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Deploying IP video over DOCSIS

BRKSPV-1126

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Cable Access Business Unit

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Agenda

- IP Video Use Cases
- Delivering IP Video over DOCSIS 3.0 Networks
- Admission Control and QoS
- Optimizing for Adaptive Bit Rate Video
- Bandwidth requirements for IP Video

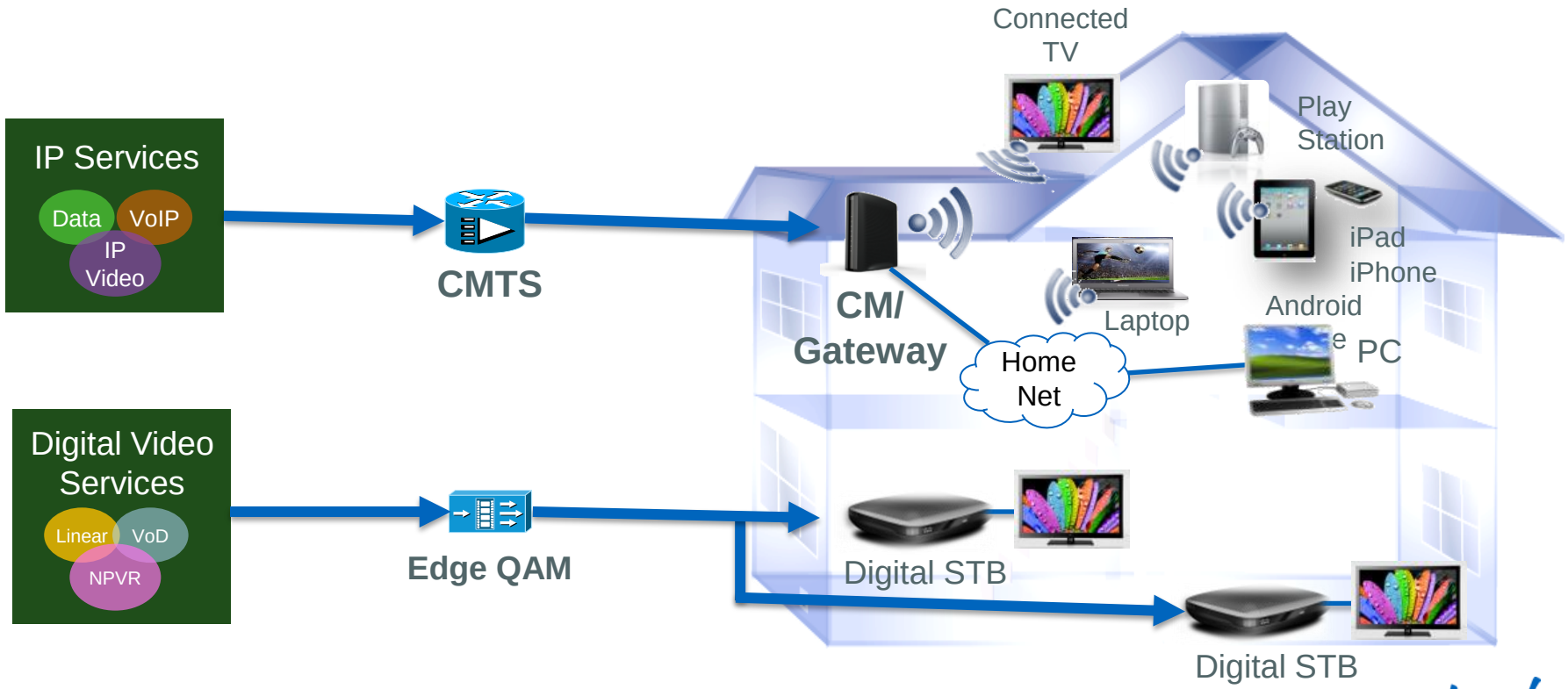



IP Video Use Cases

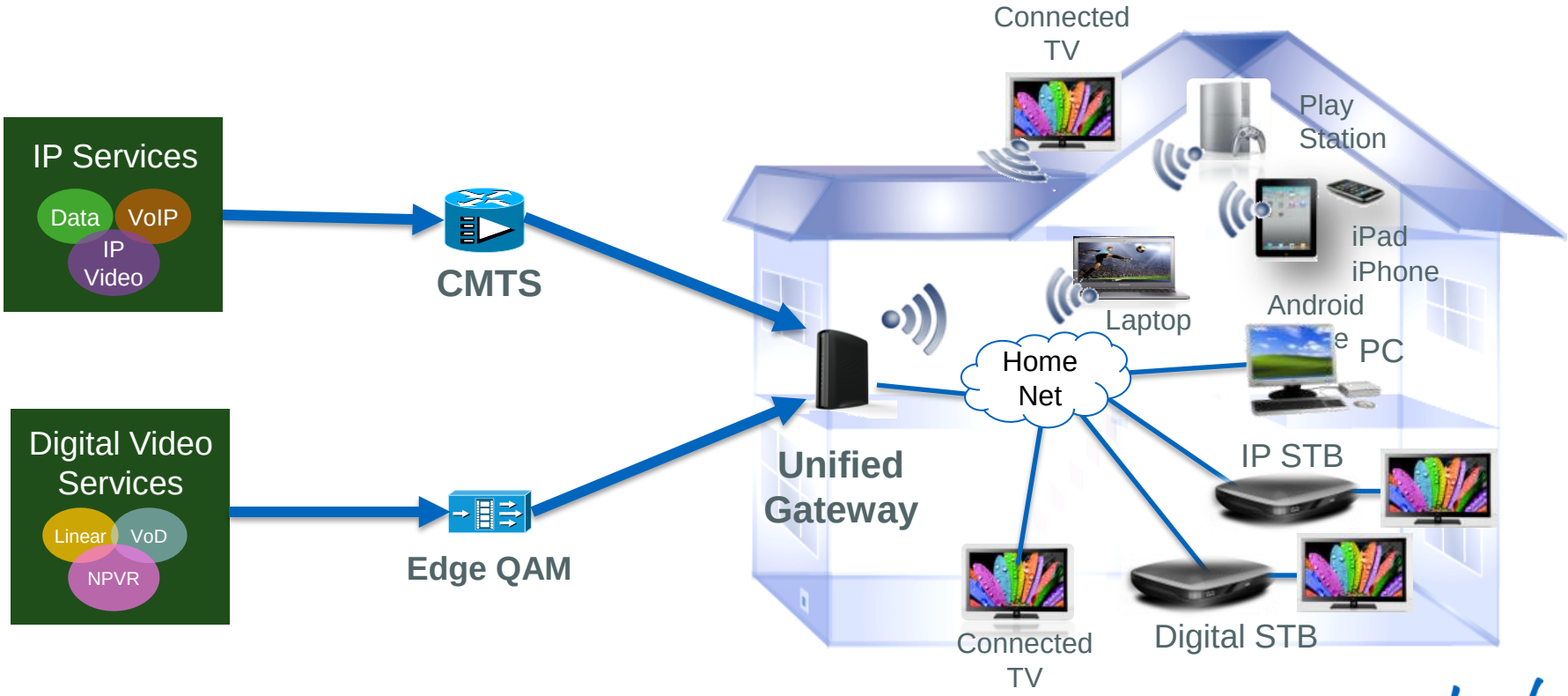
IP Video Use Cases

- TV Everywhere
- Video Gateway
- Analog reclamation with IP STB
- Full-service IPTV

