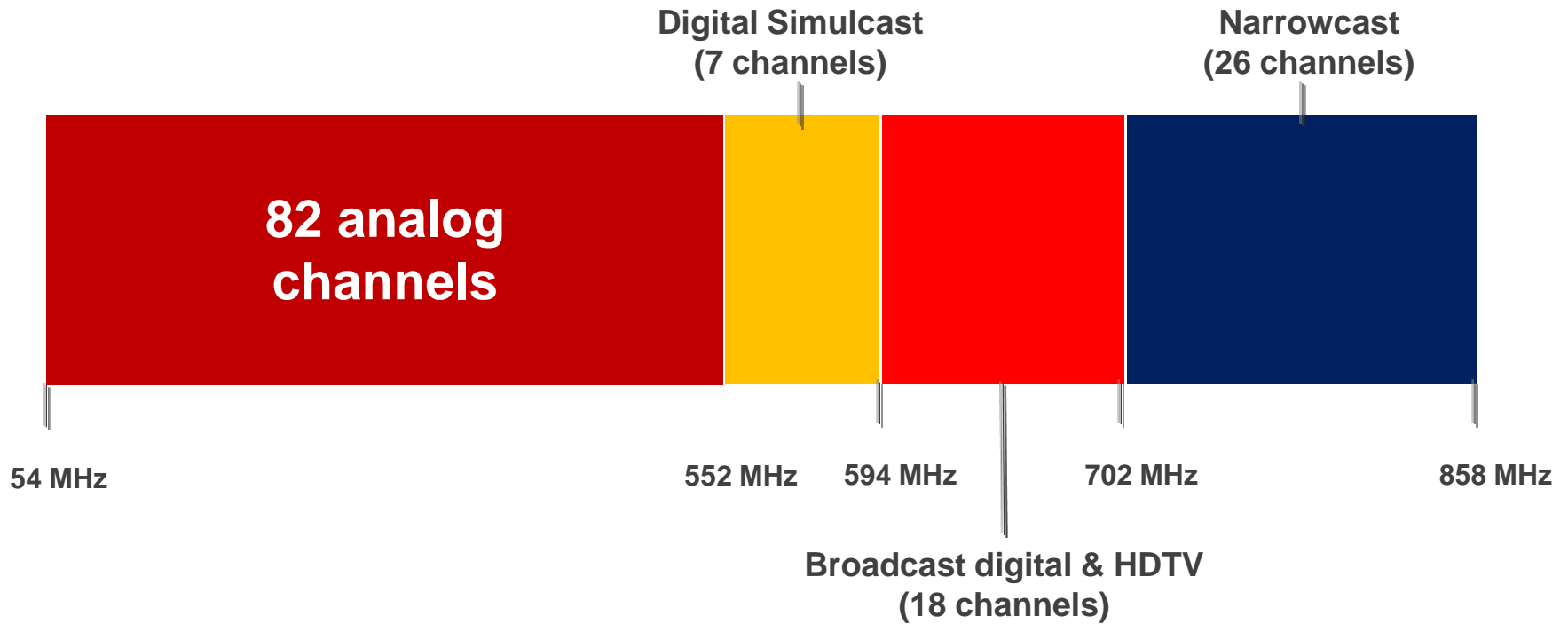# Oversubscribing the plant

» Broadcast no longer scales with available programming

» SDV reclaims bandwidth and allows channel lineup expansion

Plant Utilization

Downstream allocations 860 MHz

Digital Simulcast
(7 channels)

Narrowcast
(26 channels)

**82 analog
channels**

54 MHz

552 MHz

594 MHz

702 MHz

858 MHz

Broadcast digital & HDTV
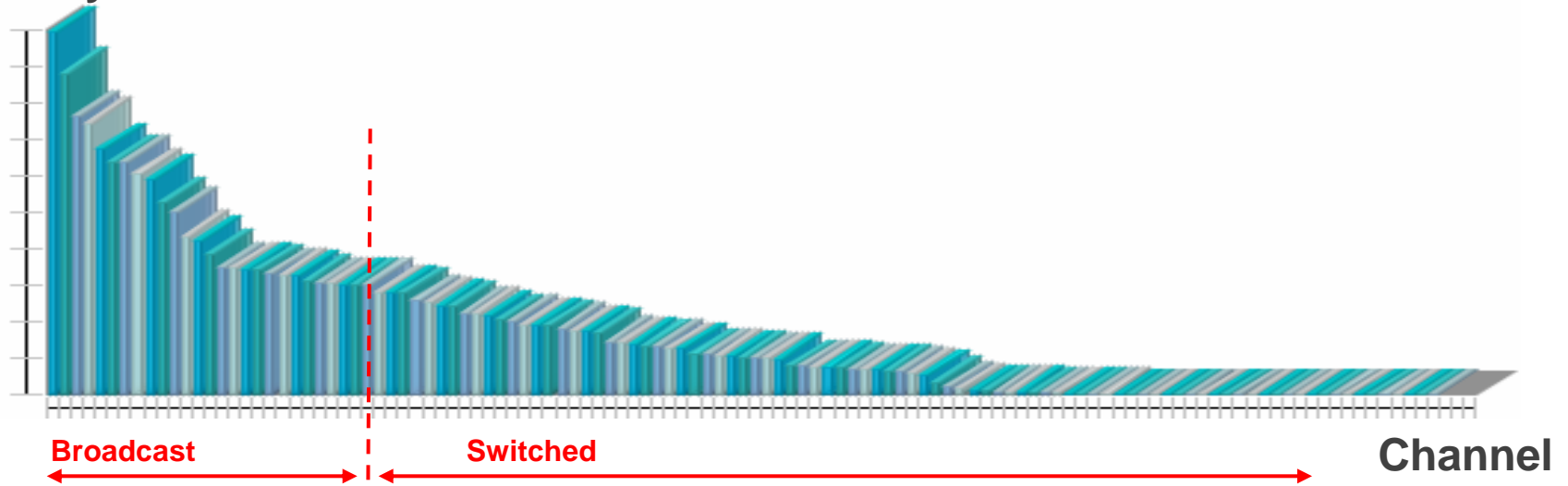(18 channels)

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SDV Underlying Guidelines

» No change in the customer's experience

» Fast channel change

» Efficient bandwidth utilization across entire delivery network

» Better Troubleshooting tools for delivery problems similar to VoD:

- Thru-the network views for Operations
- Non-responders & intermittent return path

» Co-existence with VoD and other narrowcast services

» Scalability with respect to

- Service Group size (number of tuners)
- Number of QAMs in service group
- Number of programs in the SDV tier

Typical SDV Deployments Metrics

Location	Digital Subs	SD Programs Switched	HD Programs Switched	QAMs	SG Size Tuners	No of SGs	Service Started	Over subscription
New York - 1	2,400,000	114	18	6	3000	916	Oct 06	310%
Virginia	355,000	180	19	14	800	483	Fall 08	183%
New York - 2	350,000	124	88	16	500	670	Feb 08	298%
Texas - 1	299,000	133	49	12	500	636	Nov 06	408%
Texas - 2	264,000	162	29	12	1000	323	Jul 05	353%
South Carolina	198,000	103	45	8	462	236	Nov 05	354%
Maine	139,000	103	37	8	500	204	May 06	314%
New York - 3	110,000	97	87	16	500	518	Mar 08	278%
North Carolina - 1	82,000	107	44	8	500	301	Jun 06	354%
North Carolina - 2	75,000	213	76	16	500	240	Jul 07	325%
Texas - 3	73,000	146	33	8	500	192	Oct 07	348%
Wisconsin	67,000	95	29	8	500	228	Feb 07	264%

Typical SDV Systems with Full Analog Tier

» 60-70 analog channels (Basic, Expanded)

» 15-20 Broadcast QAMs

» Switching everything but 70-120 most popular channels

» Service Groups: 500-800 tuners, 8 – 20 QAMs

» ~3:1 oversubscription gain → ~24 QAM worth of spectrum gained

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Typical Channels in the SDV Tier

- New HD channels
  - Beyond 50 most popular HDs

- 3DHD
  - Low initial penetration
  - Active not necessarily during prime time

- Niche channels

- Ethnic content
  - Incremental ethnic packages at $15-$45 per month

- Premium channels
  - Beyond the signature channel (Ex: HBO east/west, HBO comedy)

- Sports packages
  - Active not necessarily during prime time

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What are the Driving Factors for SDV?

» Sheer number of channels as a marketing differentiator

- Competition from Satellite and Telco providers

» Expansion of HDTV Lineup

- Typical HDTV channel consumes 3-4 times the bandwidth of its SD equivalent
- >200 HD channels is now the norm

» Incremental revenue through special-interest channels

- Ethnic Programming
- Premium Packages
- Sports Packages

» Channels that are not active all the time, e.g. NFL Red Zone

» Video Delivery to 3 Screens, Migration to Cable IPTV

Coming Soon – 3DTV

» Push by CE manufacturers, content providers

» Yet another high bit-rate form, low initial penetration

Other Options for Bandwidth Increase

» Analog tier reclamation

- Can recover up 500MHz
- Lose market differentiator – once customer gets STB, they can go with anyone

» Increase to 1Ghz

- Ad 42 QAMs to 750MHz systems, 24 to 860MHz
- Very costly, many still paying for increase to 860MHz

» Spectrum Overlay

- Vyyo had a solution to increase to 3GHz with taps and network passive elements
- Never took off

» SDV is by far the least expensive and least invasive technique to gain bandwidth

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BigBand SDV Overview

» ~500 Million Switches per day

» >37 Million Households Passed

» Highly Scaled Deployments

» Switching SD and HD @ >3:1 Oversubscription

» Support for many STBs and EPGs

» SA, Motorola and DVB environments

» Comcast NGOD Operation

» Acquired Camiant ERM

» Rapid Deployment and Professional Services

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BigBand SDV Deployed Systems

» **Time Warner Cable**
- Austin, TX
- Columbia, SC
- Syracuse, NY
- Portland, ME
- Greensboro, NC
- San Antonio, TX
- Waco, TX
- Green Bay, WI
- Binghamton, NY
- Milwaukee, WI
- Kansas City, KS
- Northern Los Angeles, CA
- Augusta, ME
- Dallas, TX
- Buffalo, NY
- El Paso, TX
- Richmond, KY
- Los Angeles, CA

- Lincoln, NE
- Staten Island, NY
- Manhattan, NY
- Hudson Valley, NY
- Columbus, OH
- Corpus Christi, TX
- Rio Grande valley, TX
- Wichita Falls, TX
- Laredo, TX
- Golden Triangle, TX

» **Buckeye Cable**
- Northwest Ohio

» **SureWest**
- Kansas

» **Cox Communications**
- Northern Virginia, DC
- Orange County, CA
- Phoenix, AZ
- La Fayette, LA
- Baton Rouge, LA
- New Orleans, LA
- San Diego, CA
- Gulf Coast
- Hampton Roads

» **Cablevision**
- Entire footprint, NY/NJ **(DVB Encryption)**

» **Videotron**
- Montreal West, CANADA

» **Charter**
- Glendale / Malibu, CA
- Newtown, CT
- Worcester, MA
- Southern California KMA

» **BrightHouse**
- Orlando, FL
- Tampa, FL
- Indianapolis, IN
- Detroit, MI

» **LG Powercom**
- Seoul, KOREA

Legend
Cisco
TVguide/Motorola
Aptiv/Motorola

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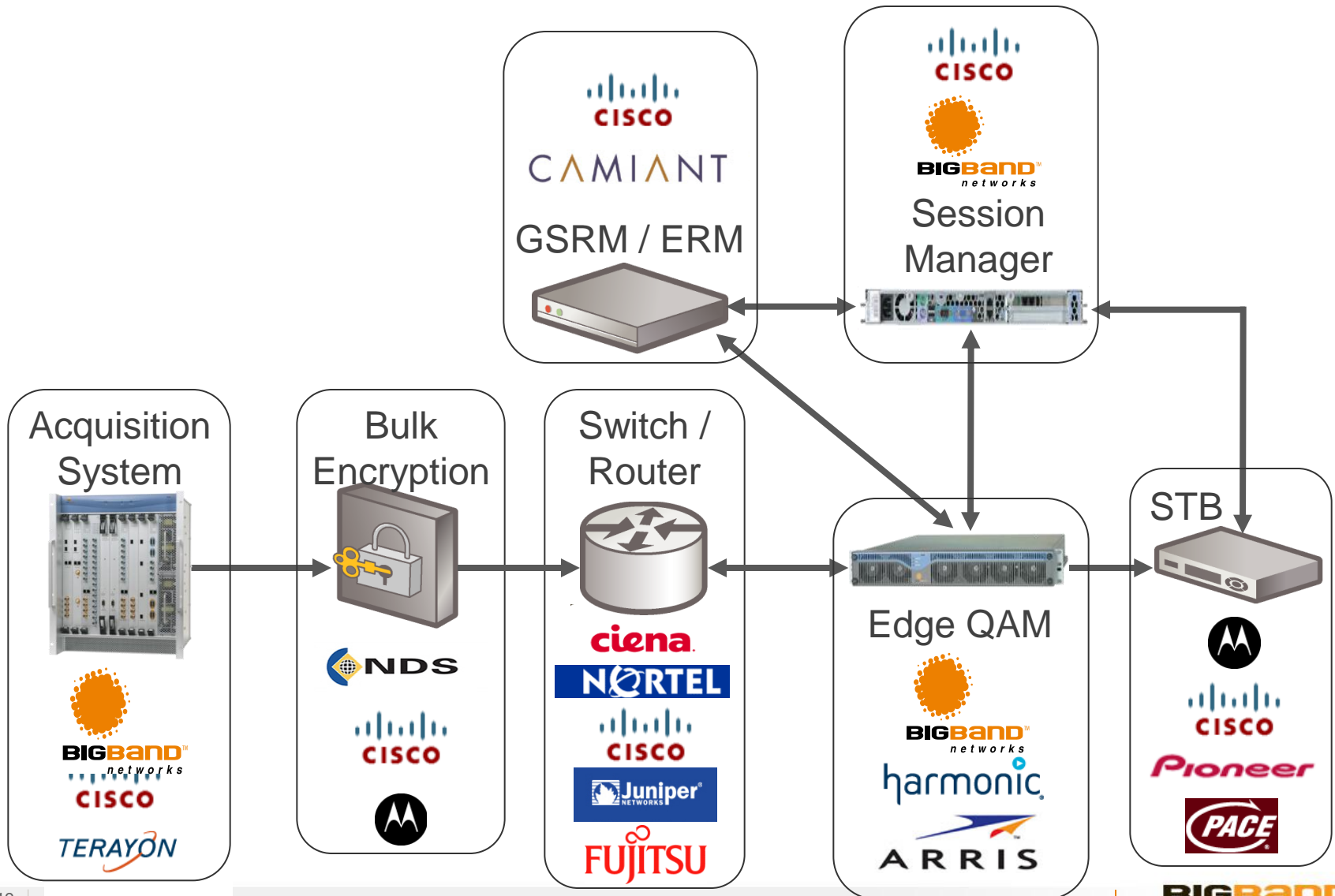# SDV Components and Subsystems

Components and Subsystems of SDV

» Breakdown of SDV subsystems

- Acquisition Subsystem
- Bulk Encryption Subsystem
- Switched Resource Manager (SRM) or Control Plane Subsystem
- Transport – Switch/Router Subsystem
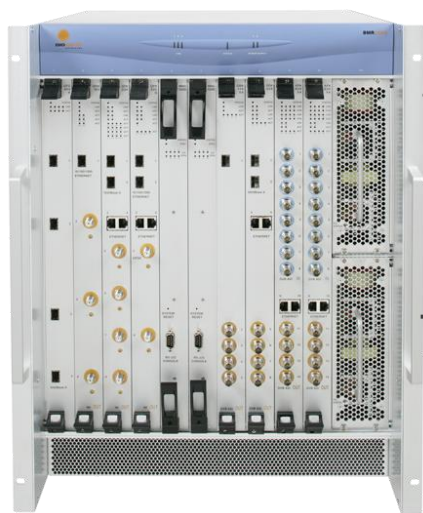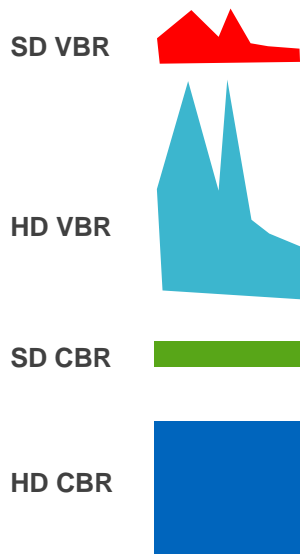- Edge Subsystem
- Subscriber/STB System

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Open Systems Ecosystem

Acquisition Subsystem

1. **Convert VBR to CBR**
2. **IP Encapsulation**

Sources

SD VBR

HD VBR

SD CBR

HD CBR

MPTS/VBR

Broadcast SD MUX
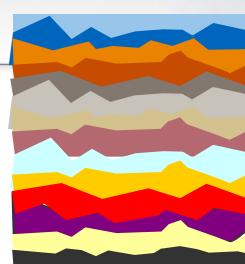
Broadcast HD MUX

Transport

CBR
SPTS
UDP/IP

SDV MUX

CBR example = 3.75Mbs for SD, 15Mbs for HD

Encryption Subsystem

» The Cisco/SA NetCrypt is the bulk encryptor of choice for SDV in SA systems

- Supports up to 250 SPTS (SD 3.75Mbps) in 2RU
- GigE port must be used as full duplex (unencrypted ingress/encrypted egress)
- Totally controlled and configured through the DNCS (no front panel)