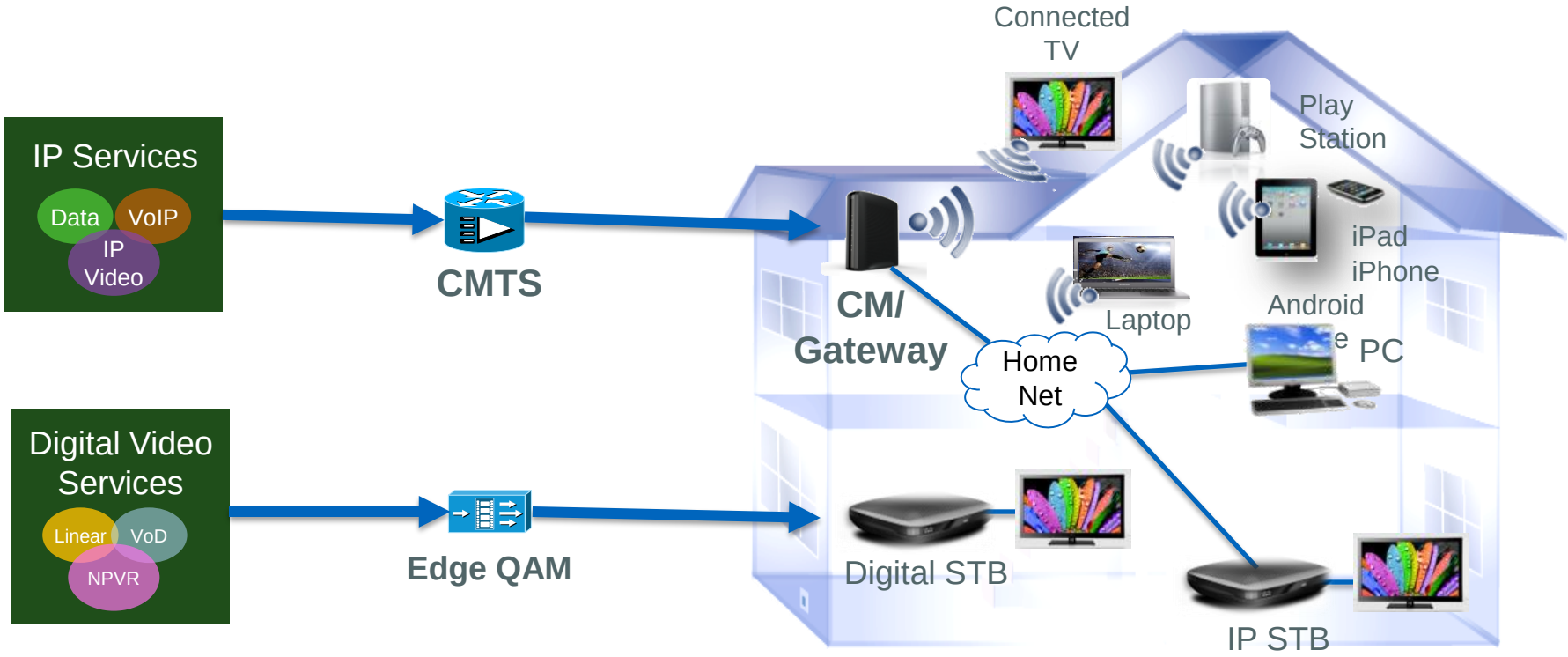
IP Video Use Case #1: TV Everywhere



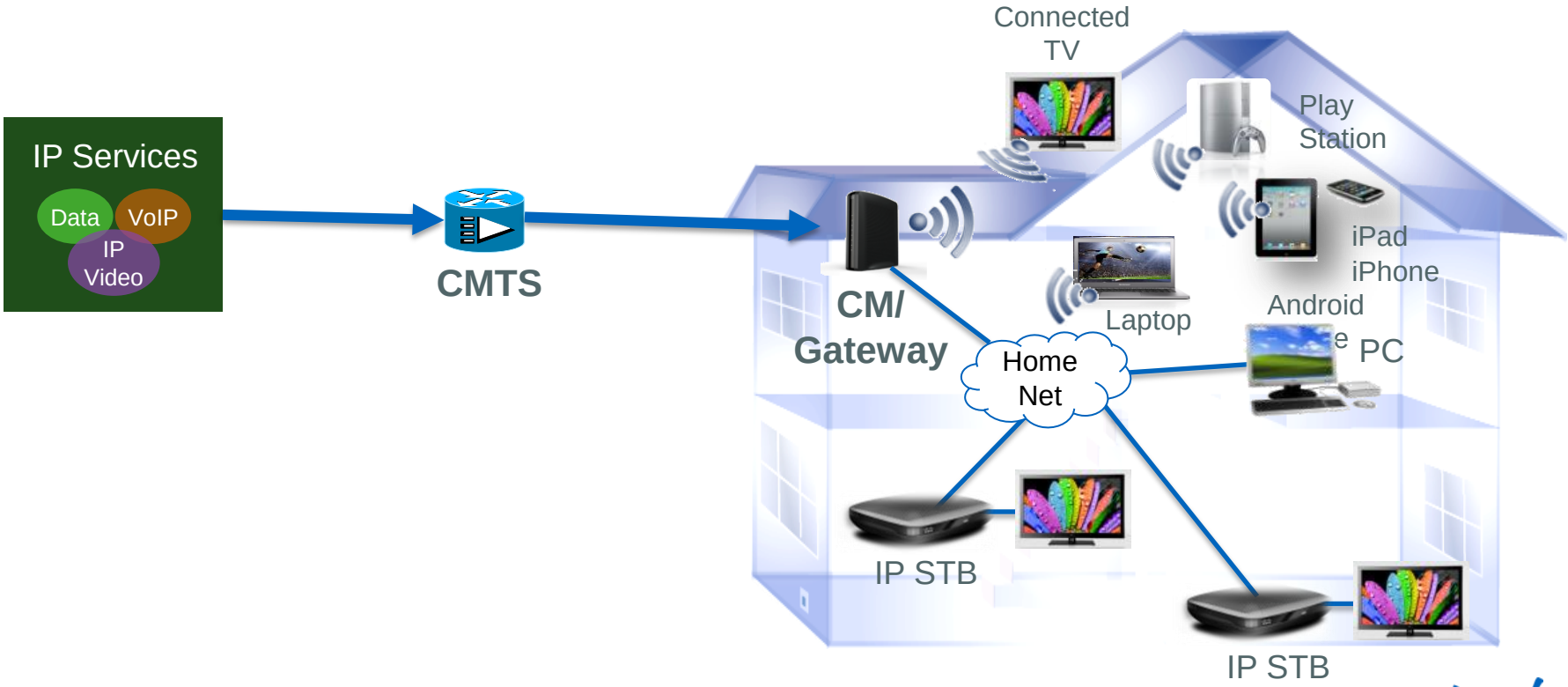
IP Video Use Case #2: Video Gateway



IP Video Use Case #3: Analog Reclamation

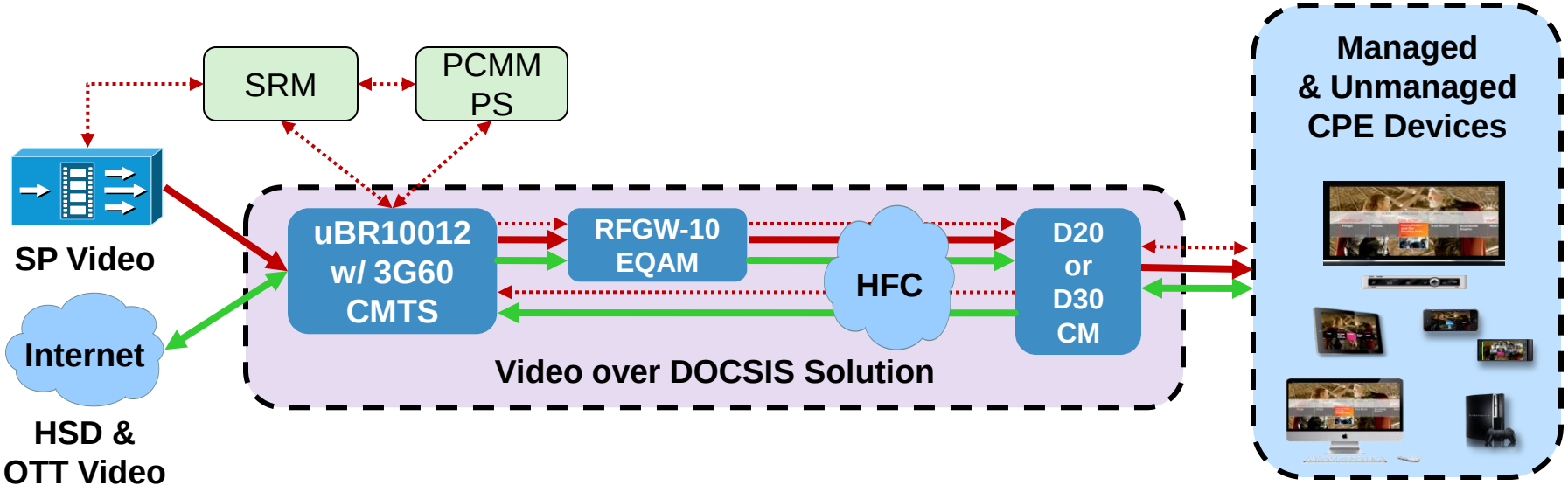


IP Video Use Case #4: Full-service IPTV



Delivering IP Video over DOCSIS 3.0 Networks

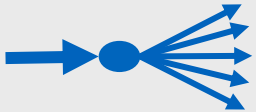
Cisco Video over DOCSIS 3.0 Solution



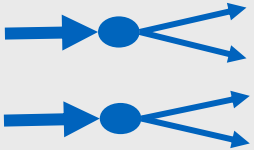
Cisco Video over DOCSIS 3.0 Solution

Delivery Method

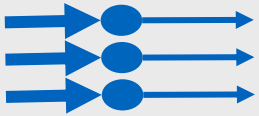
Broadcast



Switched

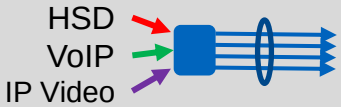


Unicast

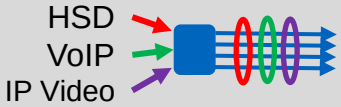


Service Separation

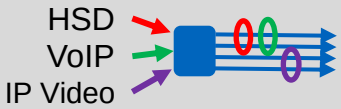
Shared



Soft Partition

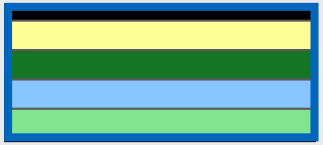


Hard Partition

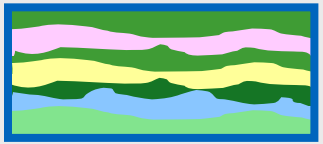


Content Format

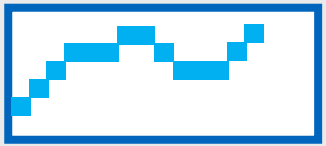
CBR