» The NE1000 is the MOTO equivalent of the SA Netcrypt
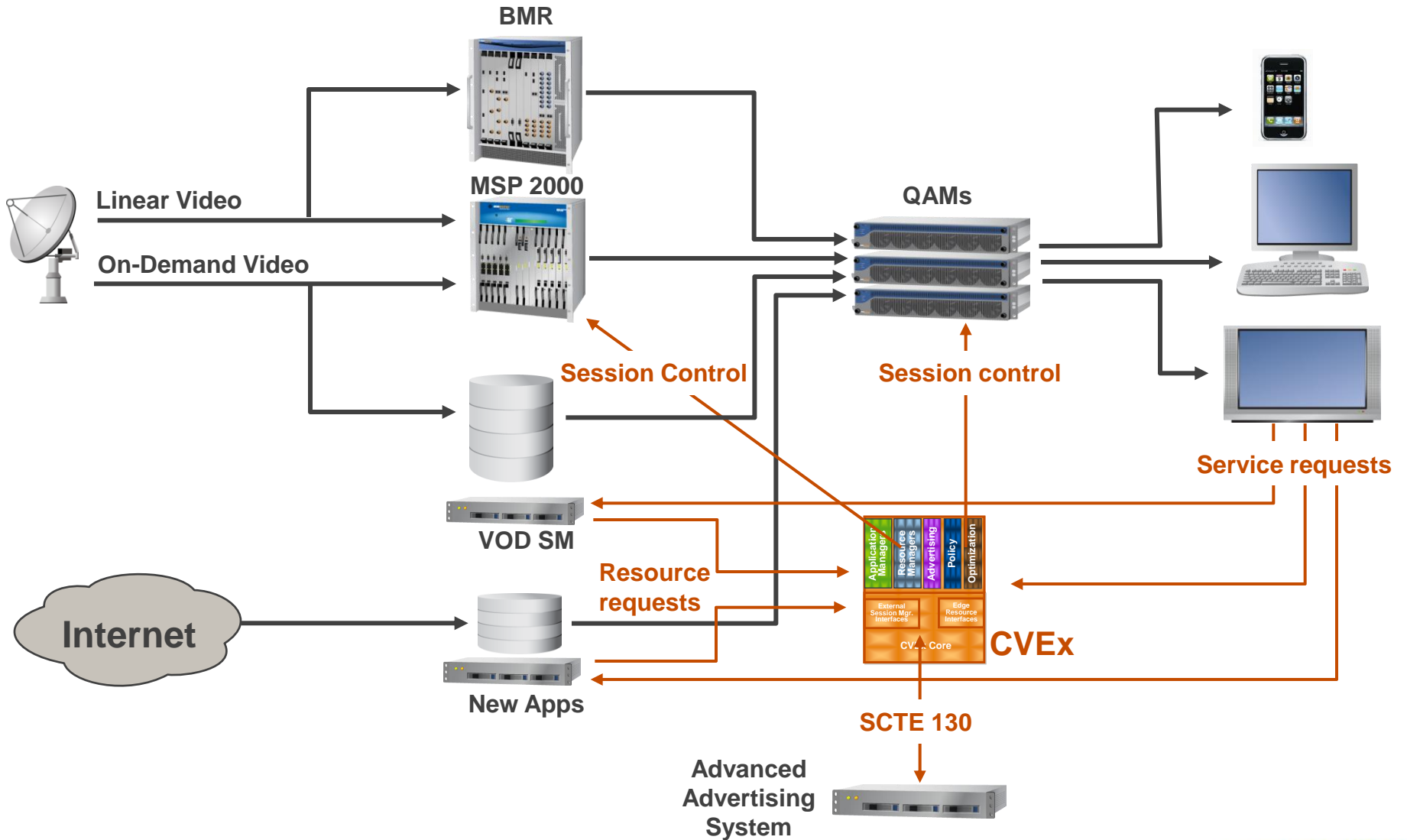
- Supports up to 192 SPTS in 1-RU

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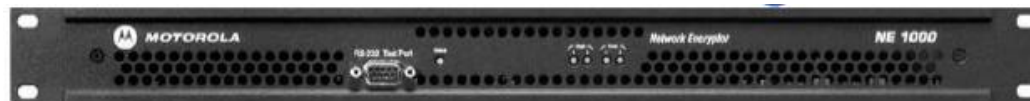
Session Manager

» AKA switched resource manager, session server – BigBand's CVEx SDV-SM

» The Session Manager's job is multifold:

- To manage, in conjunction with an Edge Resource Manager, service group information distributed among EdgeQAMs
- To receive Channel Change messages and create dynamic sessions based on those messages
- To generate a Mini-Carousel that is transmitted to the STBs to update the dynamic channel map

» There is usually a GUI front end to the session manager to allow users to manage – BigBand's SBM
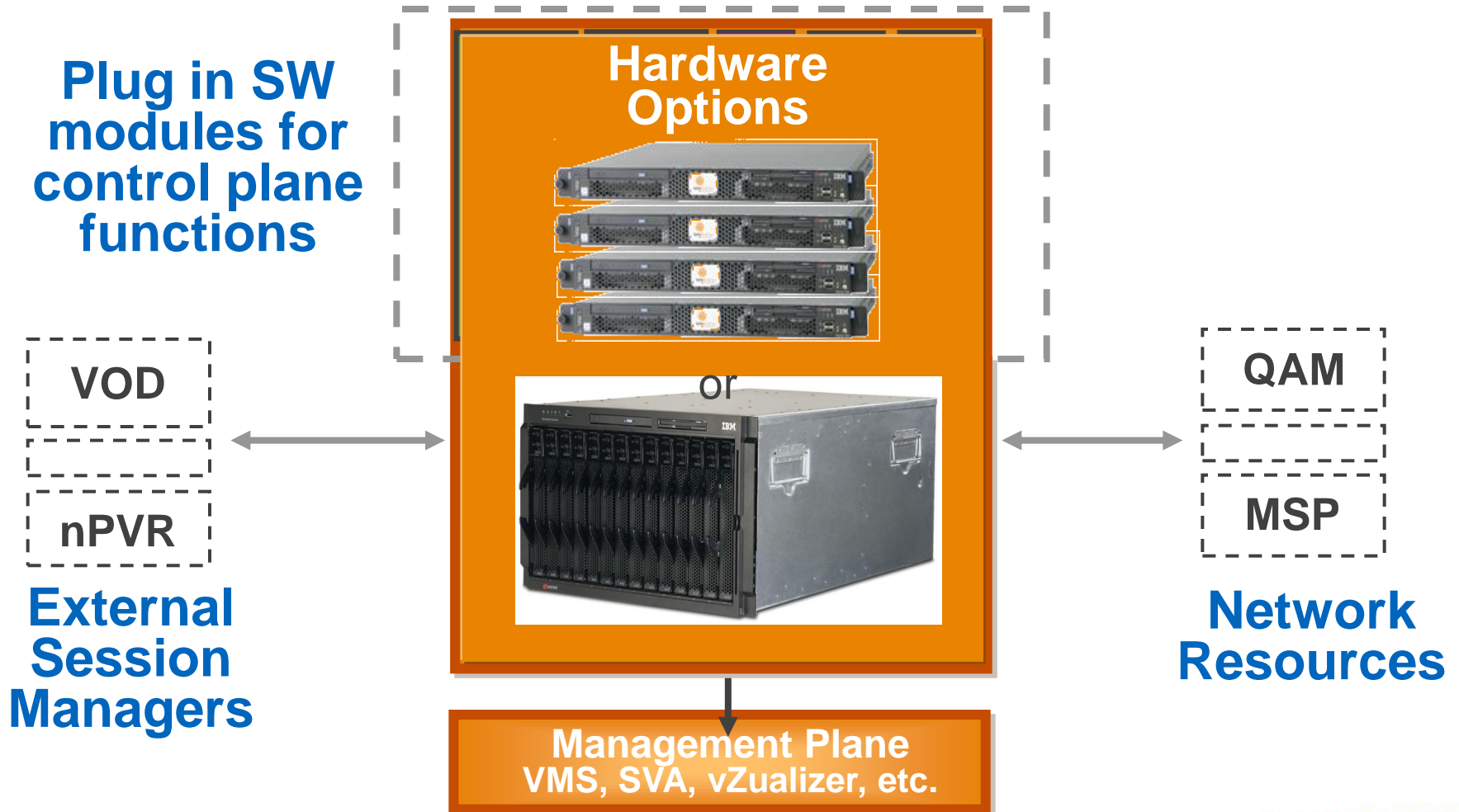
CVEx Server

- Detects the edge QAM topology (service groups and QAM frequencies)
- Initiates shell and program session requests to the ERM/SRM
- Generates the mini-carousel
- Receives and parses the channel change messages
- Confirms channel change messages to STBs
- Initiates sessions on the edge QAMs
- Logs all STB switched activity (which may be exported for traffic analysis)
- Maintains timers for bandwidth reclamation and prioritization

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CVEx Unifies the Video Control Plane

BMR

MSP 2000

QAMs

Linear Video

On-Demand Video

Session Control

Session control

VOD SM

Service requests

Application Manager

Resource Managers

Advertising

Policy

Optimization

External Session Mgr. Interfaces

Edge Resource Interfaces

CVEx Core

CVEx

Internet

Resource requests

New Apps

SCTE 130

Advanced Advertising System

BigBand Video Control Exchange (CVEx)

Single context for managing all video services

Plug in SW modules for control plane functions

Hardware Options

or

VOD

nPVR

External Session Managers

QAM

MSP

Network Resources

Management Plane
VMS, SVA, vZualizer, etc.

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Intelligent QAM Stacking

» Advanced SDV algorithms are critical to:

- Optimizing bandwidth utilization
  - Which Minimizes blocking probability

…. Especially when switching HD

An Algorithm using an intelligent strategy (heuristics) optimizes this example

<u>If QAMs Stacked intelligently, can add the next HD request</u> ·

				Available SDV Bandwidth	
SD	Multi-Rate SD	HD	Multi Rate SD		
SD	SD		SD		
SD	SD		Multi-Rate SD		Multi-Rate SD
SD	Multi-Rate SD		SD		Multi-Rate SD
SD	Multi-Rate SD	SD	SD	SD	SD
SD	Multi-Rate SD	Multi-Rate SD	SD	SD	HD
SD	SD			SD	
SD	Multi-Rate SD	SD	HD	SD	
SD	Multi-Rate SD	SD		SD	
SD	Multi-Rate SD	Multi-Rate SD		SD	
SD	SD	Multi-Rate SD		SD	SD

6 QAM Channel SG
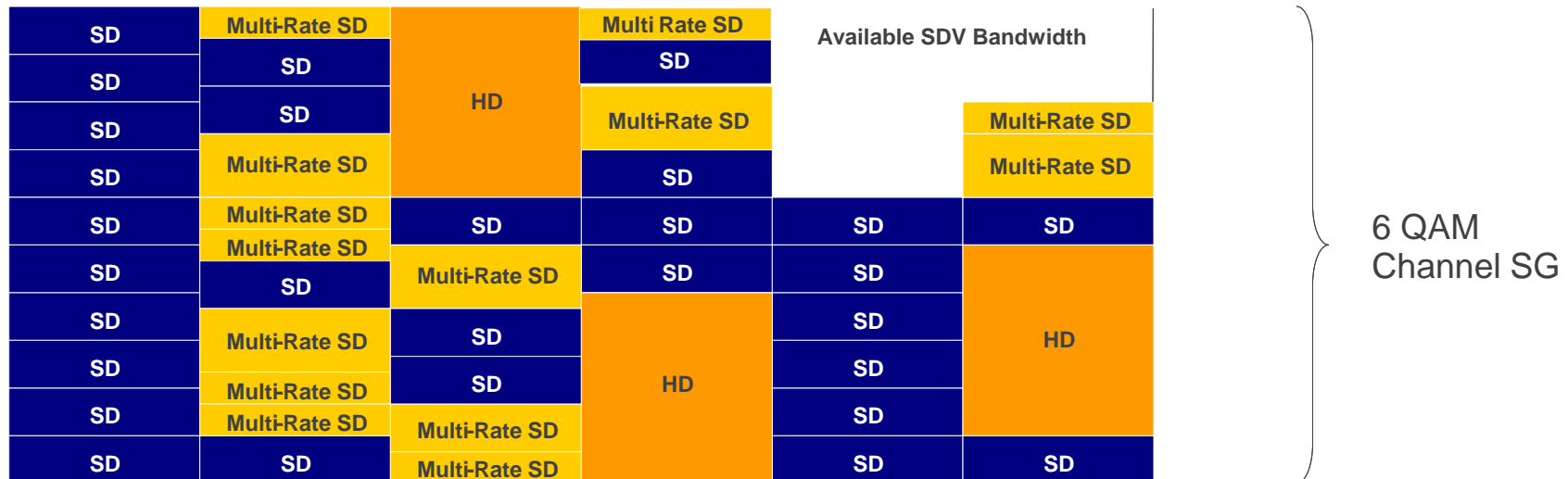
Rationale for Operation

» Will intelligently stack QAMs in a SG group until bandwidth runs out

» Will never close a session so long as one tuner is still tuned in

» Can optionally set a bandwidth reclaim timer to send a barker on a channel with longest idle period (measured by Last User Activity)

- If no confirmation, the program is reclaimed
- DVRs constantly update the LUA while recording

» Popularity factor used a tie-breaker for reclamation

Transport Subsystem

» The transport subsystem requires a modern L3 converged network that is multicast-enabled, preferably with Source Specific Multicast (an option of the PIM multicast routing protocol)

» Network capacity should be able to accommodate worse-case loads

» Redundancies and failovers should be built in

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Edge Subsystem

» The Edge Subsystem physically reside in the hub and consist of EdgeQAMs

» Its main function is to ingest SPTSs from the acquisition subsystem (or request them from the transport subsystem) and make available for switching

» The edge devices also receive a Dynamic Channel Map (DCM) or a mini-carousel

  ▪ The DCM is sent over a multicast with the last octet being service group number

  ▪ The edge device strips the multicast headers and forwards the carousel to each service group

» Finally, the edge devices take control information, or signaling, from the SM subsystem for dynamically opening sessions (if not already open) based on subscriber actions

SDV STB Clients

» Cisco SARA

» Rovi A.28

» TWC MDN, ODN

» Aptiv Passport

» Digeo Moxi

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SDV Signal Flow

Open Standards Architecture

① MPEG-2 over User Datagram Protocol (UDP) over Internet Protocol (IP)

② Internet Group Management Protocol (IGMP) versions 2 and 3

③ Remote Procedure Call (RPC) or Real-Time Streaming Protocol (RTSP)
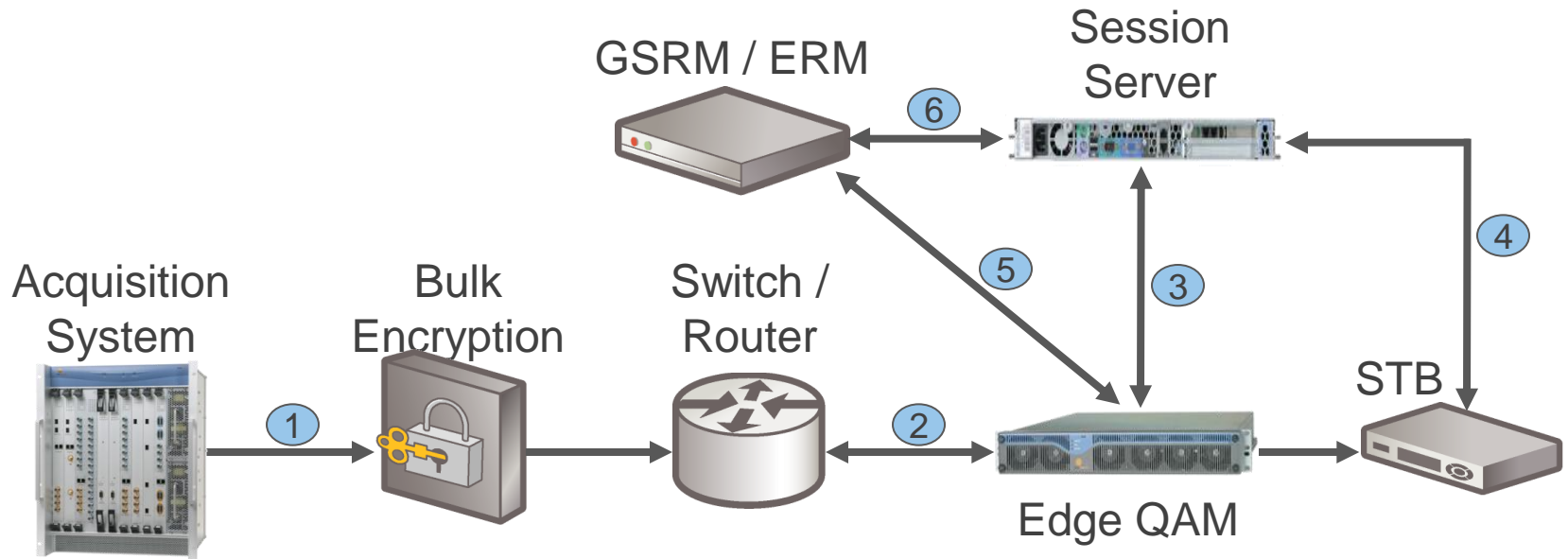
④ Channel Change Protocol (CCP)

⑤ Remote Procedure Call (RPC) and/or Auto Discovery (D6)

⑥ Shell Session Protocol / Session Initiation (SSP/SIS or S6)

Open Systems Ecosystem

Interface	Open Specification
1	UDP / IP
2	IGMP v2 / v3
3	RPC / R6, MCP
4	CCP (DSM-CC)
5	RPC / R6 / D6
6	SSP-SIS / S6