VBR

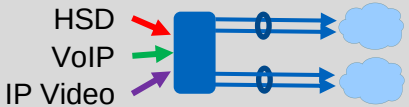


ABR

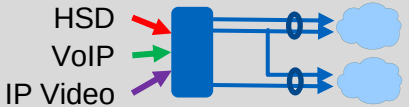


DOCSIS Topology

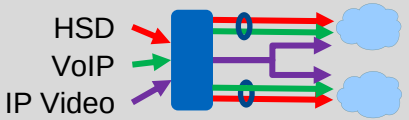
1:1



DOCSIS Overlay



IP Video Overlay



Bandwidth Allocation

CIR

Best Effort

Dynamic Bandwidth Sharing

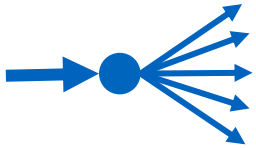
Dynamic Load Balancing

Fairness

PCMM/IGMP

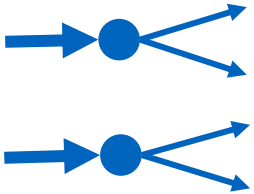
IP Video Delivery Methods

Broadcast



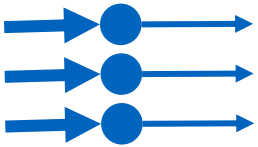
- Linear TV delivered to all subs all the time (independent of viewership)
- Lowest CMTS DS capacity/cost; typically requires more spectrum than switched
- Most suitable for large number of subs and popular programming

Switched



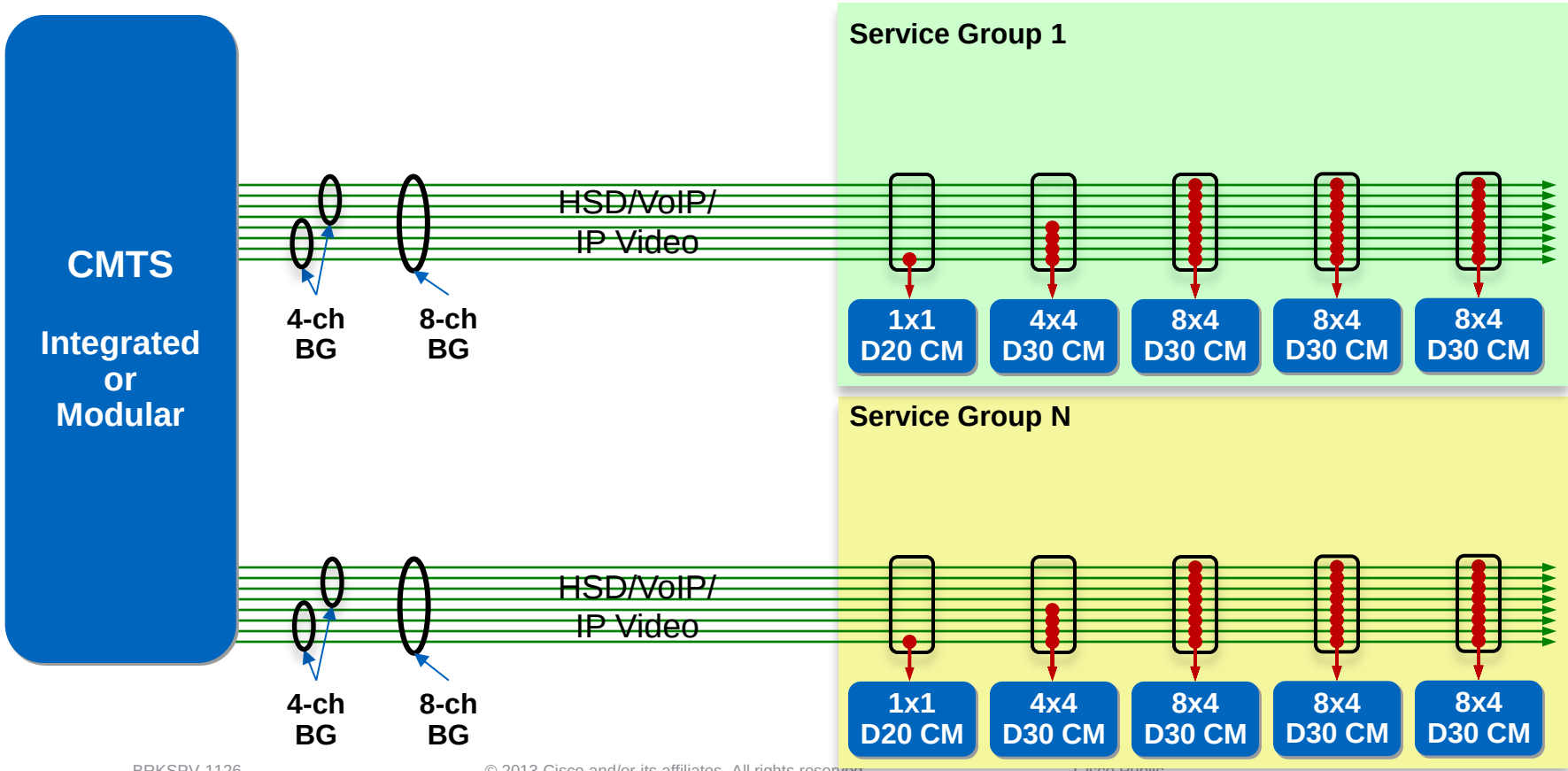
- Linear TV delivered only to active viewers
- Most efficient use of spectrum; higher CMTS DS capacity/cost than broadcast
- Network sizing based on viewership statistics