CISCO
CAMIANT
GSRM / ERM

CISCO
BIGBAND networks
Session Server

Acquisition System
BIGBAND networks
CISCO
TERAYON

Bulk Encryption
NDS
CISCO

Switch / Router
ciena.
NORTEL
CISCO
Juniper NETWORKS
FUJITSU

Edge QAM
BIGBAND networks
harmonic
ARRIS

STB
CISCO
Pioneer
PACE

BIGBAND networks
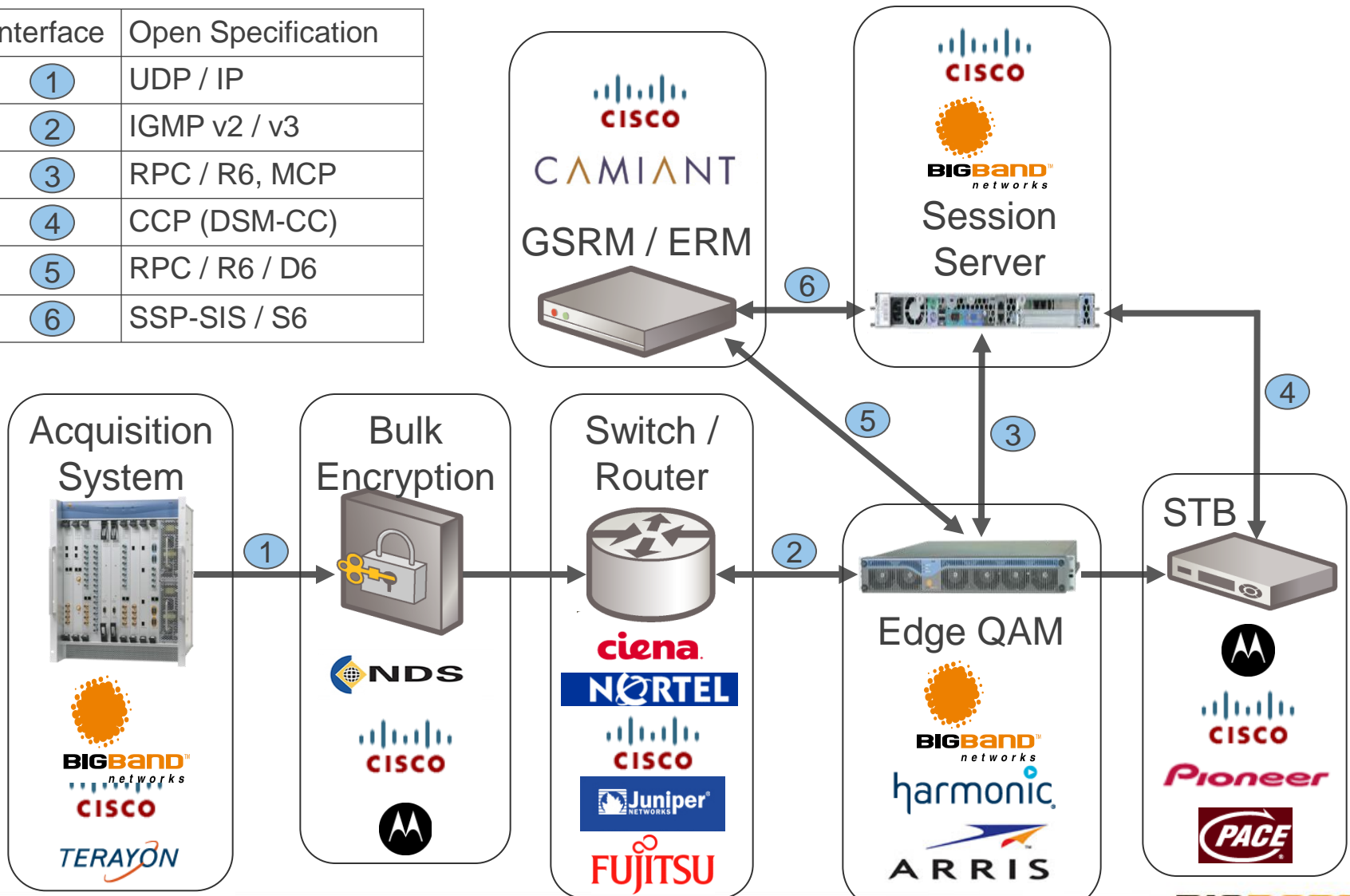
TWC Signaling Architecture

VOD Server

VOD SM

ISA

SSP-SIS

SSP

UERM

SSP-SIS

SDV Server

CCP

Session Bulk Encryption

RPC

RPC

Clamper

SPTS / MPTS

SPTS

IGMP

MCP

STB

Broadcast Bulk Encryption

L2/L3 Switch

EQAM

Redundant Switching

Splicing

Clamping

Multi Casting

Dejittering

Digital Modulation

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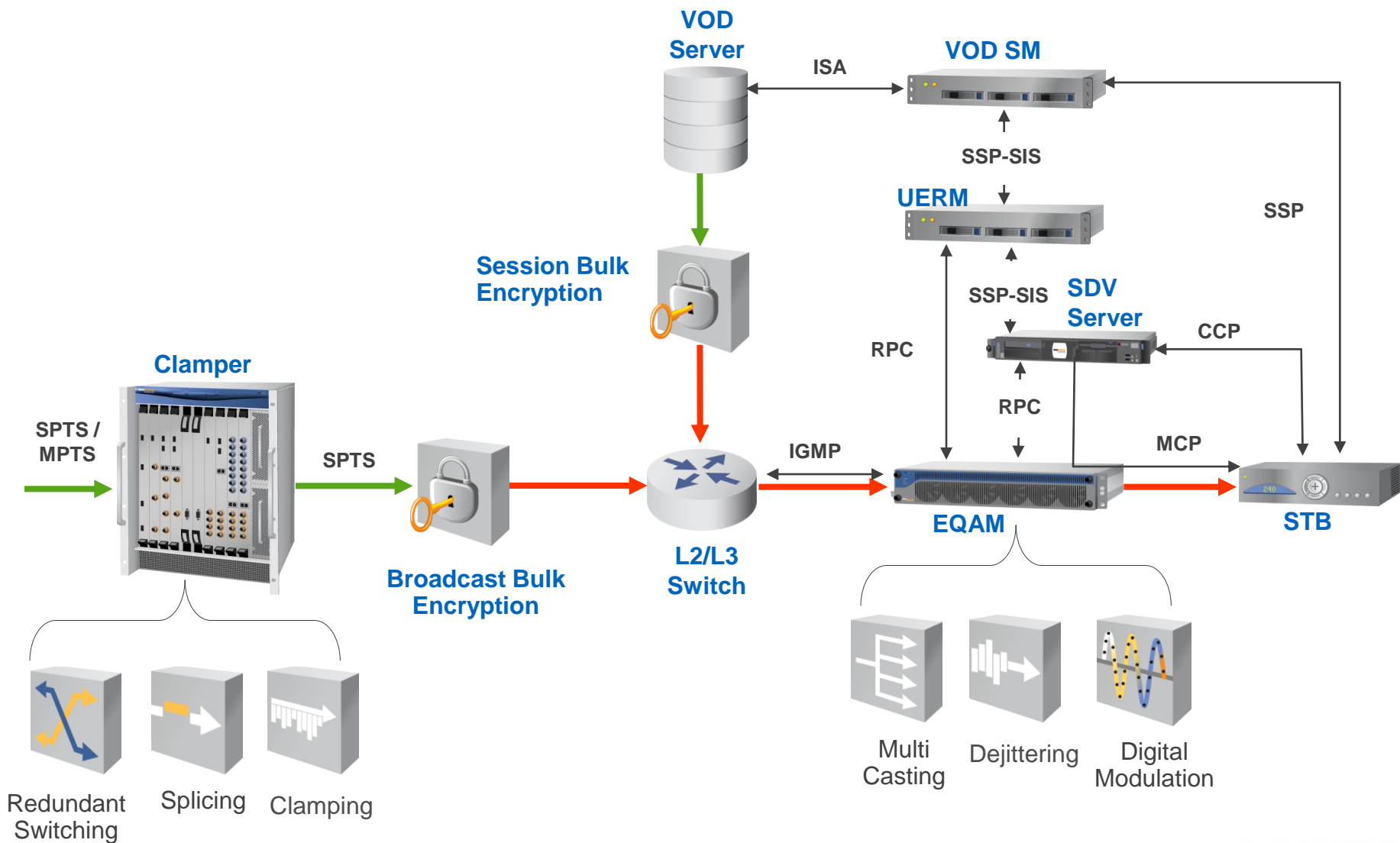
TWC SSP-SIS Signaling Flow

STB **SM** **ERM** **EQAM**

Step 1:
Pre-allocation
of shell
sessions

SSP-SIS: request shell sessions
ServerInteractiveSessionRequest

RPC: create shell session
CreateShellSessionGroupEdge

CreateShellSessionGroupEdge
Response

ServerInteractiveSessionConfirm

Step 2:
Binding of shell
session

CCP: request new channel
ChannelChangeRequest

RPC: bind session
SessionBinding

SessionBindingResponse

ChannelSelectResponse

» SDV Server manages sessions on its pre-allocated resources (shell –sessions)

» SRM could be one of the following:

- DNCS (4.2.1 and on) – Coupled with VOD SM

- GSRM as defined by TWC – Coupled with VOD SM

- Camiant UERM

STB Initialization – SG Auto-discovery
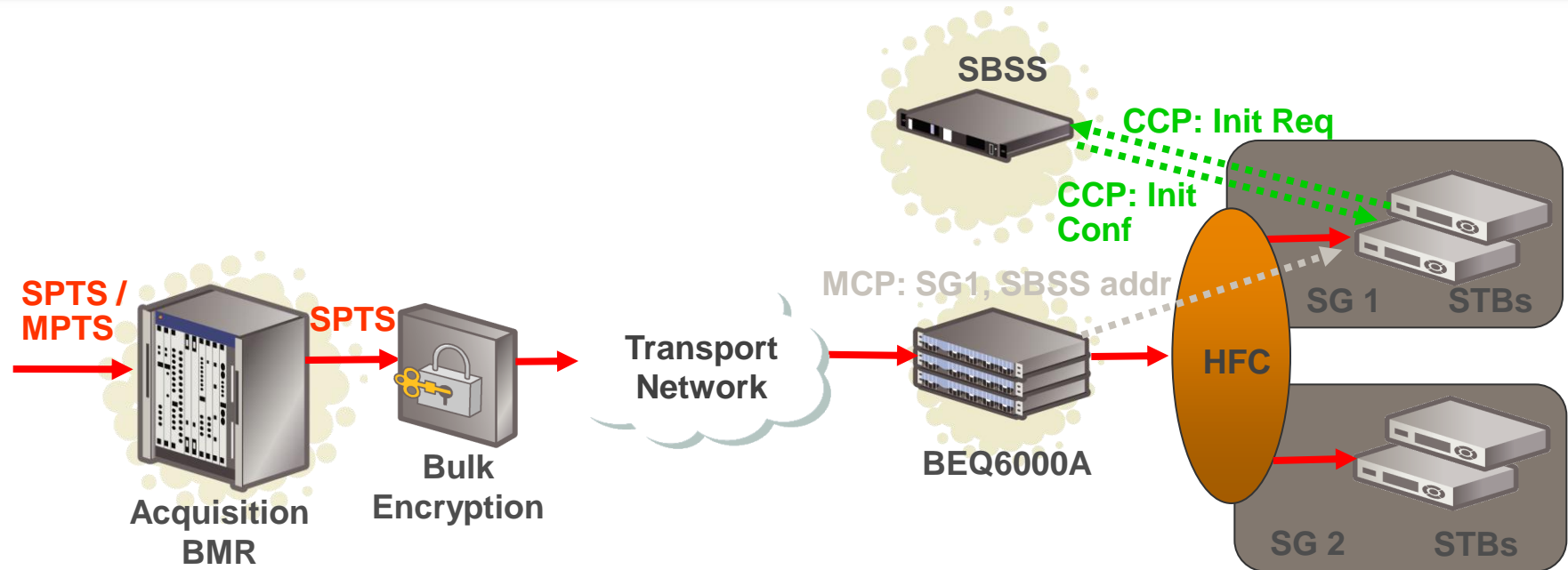
1. BEQ continuously sends SBSS address and Service Group ID in MC

2. STB boots and Client receives the SBSS address and SG ID

3. STB sends CCP:Init Req with SG and MAC address to SBSS

4. SBSS registers the STB MAC as a member of the service group

5. SBSS sends CCP:Init Conf to STB

Channel Change – Existing channel

SBSS

CCP: Prog select

CCP: Prog Conf

SG 1   STBs

SPTS / MPTS

SPTS

Acquisition BMR

Bulk Encryption

Transport Network

BEQ6000A

HFC

SG 2   STBs
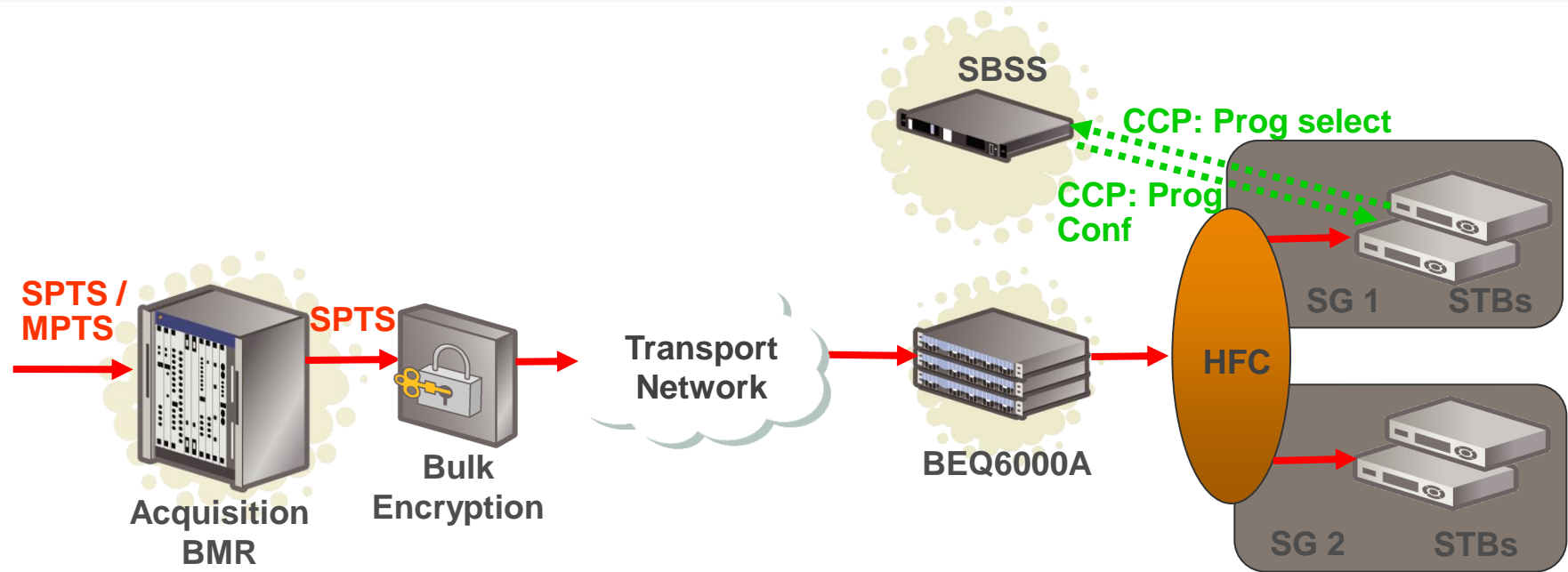
1. STB tunes to the channel based on its last MC info. *Tuning may be incorrect if MC info is not up-to-date*

2. STB sends "CCP: Program Select" to SBSS

3. SBSS looks up channel in its database, and returns "CCP: program conf" with tuning information to STB

4. STB updates tuning if MC was out-of-date, SDV Client caches new MC

5. SBSS logs channel change

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Channel Change – New channel
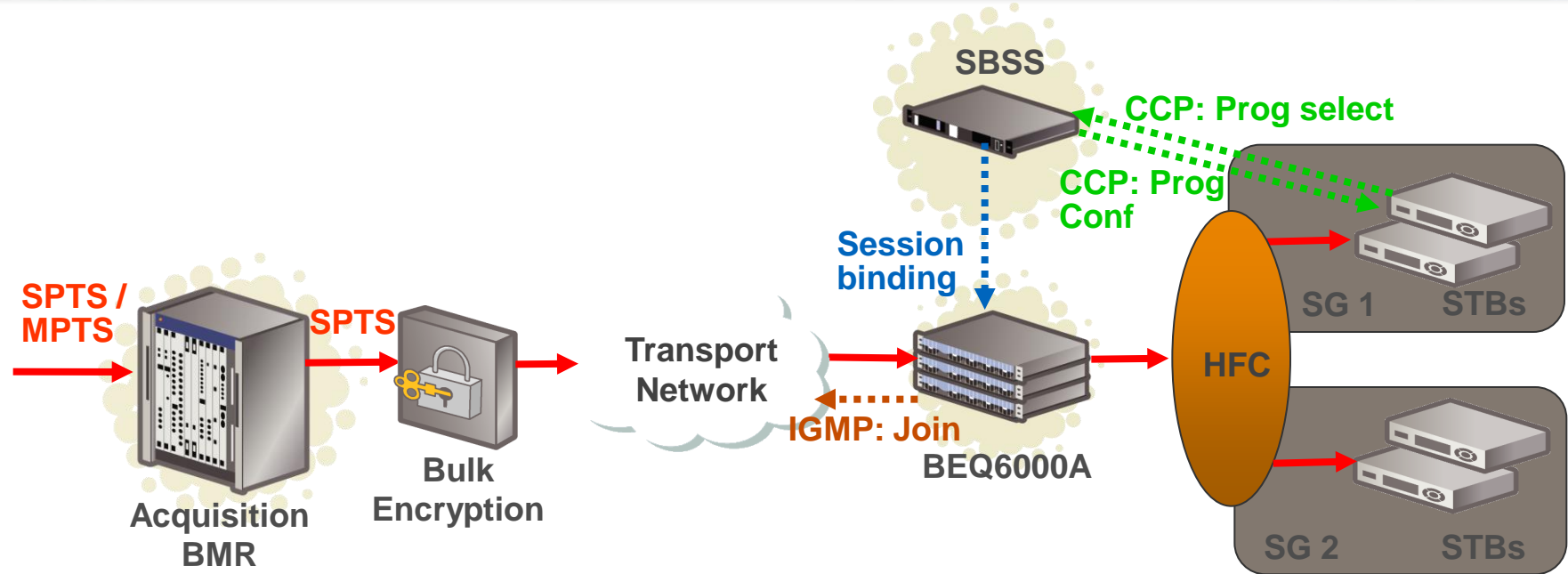
1. STB sends "CCP: Program Select" to SBSS
2. SBSS looks up channel in its database, and realizes channel is currently not switched
3. SBSS configures BEQ6000A with a new IP Multicast address QAM and PID
4. BEQ6000A sends "IGMP join" for new multicast address
5. SBSS returns "CCP: program conf" with tuning information to STB
6. STB tunes to new channel information, SDV Client caches new MC
7. SBSS updates MC table, *all SG Tuners have access in-band to updated MC*
8. SBSS logs channel change

NGOD-Based SDV Architecture
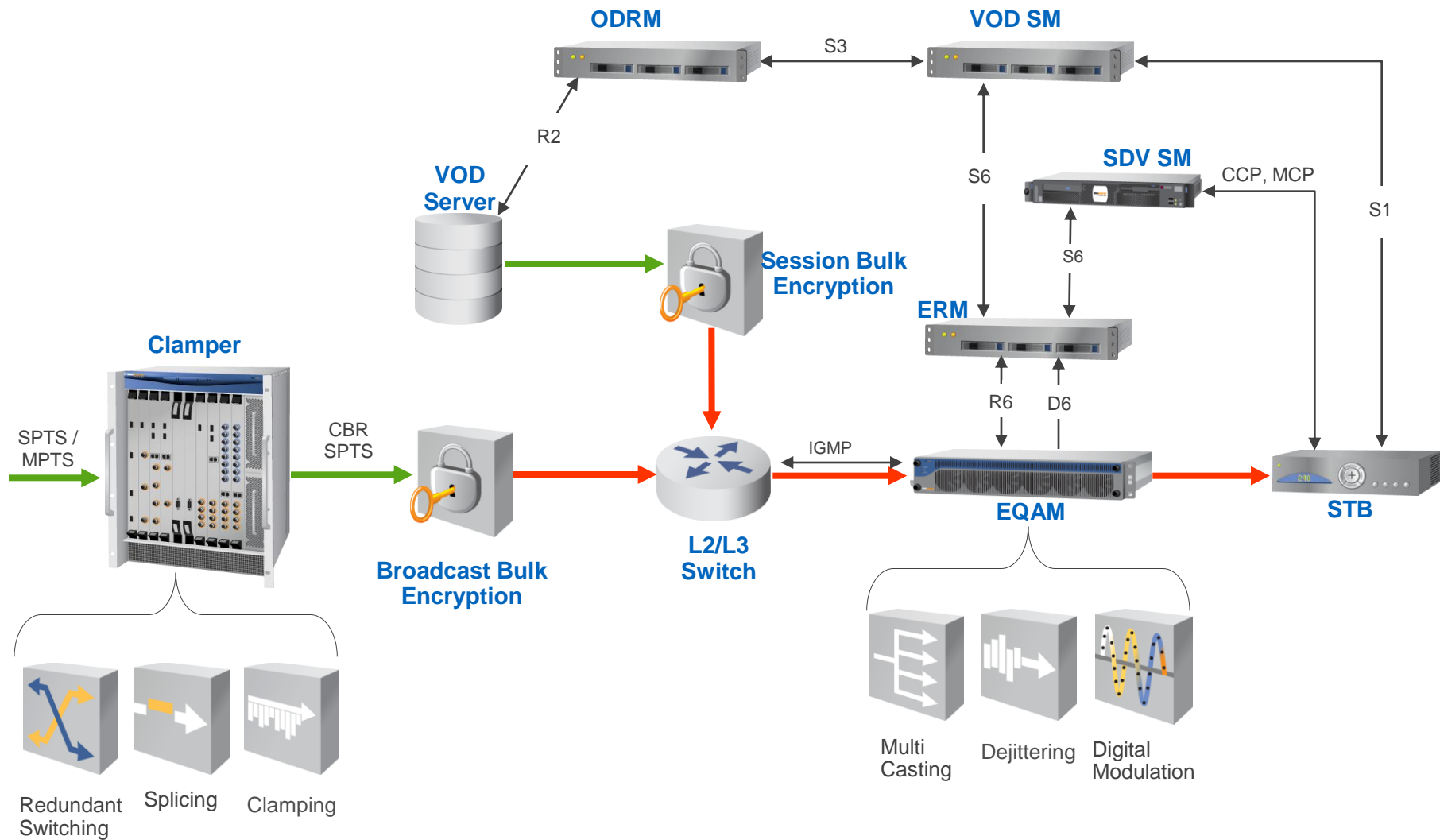
Legacy Motorola Network
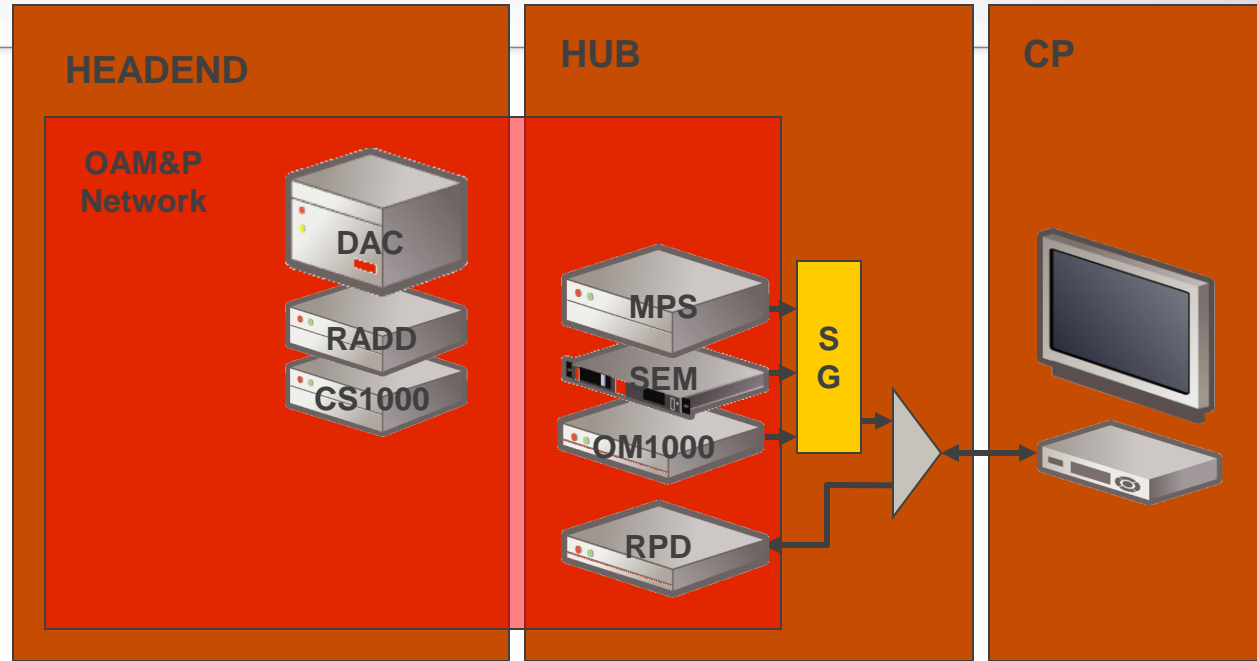
Incumbent Motorola Network

HEADEND

Interactive Applications Network

VOD Server

NC1500

VOD

HEADEND

OAM&P Network

DAC

RADD

CS1000

VOD

HUB

MPS

SEM

OM1000

RPD

S G

CP

VOD
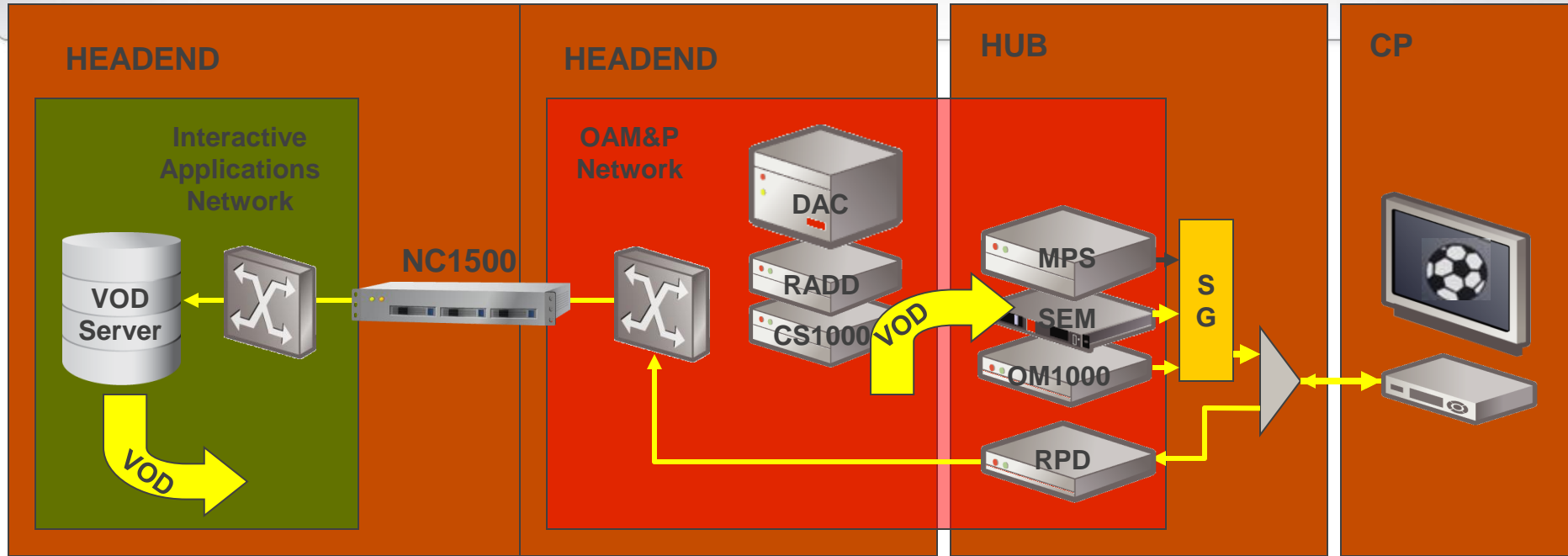
VOD-related traffic

BigBand SDV Motorola Network
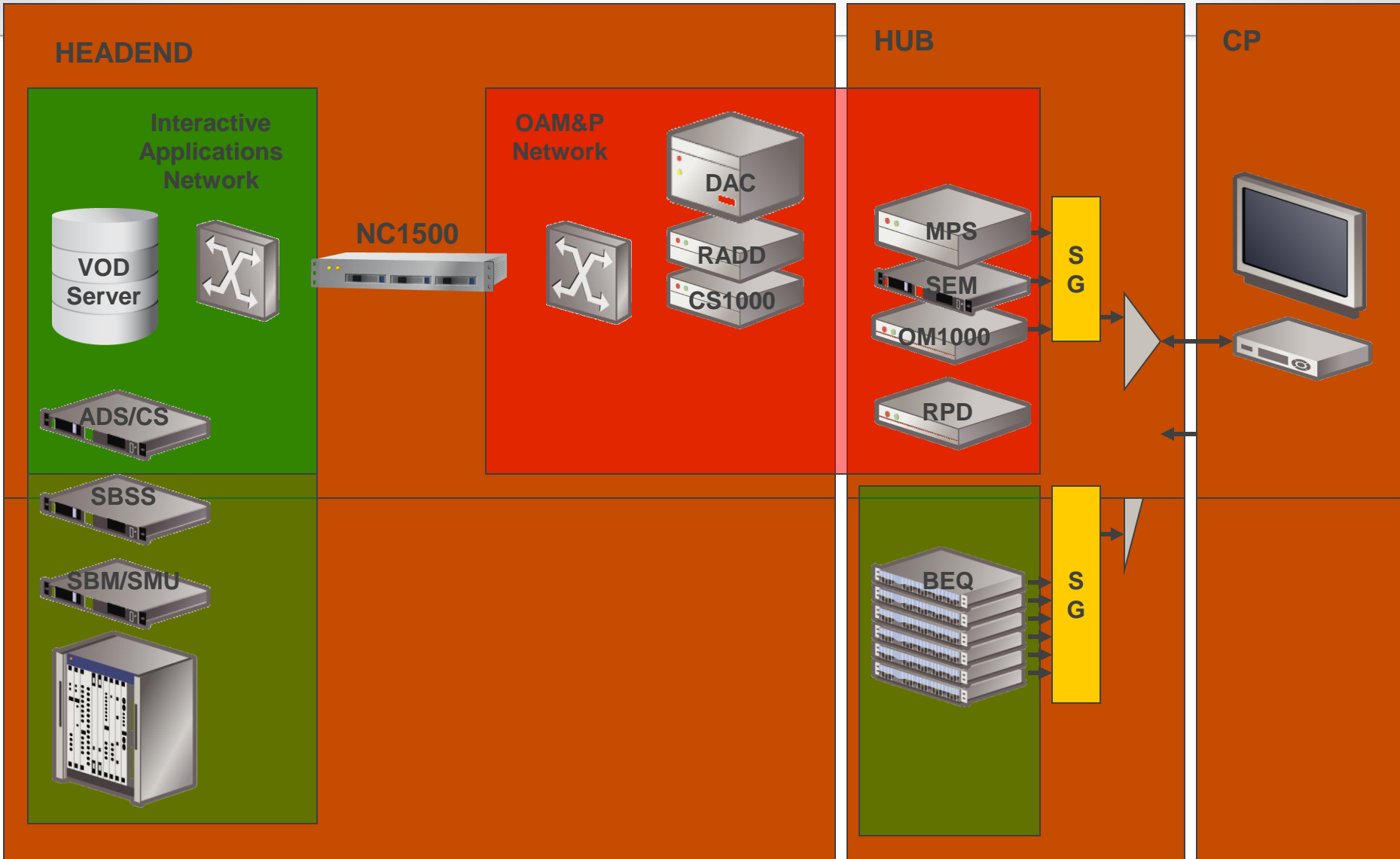
BigBand SDV Motorola Network - Mini Carousel

HEADEND

Interactive Applications Network

VOD Server

NC1500

OAM&P Network

DAC

RADD

CS1000

ADS/CS

SBSS

SBM/SMU

HUB

MPS

SEM

OM1000

RPD

S G

BEQ

S G

CP

→ **Mini-carousel traffic**
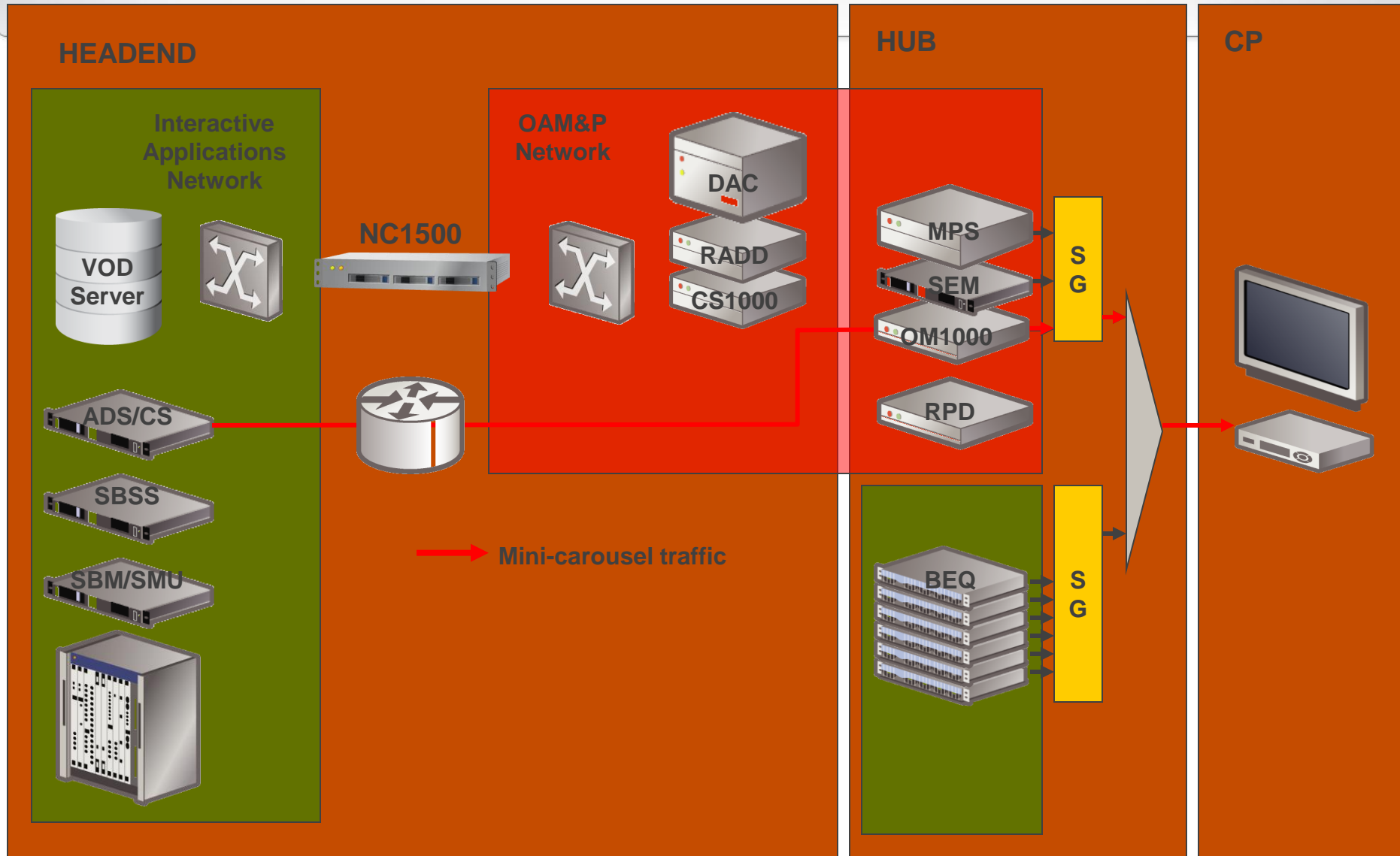
The STB now knows the IP address of the ADS and which frequencies are being used for SDV, tunes to one of the frequencies from the BEQ, and acquires the TSID from the PAT

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BigBand SDV Motorola Network - Autodiscovery