Unicast

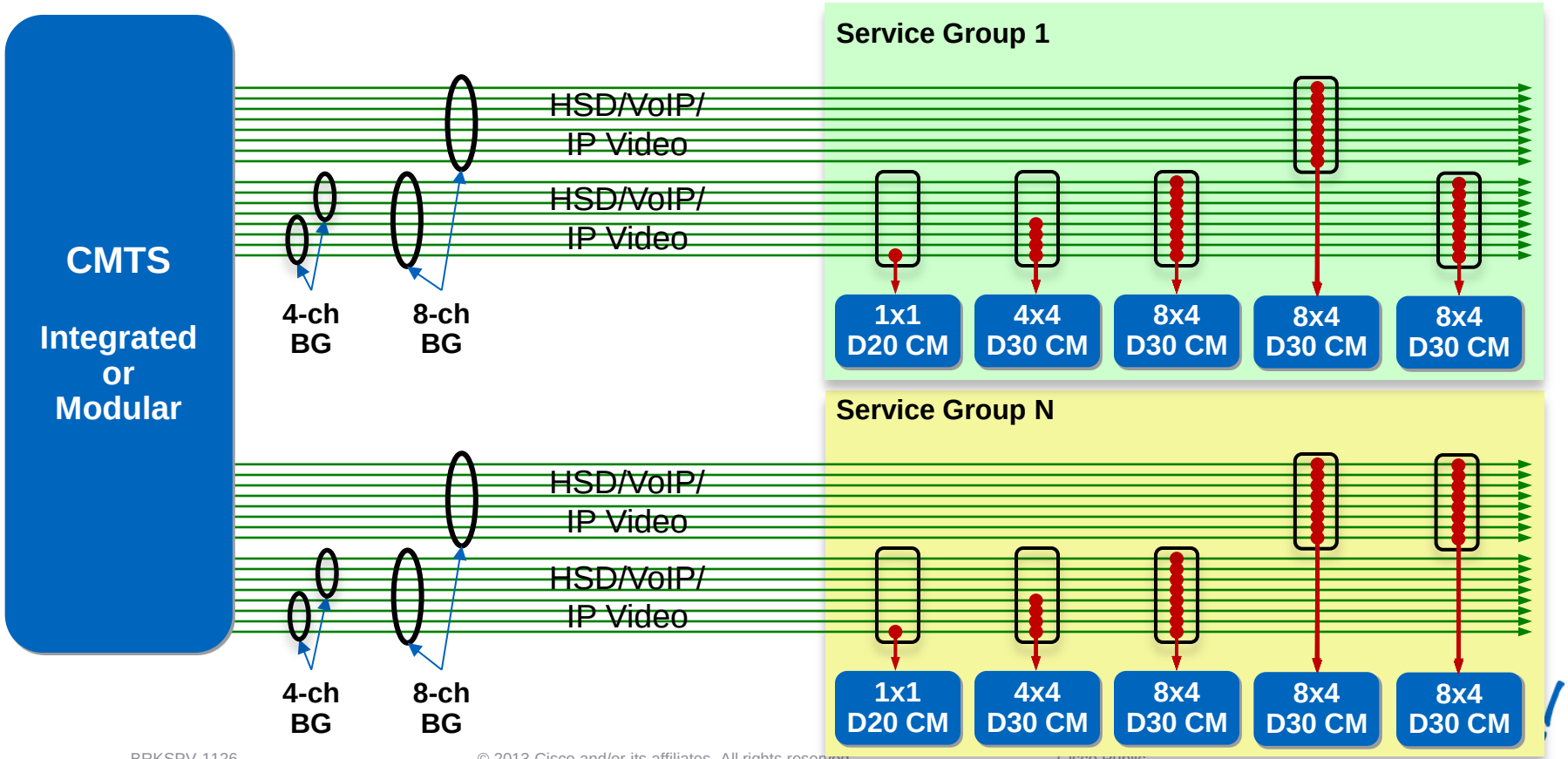


- Personalized linear TV and VoD delivered to each sub
- Highest CMTS DS capacity/cost and spectrum requirement for linear TV
- Alleviates multicast requirements on end-to-end IP Video system

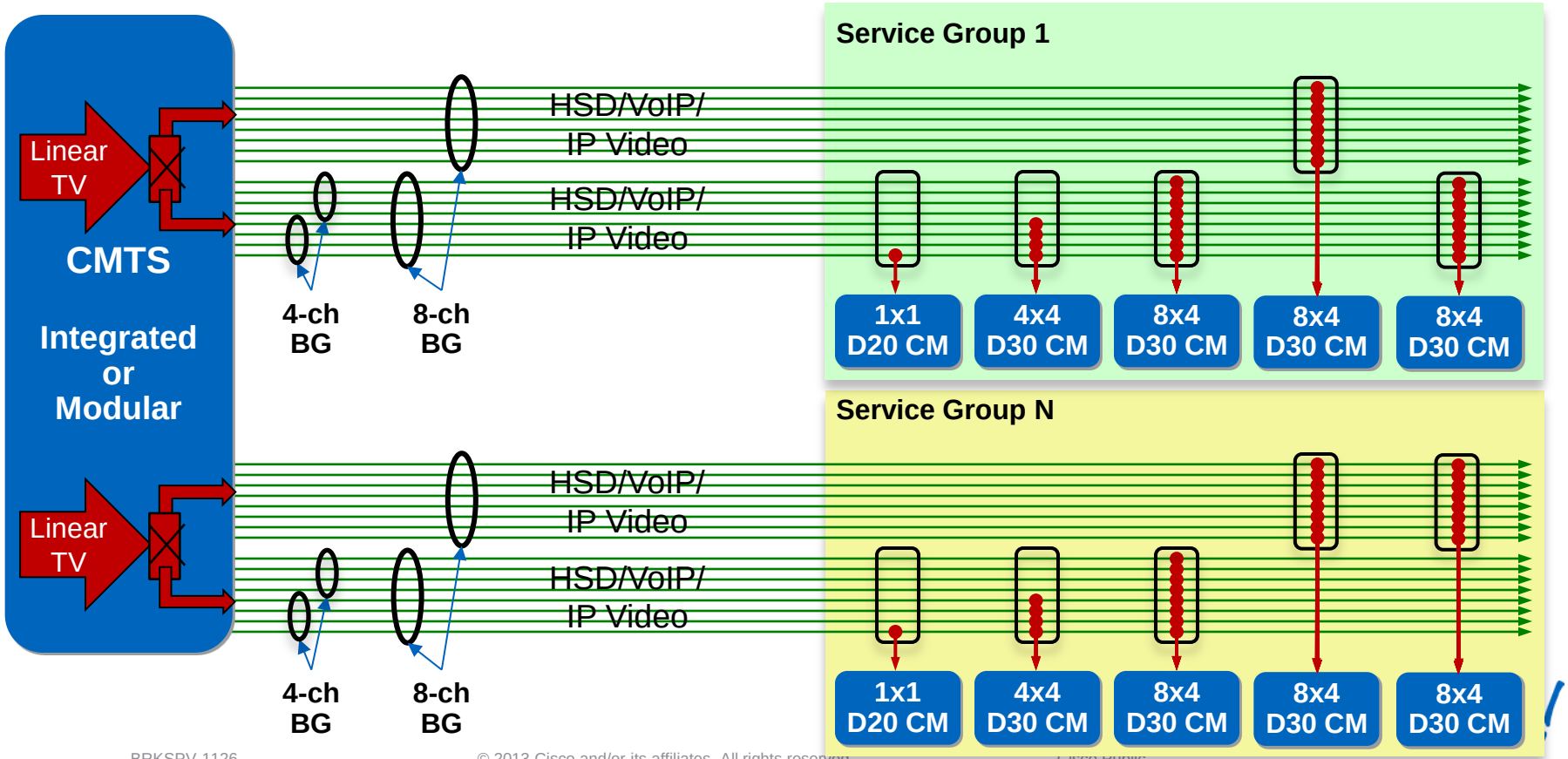
Delivery of IP Services over DOCSIS