HEADEND

Interactive Applications Network

VOD Server

ADS/CS

SBSS

SBM/SMU

NC1500

OAM&P Network

DAC

RADD

CS1000

HUB

MPS

SEM

OM1000

RPD

S G

BEQ

S G

CP

← Autodiscovery Request traffic

→ Autodiscovery Confirm traffic
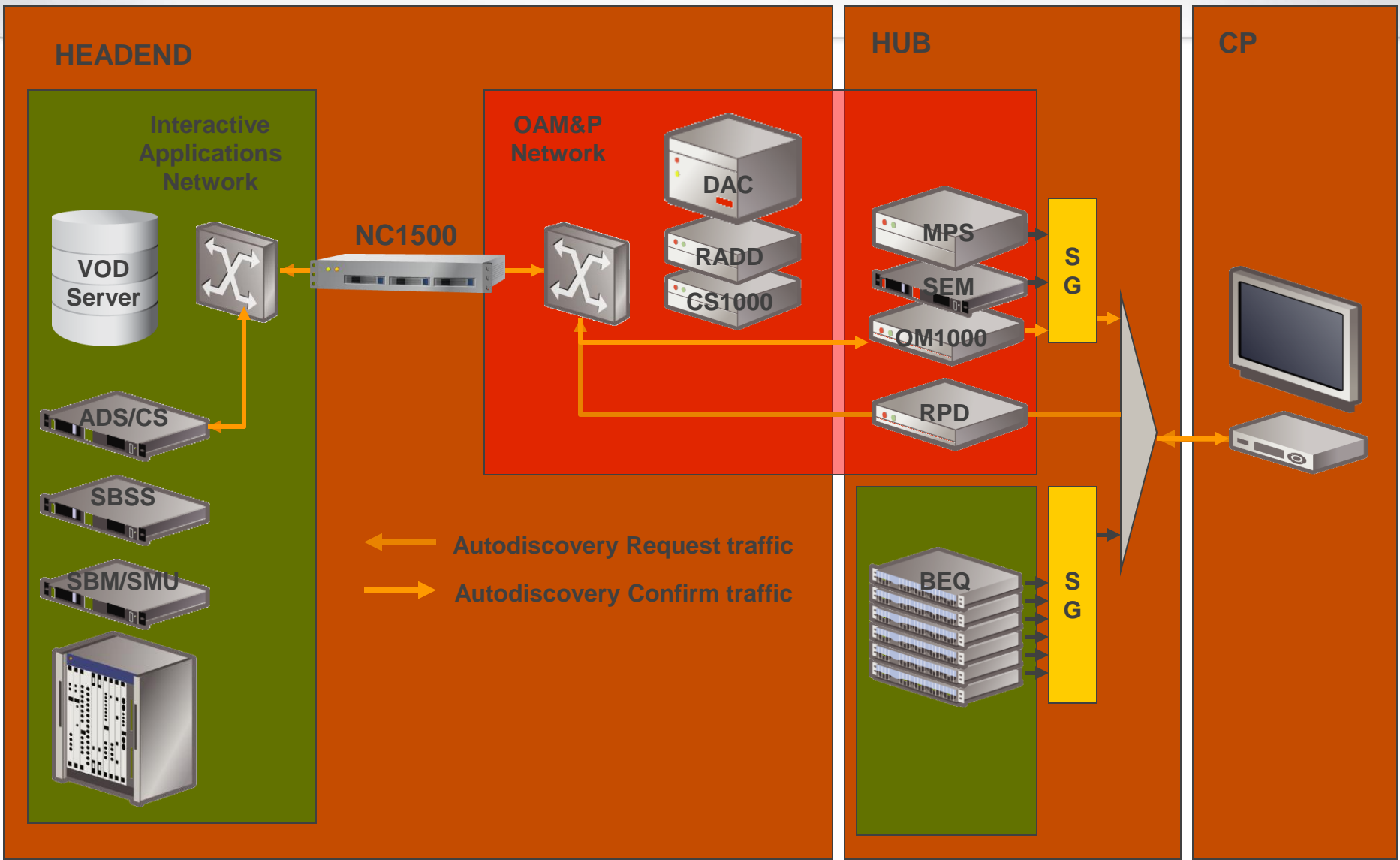
The ADS resolves the TSID to the SGID and forwards an Autodiscovery confirm message back to the STB

The STB then learns its SGID and from the mini-carousel discovers his relevant SBSS's IP address

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BigBand SDV Motorola Network

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Interactive Applications Network

VOD Server

NC1500

OAM&P Network

DAC

RADD

CS1000

ADS/CS

SBSS

SBM/SMU

Init Message

HUB

MPS

SEM

OM1000

RPD

S G

BEQ

S G

CP
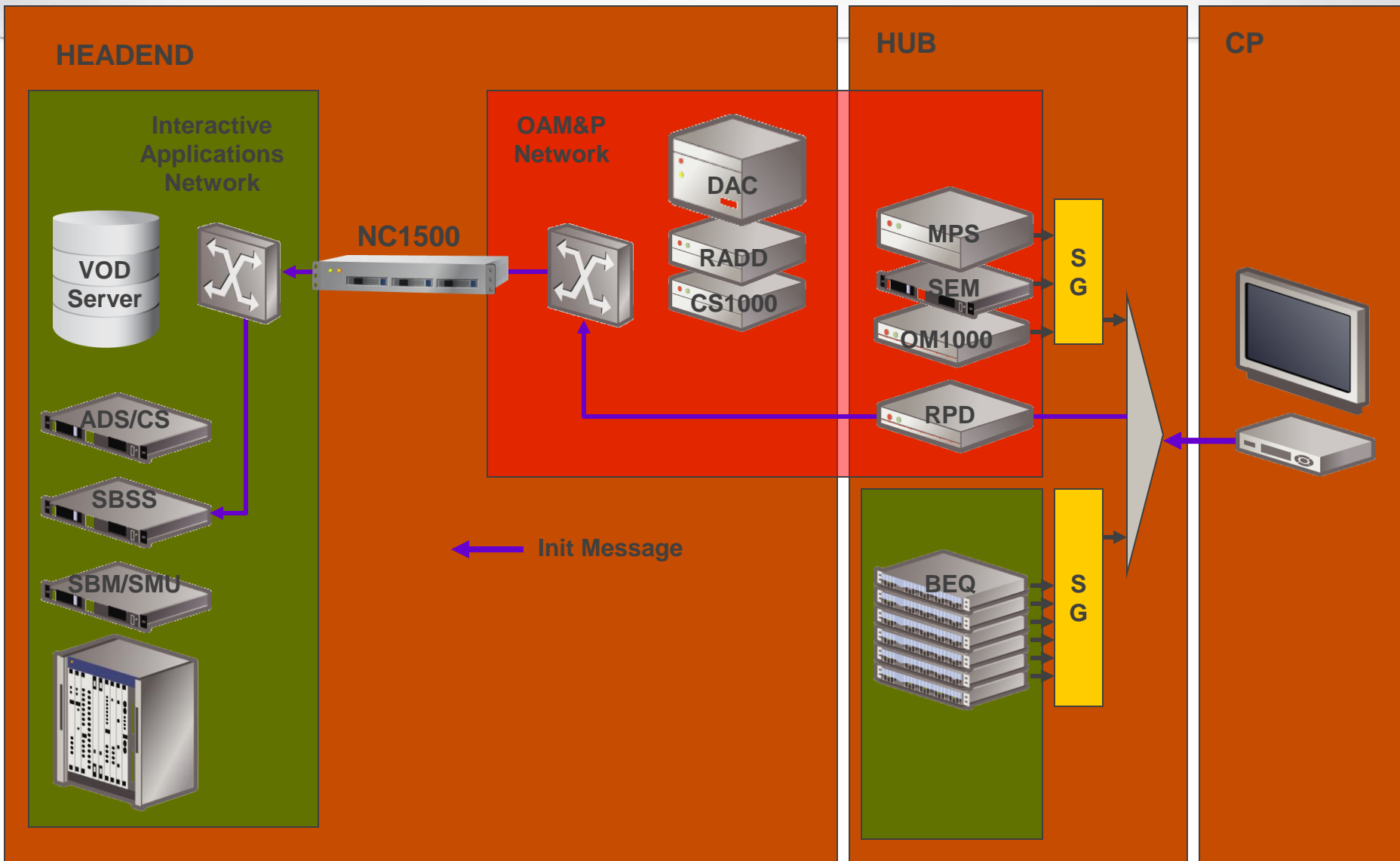
The STB then registers with the SBSS and is now ready for switching

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BigBand SDV Motorola Network - Program Switching

HEADEND

Interactive Applications Network

VOD Server

ADS/CS

SBSS

SBM/SMU

NC1500

OAM&P Network

DAC

RADD

CS1000

HUB

MPS

SEM

OM1000

RPD

S G

BEQ

S G

CP

→ **Channel Change Request Msg**

→ **Session Setup**

→ **Channel Change Confirm Msg**
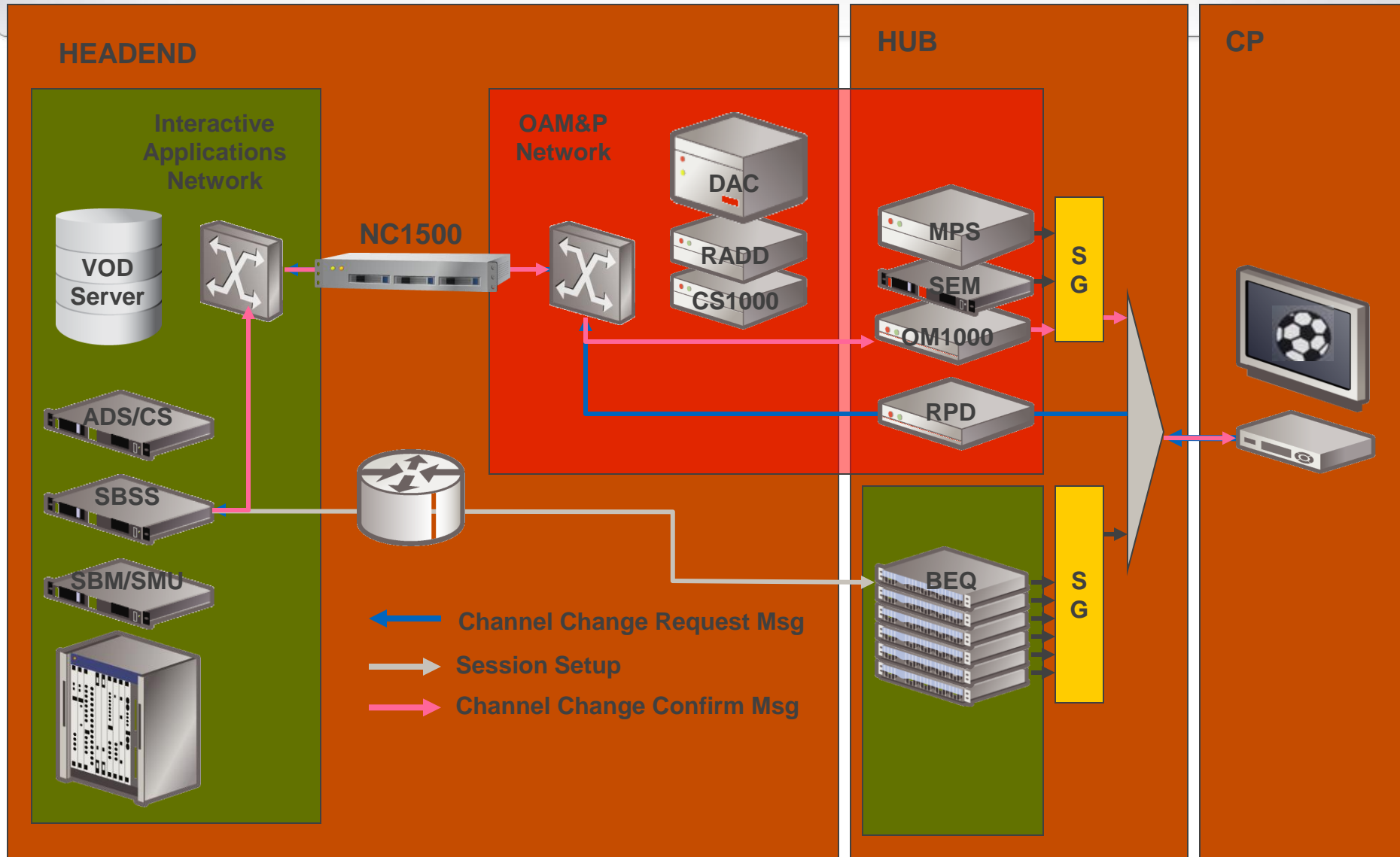
The STB makes a channel change request for a new program in the SG

The SBSS opens session on a BEQ   The SBSS issues a channel change confirm message

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SDV Design and Deployment

Narrowcast QAMs

Broadcast QAMs

Typically *550MHz-750MHz (EIA 70-116)*

| QAM-01 | QAM-02 | QAM-03 | QAM-04 | QAM-05 | QAM-06 | QAM-07 | QAM-08 | QAM-09 | QAM-10 | QAM-11 | QAM-12 | QAM-13 | QAM-14 | QAM-15 | QAM-16 | QAM-17 | QAM-18 | QAM-19 | QAM-20 | QAM-21 | QAM-22 | QAM-23 | QAM-24 |

1 Set

SDV QAMs

| QAM-01 | QAM-02 | QAM-03 | QAM-04 | QAM-05 | QAM-06 | QAM-07 | QAM-08 |

Service Group 01

| QAM-01 | QAM-02 | QAM-03 | QAM-04 | QAM-05 | QAM-06 | QAM-07 | QAM-08 |
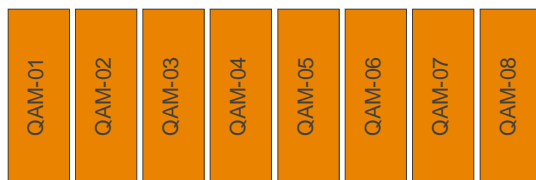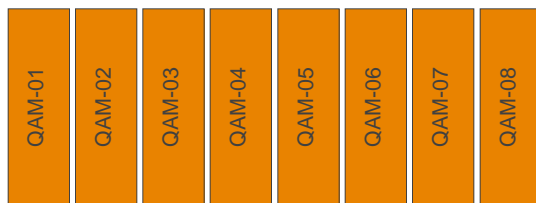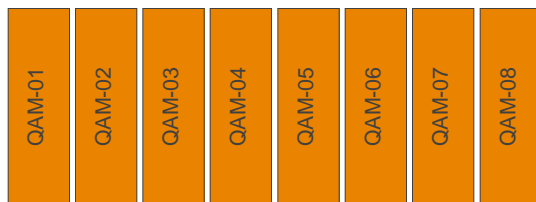
Service Group 02

Multiple Narrowcast Sets

Typically Contiguous

Typically same Frequencies in each service Group

| QAM-01 | QAM-02 | QAM-03 | QAM-04 | QAM-05 | QAM-06 | QAM-07 | QAM-08 |

Service Group XY

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What To Switch

Few of the Programs are watched Most of the time

Most of the Programs are Hardly watched at all

Popularity Index

Service ID	Aggregate Viewing Minutes	Min per Day
1	74,391,837	34.96
2	65,636,334	30.84
3	57,167,771	26.86
4	51,591,374	24.24
5	47,214,135	22.19
6	45,827,624	21.54
7	44,971,682	21.13
8	42,719,368	20.07
9	41,623,165	19.56
10	40,795,084	19.17
11	35,242,590	16.56
12	33,486,559	15.74
13	29,028,231	13.64
14	28,409,579	13.35
15	28,202,088	13.25
16	27,103,379	12.74
17	25,969,624	12.20
18	24,437,261	11.48
19	23,540,362	11.06
20	21,740,764	10.22
21	20,129,669	9.46
22	19,448,868	9.14
23	19,263,275	9.05
24	19,199,877	9.02
25	18,963,005	8.91
26	18,850,166	8.86
27	18,783,985	8.83

Most Watched   Least Watched

SDV Tier
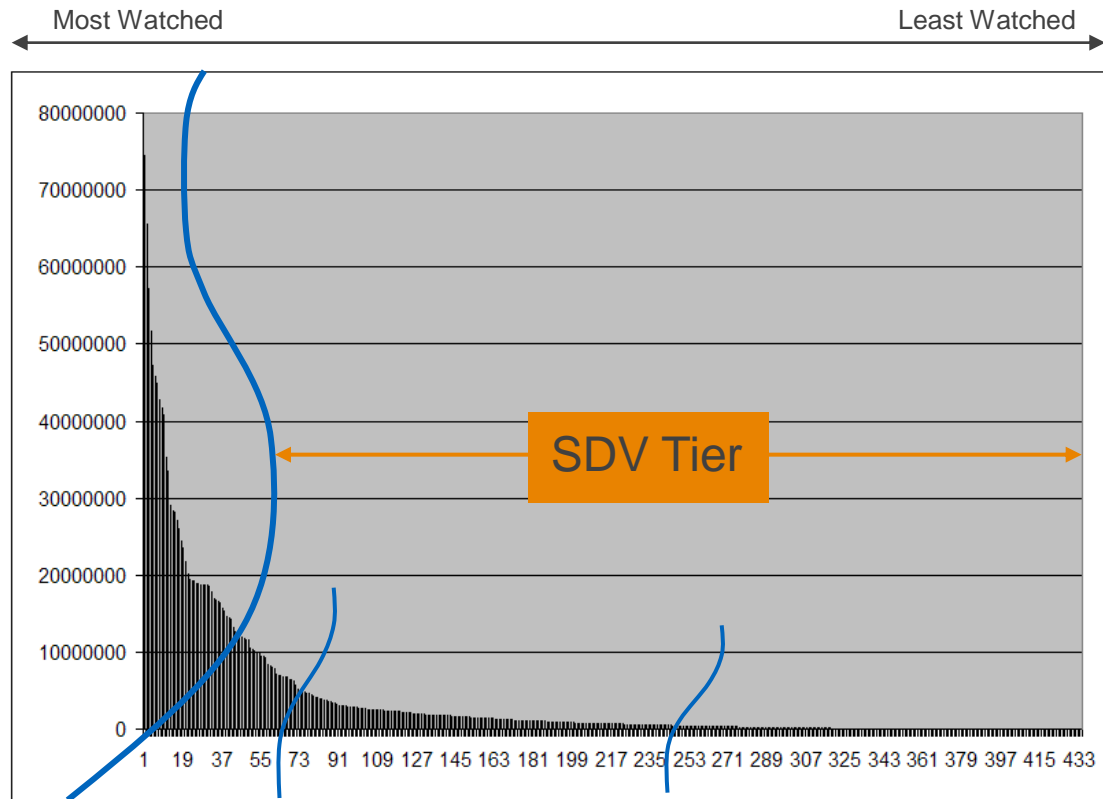
152000 STB Sample Size
20160 Total sample Minutes for 2 weeks

Class1, Class 2, Class 3

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Long Tail content Example

A Tuesday afternoon 3:00pm to a Wednesday afternoon 3:00pm (24 Hr Period)

Disney: a Popular Program

DHT2: not very Popular

Graph

List

Maximum Viewers Reports

Start Time	Tue Jul 18 13:00:00 EDT 2006
End Time	Wed Jul 19 13:10:00 EDT 2006
Service Groups	0
Channels	0

Maximum number of viewers

Channel Names

Channel	Max Viewers
Disney	66
SVILLE NICK	59
SVILLE TNT	58

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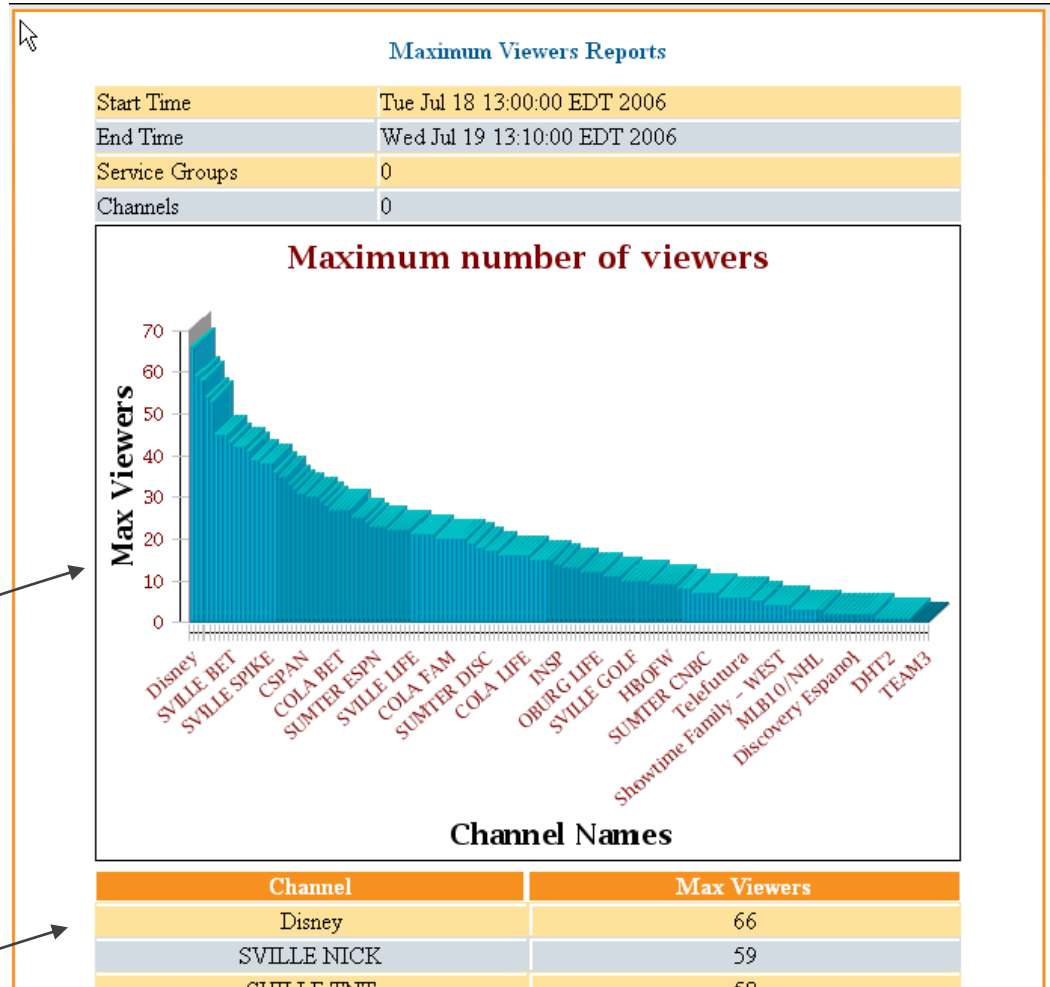
SDV Design Factors

» **Oversubscription Ratio**

- Program Source Bitrate vs QAM Supply Bitrate
  - 940Mbs vs. 310Mbs = 3:1
  - 24 QAMs vs. 8 QAMs = 3:1

- Service Group sizing (# of QAMs per Service Group)
  - Tuner Based
    - As the # of Tuners per Service Group increase, the # of QAMs required increases (Because Probability Increases)
    - Current target typically 500 Tuners per SG

- Program Selection
  - Statistics Based Popularity Index
    - Combination of how often the Program is on, and the # of Viewers
      - Aggregate Minutes.

- Combination of Tuners per Service Group, and Program Popularity Index

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networks

SDV Launch Timeline

<90 days to 50 Hubs

Planning	Integration	Deployment

	IP Schema and Address Allocation	IP Configuration	DNCS/ DAC	Netcrypt/ NE1000	Rack and Stack	Cable and Wire			
Site Audit and Facility Prep	Determine Line-Up	Networking & Transport Implementation/Allocation		Conditional Access and Bulk Encryption		Installation	Configure and Test	Friendly Launch	Launch

Deployment Program Management

SDV Installation Procedures

» Acquisition Subsystem Configuration (Clamping/IP Binding)

» SA Environment Configuration (DNCS/Netcrypt)

» Motorola Environment Configuration (DAC/NE1000)

» Transport Subsystem Configuration (SPTS GbE Transports)

» Edge Subsystem Configuration (QAM IP/Port/RF Settings)

» SBM Configuration (Channel Lineups/Global Parameters/Elements)

» QAM Configuration (Software/Settings/Traps)

» CVEx Configuration (Starting Processes/Aging/Reclamation/etc)

» CVEx 1+1 Redundancy Configuration (Active/Standby Settings)

» Element Manager Configuration (Menu/Toolbars/Alarms)

» SDV Client (System specific see SARA/BOD/ROVI procedure, etc)

SDV Deployment Project Schedule

» Statement of Work (SoW)

- Design review & kick-off

- Site readiness (lineup, physical and network)

- Rack, stack, and wire

- Configure, test

- Friendly launch

- Production launch

- Site turn-over

- 24x7 Customer Support and RMS

Obstacles to Successful Fast Launch

» Facilities Prep

- HVAC, power, racks, etc.

» Node Splits to match service group sizing requirements

» Networking and Transport

- Design, sizing, IP addresses allocation, configuration

» Bulk Encryption and DNCS/DAC expertise

» Rack and Stack and Service Group Wiring

- Personnel constraints

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Troubleshooting and Fault Isolation

Top SDV Issues

» Reverse Operation (Two-Way Issues)

- Traditional VOD troubleshooting techniques
- Non-Responder Reports

» Misconfiguration

- Check if a problem is local to a hub/SG or across the SDV network

» Routing Issues

- Mini-Carousel not getting to the EdgeQAMs of a service group
- SPTS not getting to the EdgeQAMs of a service group

» Hardware Failures

- Mitigated by striping
- While HW is unavailable, a SG has reduced capacity

Customer may see one of two "Barker" screens

» Service Not Available
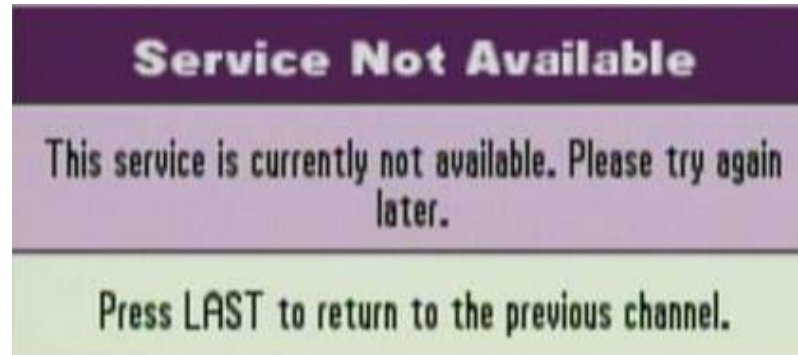
» ATTENTION: Press Select (OK) TO continue watching…
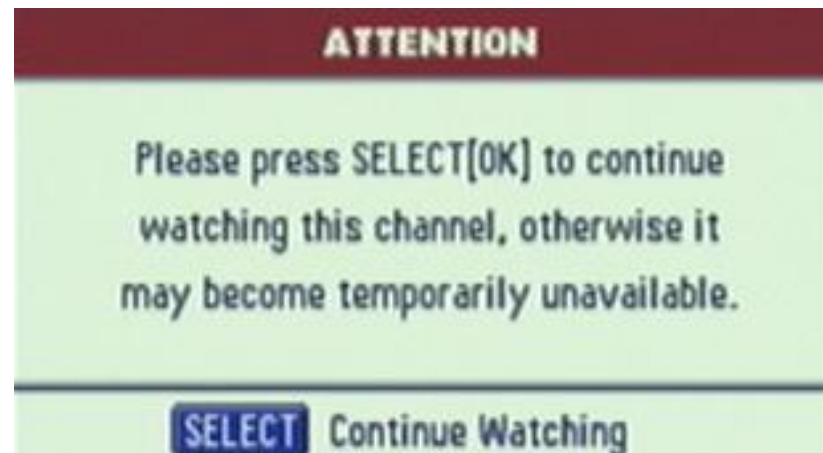
Service is Not Available Message

» May occur for either:
  ▪ Standard Broadcast
  ▪ Switched Digital Systems

» Means that the set-top tried to tune to a channel and could not find the program stream

» Possibilities
  ▪ Operator Error
  ▪ System Failure
  ▪ Set-top Failure

Service Not Available

This service is currently not available. Please try again later.

Press LAST to return to the previous channel.
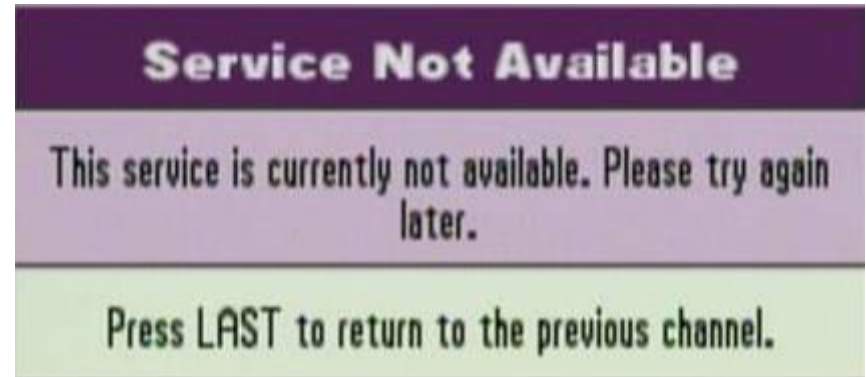
Root Causes for SDV Channels

» Return Path Failure
- Check if VOD works

» SDV service misconfigured
- Check other SDV channels

» Local Hub/EdgeQAM issue
- Check other SGs and Hubs

» Channel map updates not reaching STB

» Blocking event
- Not enough BW available on the SDV QAMs for this SG
- Check the SVA or blocking traps from the SBSS

Service Not Available

This service is currently not available. Please try again later.

Press LAST to return to the previous channel.
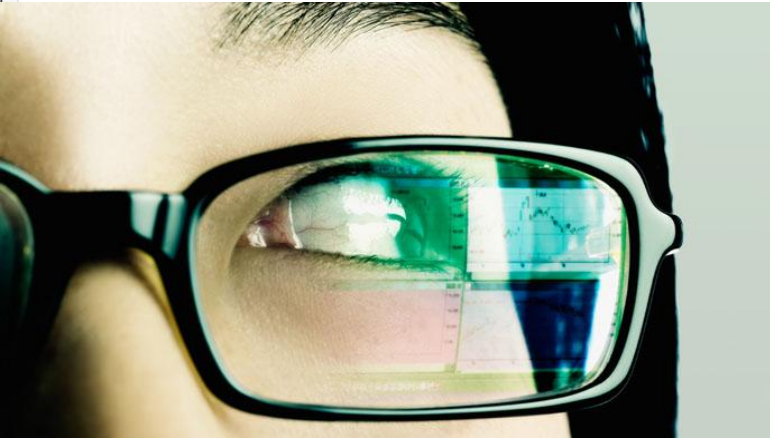
Service Reclamation

- Set-top box is monitored for inactivity
- If set-top box is the only set-top in a service group watching a given channel after pre-defined time, the channel space becomes available for use by another channel, and barks an ATTENTION message
- Customer must press channel select to guarantee that the channel space is not released to another channel request
- If a DVR set-top box is in the record mode the channel will not be released
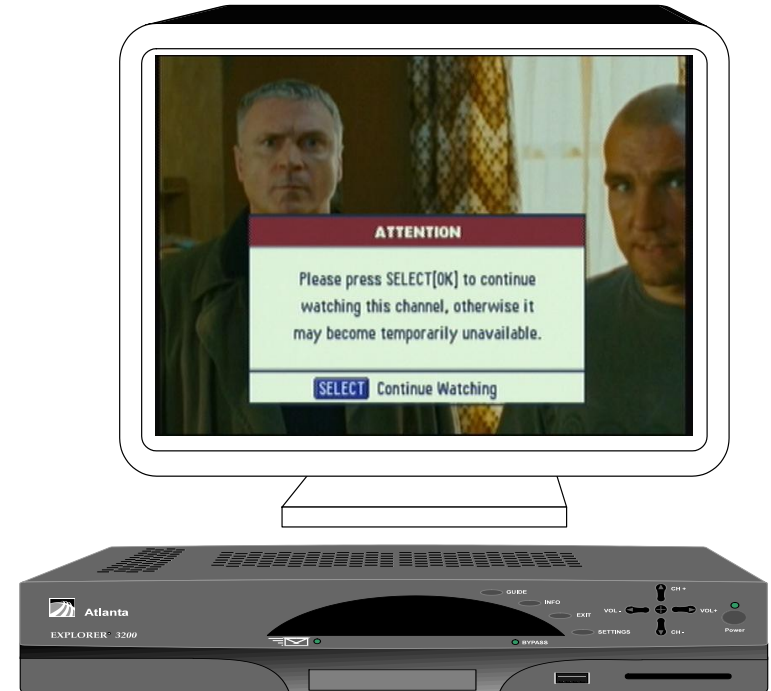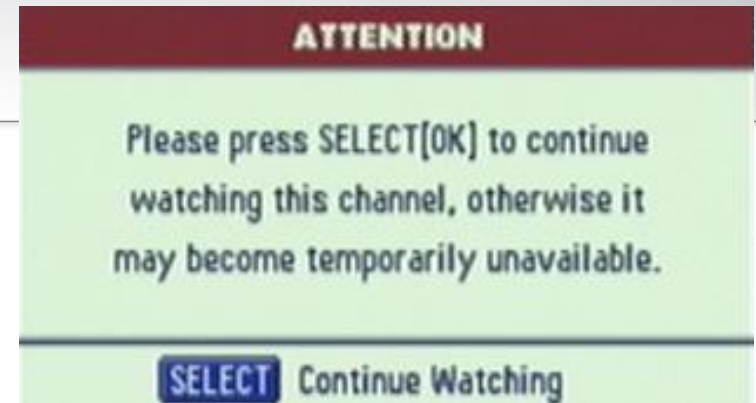
In-active set-top box

STB Diagnostics

Agenda

Is SDV Authorized?

Can the STB see the MC

Do I have an RF Problem?

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STB Diagnostics Screens

» Most settop boxes offer diagnostics that provide useful servicing information

» FSRs

  ▪ Sufficient Power from QAMs

  ▪ What client software is loaded in settop

  ▪ Check if any missing authorized channels

» Headend Technicians

  ▪ Need Service Group Number

  ▪ If missing program, need to know if SDV versus Broadcast

  ▪ What frequency was used to carry the missing program
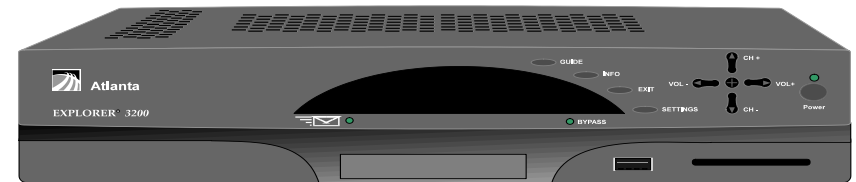
SDV Diagnostic Screens

» Press the "SELECT" button for 5 seconds

» The "Message" indicator will flash briefly

» Press the "INFO" button

» Diagnostic Screen will appear momentarily

- There are multiple diagnostic pages:
  - SDV Server registration, SG ID is on page 28
  - "Mini Carousel" and version loaded is on page 29
  - SDV Session data, tuner stats are on page 30

SARA - C Diagnostic Screens, STB Registration

Page 28 Diagnostics, SDV Authorized STB, SG ID

SARA - C Diagnostic Screens, MC Data

Page 29 Diagnostics, SDV MC Information

SARA - C Diagnostic Screens, Session Data

Page 30 Diagnostics, SDV Session Information

Mini Carousel Diagnostic Screens

» Status = Confirms that the box has read the MC.

» Load Time = Shows the last time the MC was updated.

» Version = Shows the version number of the MC.

» Number Entries = Shows the number of channels published.

» Load Failure = Indicates if there have been any MC load failures.

» Load Error = Describes the status of the last MC load attempt.

Tools for Operation, Optimization and Modeling

Analyze This.

Agenda

Why Analyze?

The SVA's Value

   Before, During and After Deployment

Report Snapshots

Future BW Management

The SVA Customer Advantage, Why Analyze?

» Unique performance reporting and viewing pattern analysis

- Standalone architecture based on Linux OS and Oracle
- Virtually no impact on STB footprint and upstream network
- System-wide SDV operational supervision every 15 Minutes in SVA3.0 (May 2009)

» Based on Deployment & Operational Experience

- No switched video infrastructure needed for installation
- Totally transparent to subscribers
- Subscriber privacy fully protected

» Optimizes all phases of SDV deployment

- Standard and High Definition growth
- New ENGR & Ops tools being implemented in future releases

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SBSS Log Files

» SBM Options: Define SBSS log Directory

» Text file: provides settop:SBSS tuning activity

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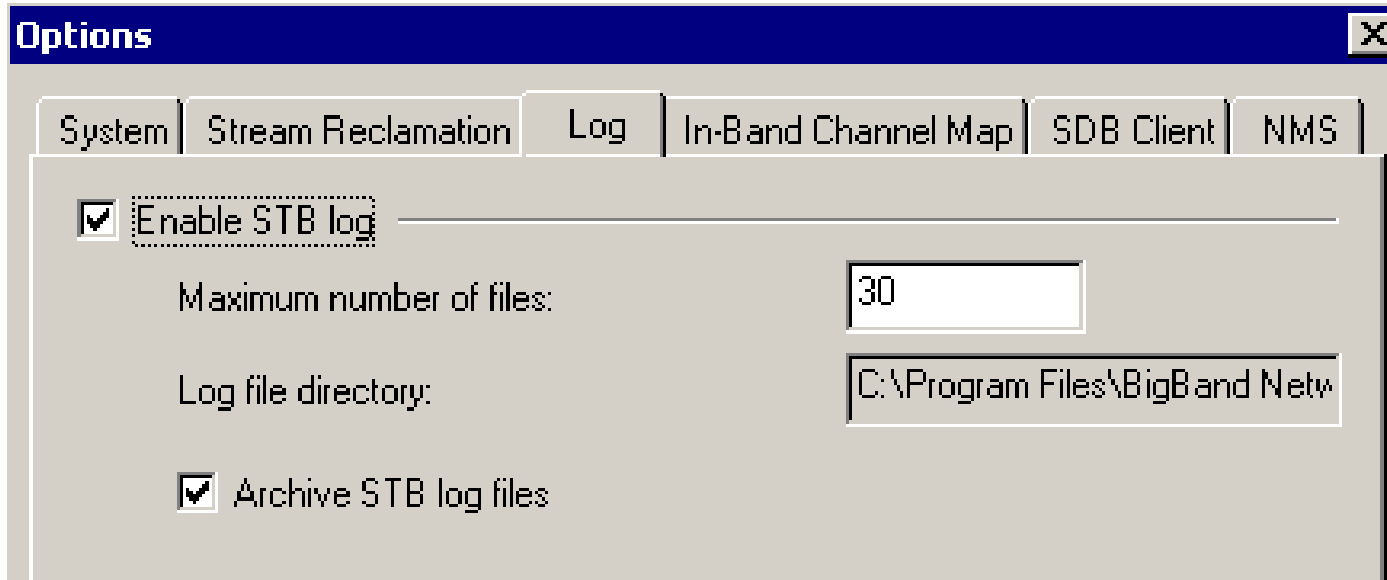
SVA Architecture

» Single SVA server gathers and processes logs from all SBSSs

» Gives insights into SDV infrastructure utilization and performance
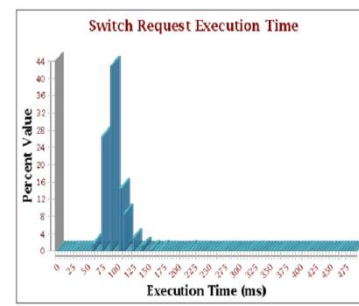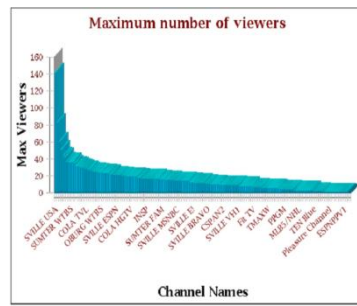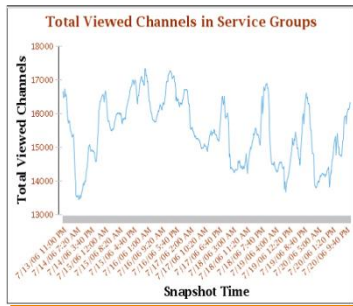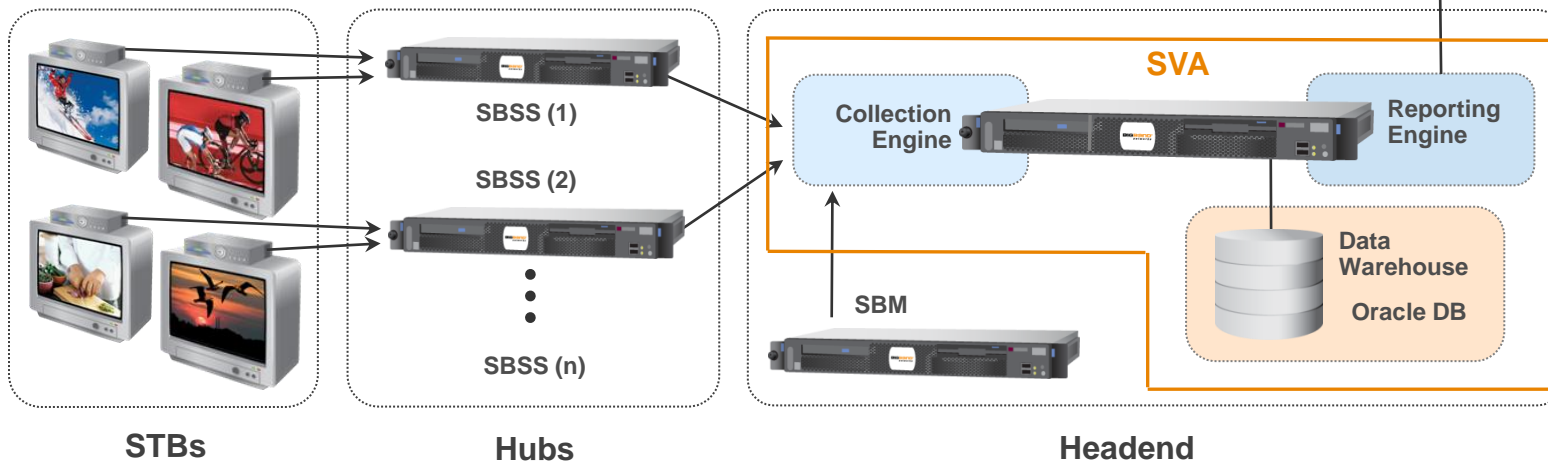
Meaningful Planning and Performance Reports

» Capacity Planning

- Broadcast and Switched channels viewership
- Number of active STBs per channel per Service Group
- Bandwidth utilization to SDV Service Groups
- What-if scenarios (Hub split, Additional QAM, New channels)

» Diagnostics

- History of channel change requests
- Blocking events and other tuning fails
- SDV servers response times

» Addressable Advertising

- STB profiling
- Advertising audience viewing trends
- National & regional advertising campaigns:
  - Bill by "number of viewers"
  - Validate tuners reached via SVA interface
  - Drive more local advertising value

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CCP Initiated New Channel for SG

Switch Request Execution Time Report

Start Time	Sat Mar 10 23:00:00 EST 2007
End Time	Thu Mar 15 23:50:00 EDT 2007
Service Groups	0

Switch Request Execution Time — chart of Percent Value vs. Execution Time (ms)
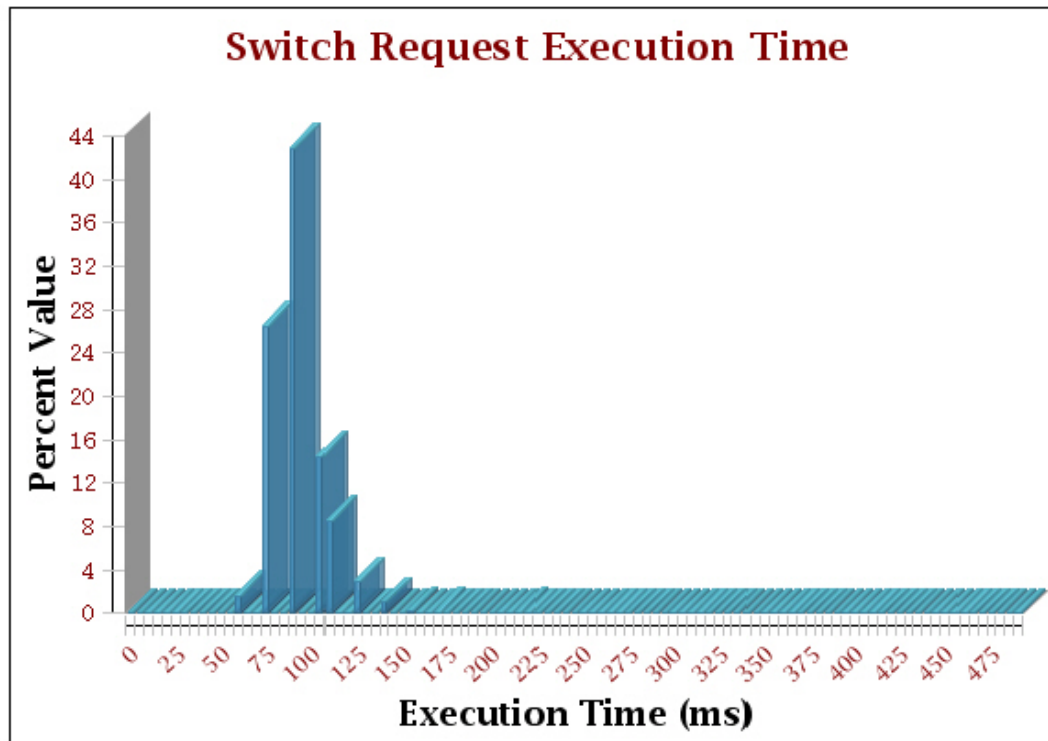
Analyzing all switching requests for the SDV Network into unwatched channels over a 5 day period

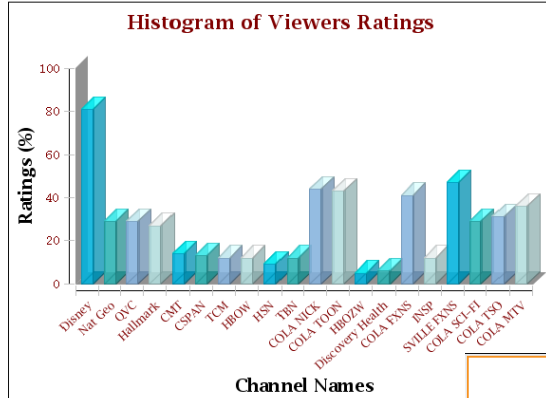*Max time between STB requesting channel change and STB receiving new channel within SG is ~ 100 ms*

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Snapshot – Channels Audience

Detailed visibility into program viewership:

- decide whether the program should be switched
- addressable advertising evaluation

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Snapshot – Subscriber Experience

Total Channel Blocking Events Report

Start Time	Sat Oct 21 00:00:00 EDT 2006
End Time	Mon Nov 20 00:00:00 EST 2006
Service Groups	1285, 1473, 1474, 1475, 1476, 1477, 1478, 1480, 5639, 5640, 5641, 5643, 5645, 6661, 6665, 6674, 10506

Total Channel Blocking Events

Service Group	Total Channel Blocking Events
1480	71
5640	52
1476	43
1474	41
5645	40
1478	34

Reports on SDV system health and end-user experience:

- Blocking when no BW available to map new program
- Tuning fails

Total Tuning Fails Report

Start Time	Tue Jul 18 13:00:00 EDT 2006
End Time	Wed Jul 19 13:10:00 EDT 2006
Service Groups	0

Total Tuning Fails

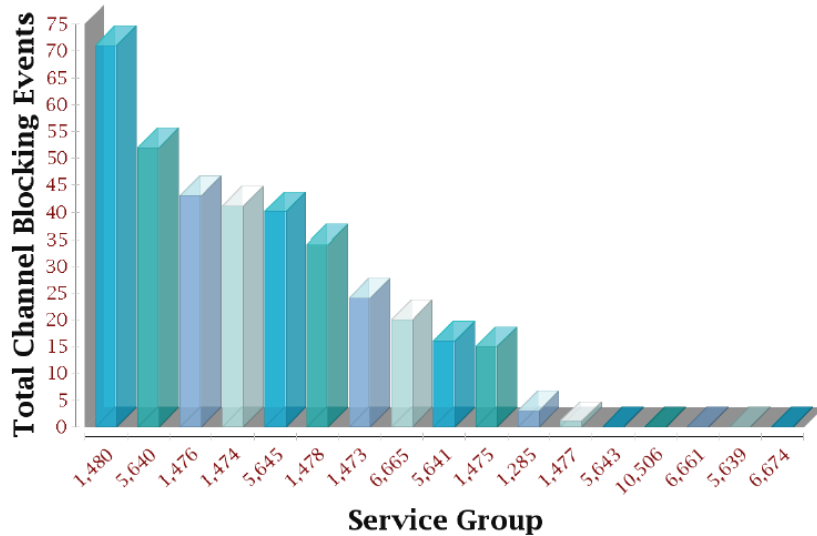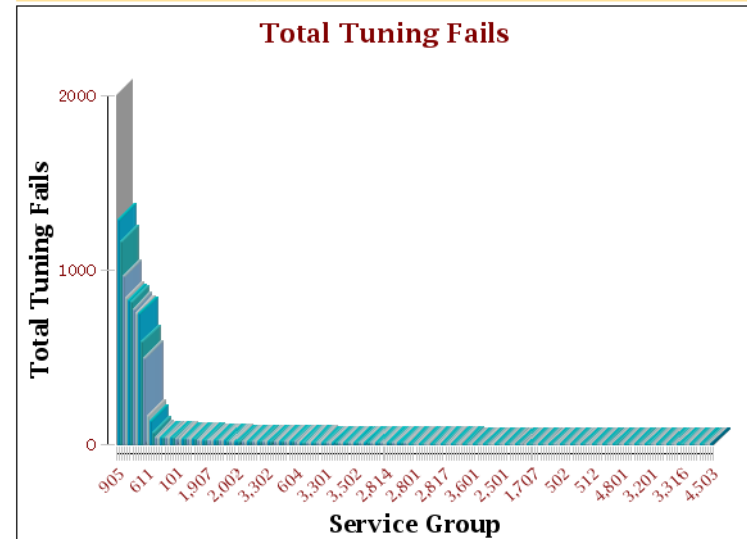| Service Group	Total Tuning Fails
905	1284
904	1161
908	961
909	838

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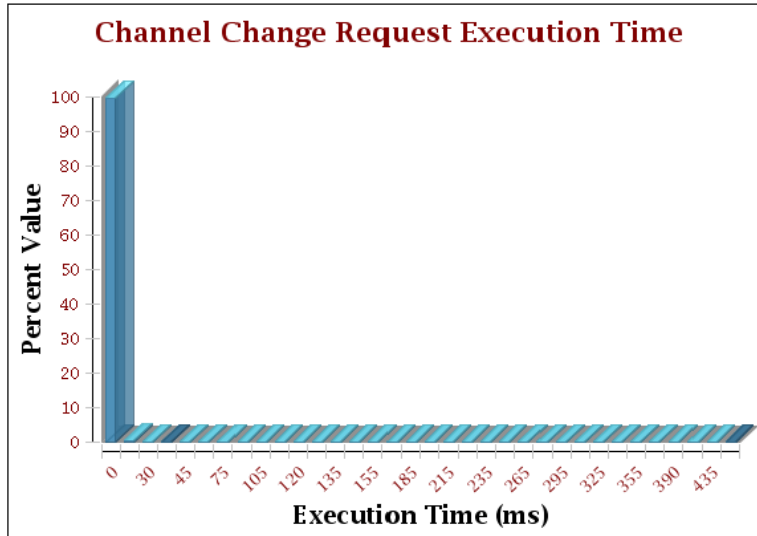
Snapshot – SWB Servers Health

Reports on SDV Server health and end-user experience:

- Time to tune to an existing program
- Time to map a new program

Channel Change Request Execution Time Report

| Start Time	Tue Jul 18 13:00:00 EDT 2006
End Time	Wed Jul 19 13:10:00 EDT 2006
Service Groups	0

Channel Change Request Execution Time

Execution Time Begin (ms)	Execution Time End (ms)	Total Channel Change Execution Count	Percent Value
0	5	4471477	99.449
15	20	19240	0.428
30	35	348	0.008

Switch Request Execution Time Report

Start Time	Tue Jul 18 13:00:00 EDT 2006
End Time	Wed Jul 19 13:10:00 EDT 2006
Service Groups	0

Switch Request Execution Time
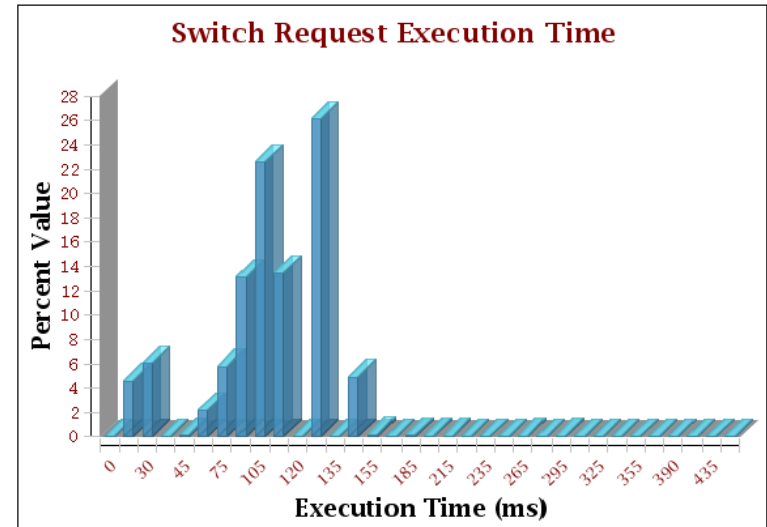
Execution Time Begin (ms)	Execution Time End (ms)	Total Switch Request Count	Percent Value
0	5	5	0.042
15	20	548	4.602
30	35	721	6.055

BIGBand networks

Holistic insight to viewership and resource utilization - vZualizer

» Tool to look across IP & RF applications

» Provide "what-if" scenarios for planning

Offline Analysis

vZualizer

Application Managers

Resource Managers

Advertising

Policy

Optimization

External Session Mgr. Interfaces

Edge Resource Interfaces

CVEx Core

Management Plane
VMS, SVA, vZualizer, etc.

QAMs

Broadcast

Shared Bandwidth SuperGroup™

BIGBAND networks
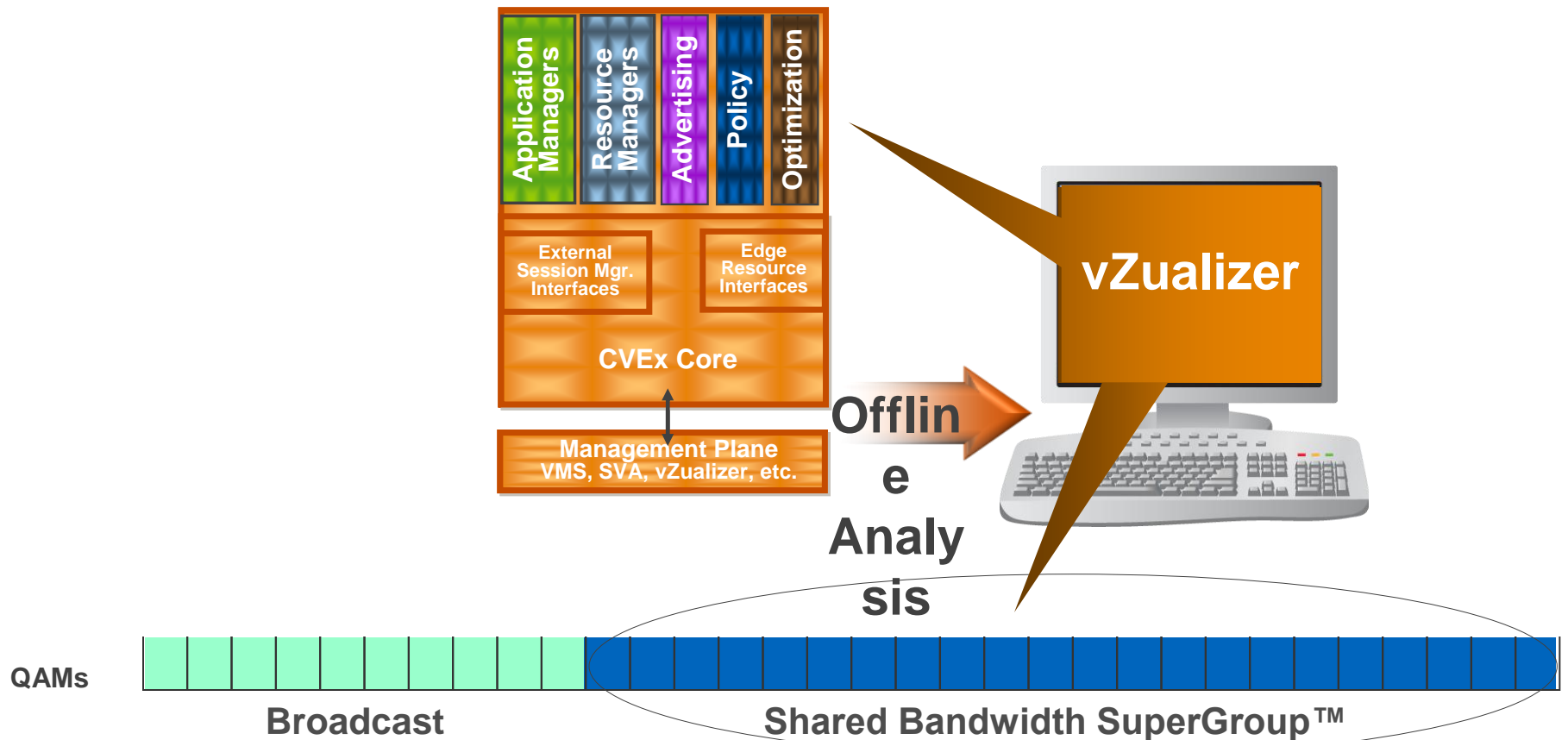
vZualizer value – Network Capacity Planning

» How am I doing on my service delivery?

- How much blocking is occurring in FVOD, SVOD, TSTV, SDV?
- What revenue opportunities am I losing due to blocking?
- When will I have to split service groups?
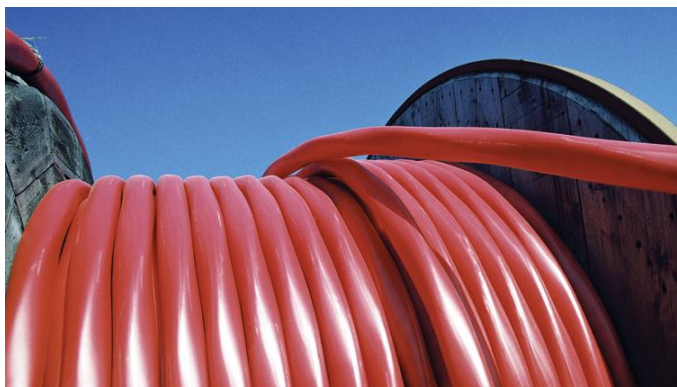
» What should my next step be?

- What channels / services should I put on SDV?
- What Service Groups should I split?

» What happens if I…

- Introduce HD versions for the following SD channels?
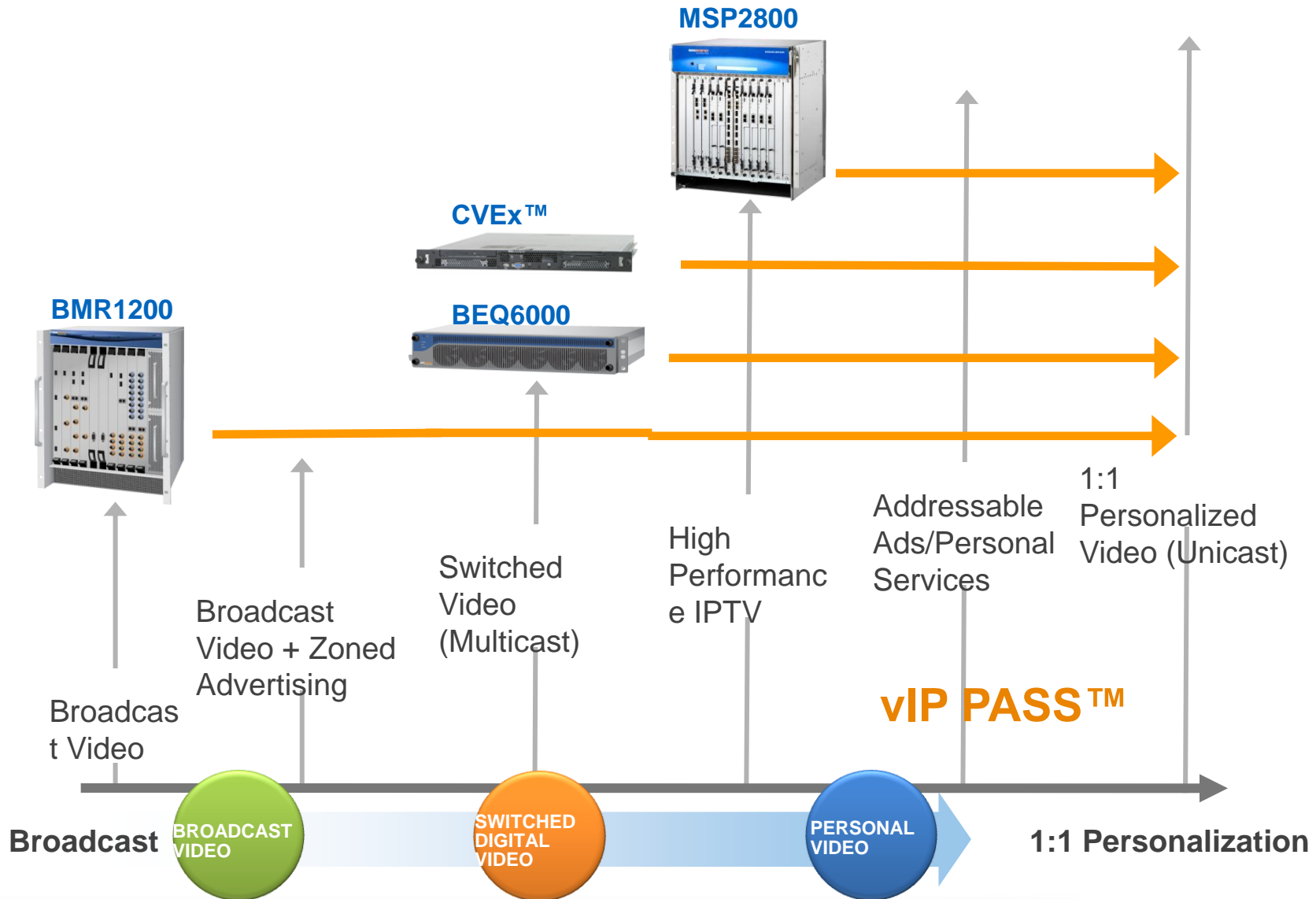- Move to Linear Unicast?
  - What channels should I choose first for unicast?

BIGBAND networks

Future Applications

Future SDV Needs

» 16 QAMs per SG installation today

- Moving to 24 QAMs per SG over the next 12 - 18 months
- Some cable operators are aggressively moving to 16 QAMs/SG right now, with more later this year

» Tools for better bandwidth management scenarios

- HDs in SDV or Broadcast? Both!
- Best means of preserving overall video quality to the end user

» How to add "over the top" or Internet Video content to HFC network

- Via the HSD path or by-pass the CMTS with video?
- M-CMTS Core ($1750/QAM) versus the SDV QAM (<$200/QAM)

» IPTV over SDV as the logical path, and manage local QAM resources

Platforms that Support the Network Evolution

MSP2800

CVEx™

BMR1200

BEQ6000

1:1 Personalized Video (Unicast)

Addressable Ads/Personal Services

High Performance IPTV

Switched Video (Multicast)

Broadcast Video + Zoned Advertising

Broadcast Video

vIP PASS™

Broadcast

BROADCAST VIDEO

SWITCHED DIGITAL VIDEO

PERSONAL VIDEO

1:1 Personalization

CVEx Unifies the Video Control Plane

BMR

Linear Video

On-Demand Video

MSP 2000

QAMs

Session Control

Session control

VOD SM

Internet

Resource requests

New Apps

CVEx

Application Manager
Resource Managers
Advertising
Policy
Optimization

External Session Mgr. Interfaces
Edge Resource Interfaces

CVEx Core

Service requests

SCTE 130

Advanced Advertising System

Switched Digital Video

BMR-1200A

VoD

CVEx Manager

CVEx Session Manager

BEQ-6000A

MPEG

RF Combining

MPEG-2 Set Top

BIGBAND networks

vIP Pass

BMR-1200A

VoD

CVEx Manager

CVEx Session Manager

DOCSIS Provisioning

BEQ-6000A

BEQ-6000A

CMTS

MPEG

IP

RF Combining

MPEG-2 Set Top

Game Console

IPTV Set Top

DOCSIS 3.0
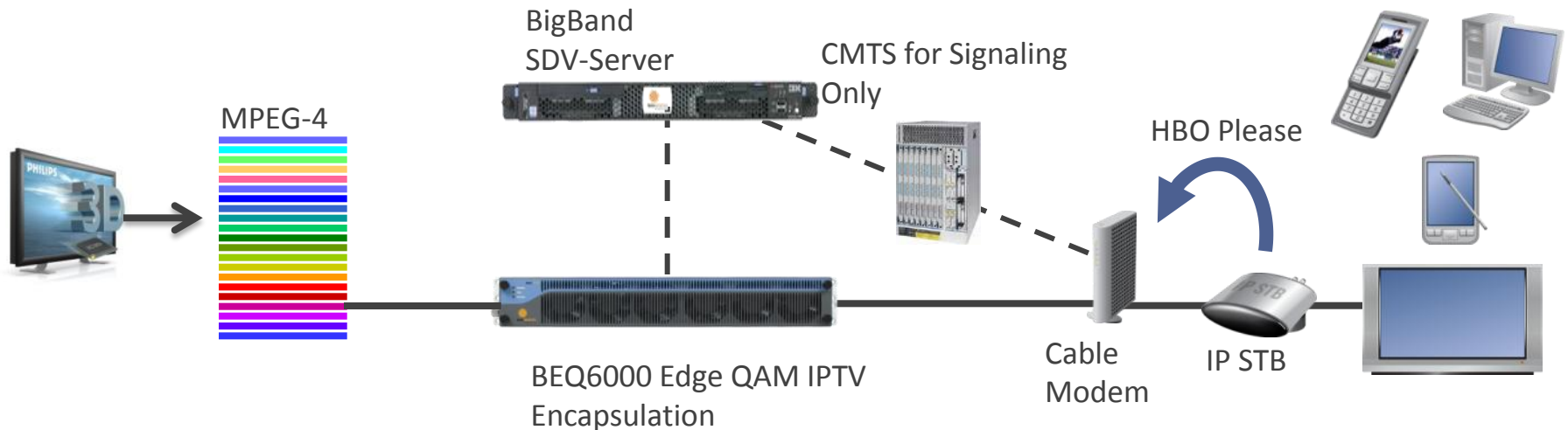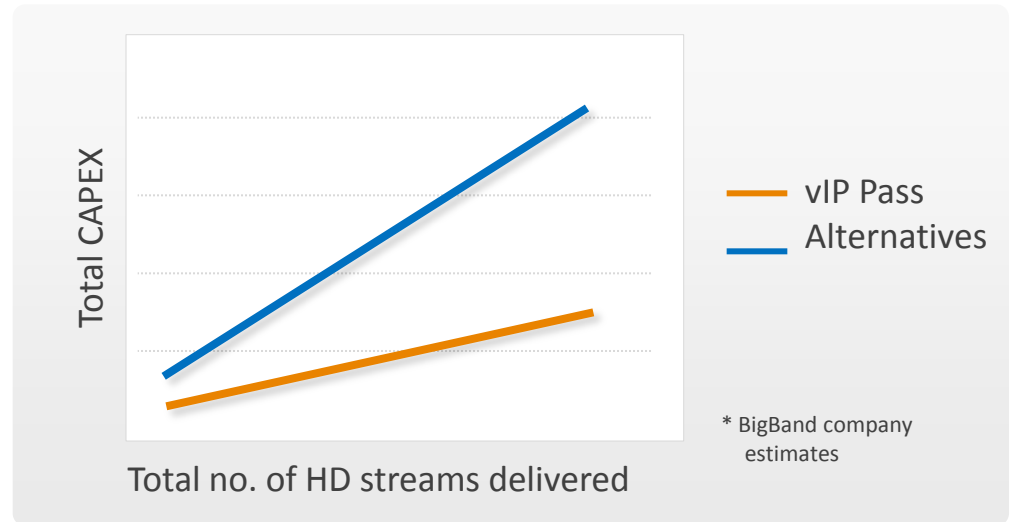Residential Gateway

dlna

Desktop PC

Laptop

iPad

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Video over IP and Multi-Screen Delivery

» Delivering video to more screens in the home

» Delivering them more cost effectively than traditional approaches

Total CAPEX

— vIP Pass
— Alternatives

* BigBand company estimates

Total no. of HD streams delivered

MPEG-4

BigBand SDV-Server

CMTS for Signaling Only

HBO Please

BEQ6000 Edge QAM IPTV Encapsulation

Cable Modem

IP STB

BIGBAND networks

Ultra Dense QAM Platform

38 Legacy
4:1/8:1 QAMs

320 QAMs/blade
3640 QAMs/chassis

4,300 W
14,670 BTU-h

16,031 W
27,383BTU-h

Simplified Operations + Less Space + Less Power
Lower Total Cost of Ownership

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Micro-Targeting or Switched Unicast

Viewers see same programs but different ads

Clamping Platform

Switching Platform

Mgmt Server

Ad Server

Subscriber #1

Subscriber #2

Subscriber #3
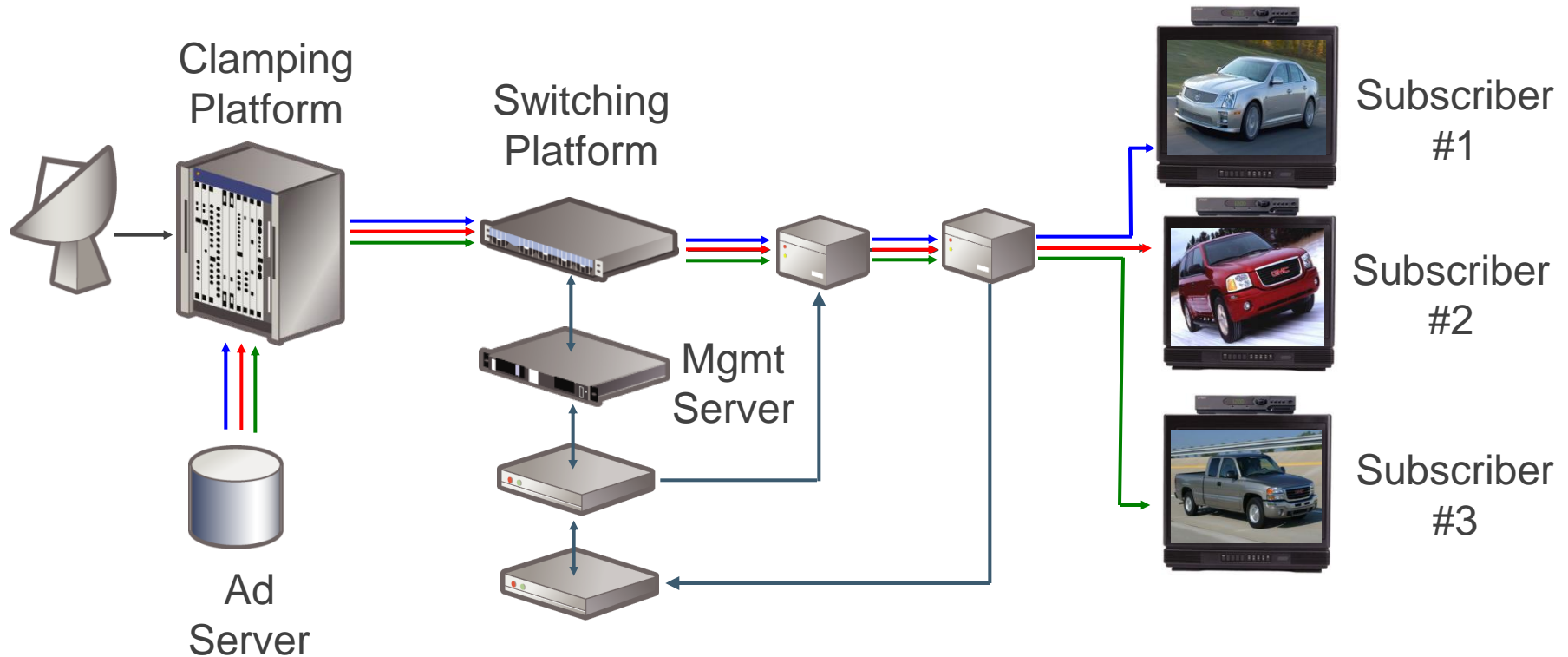
Addressability increases value of each impression

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Questions ??