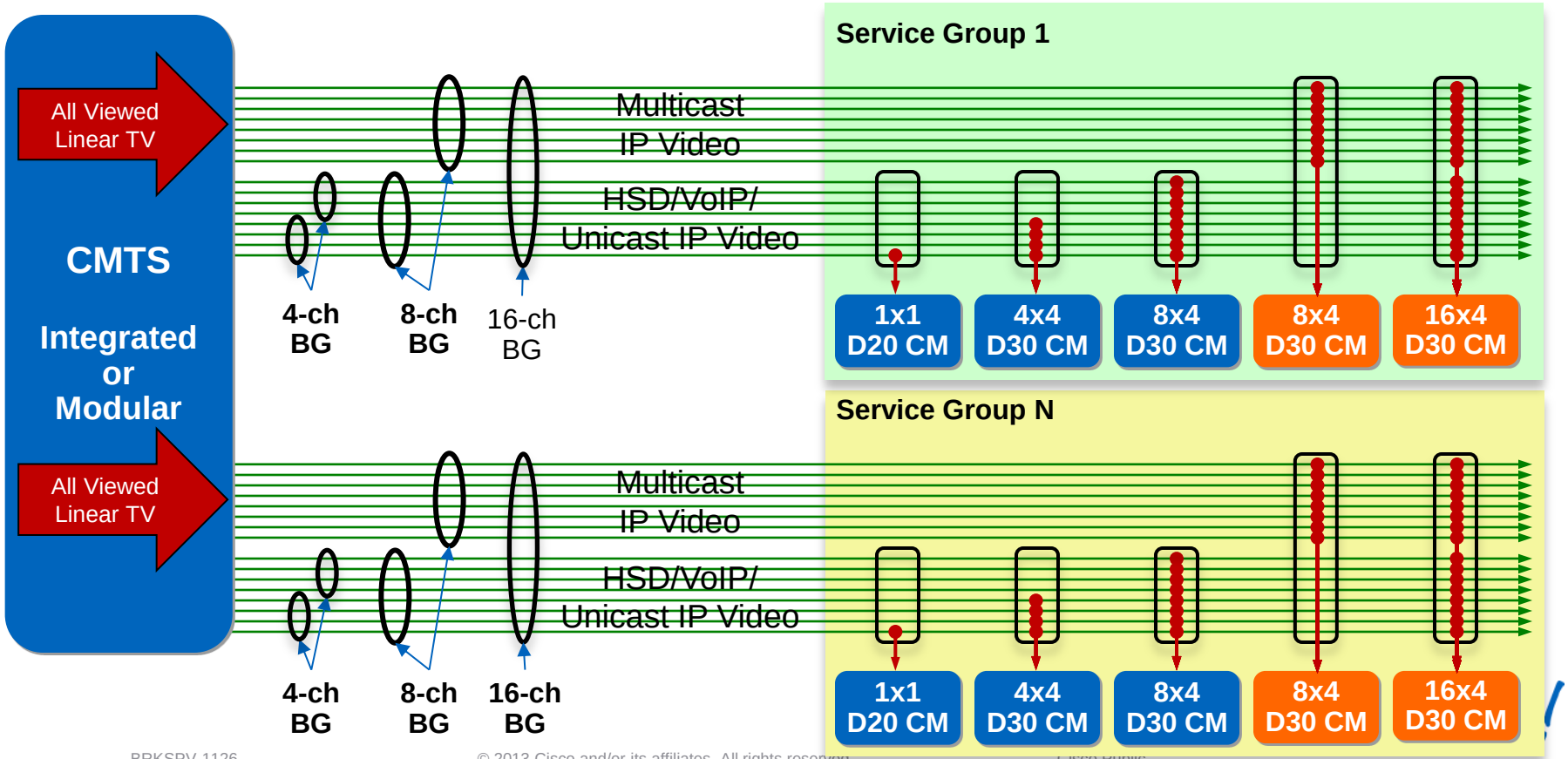
Delivery of IP Services over DOCSIS



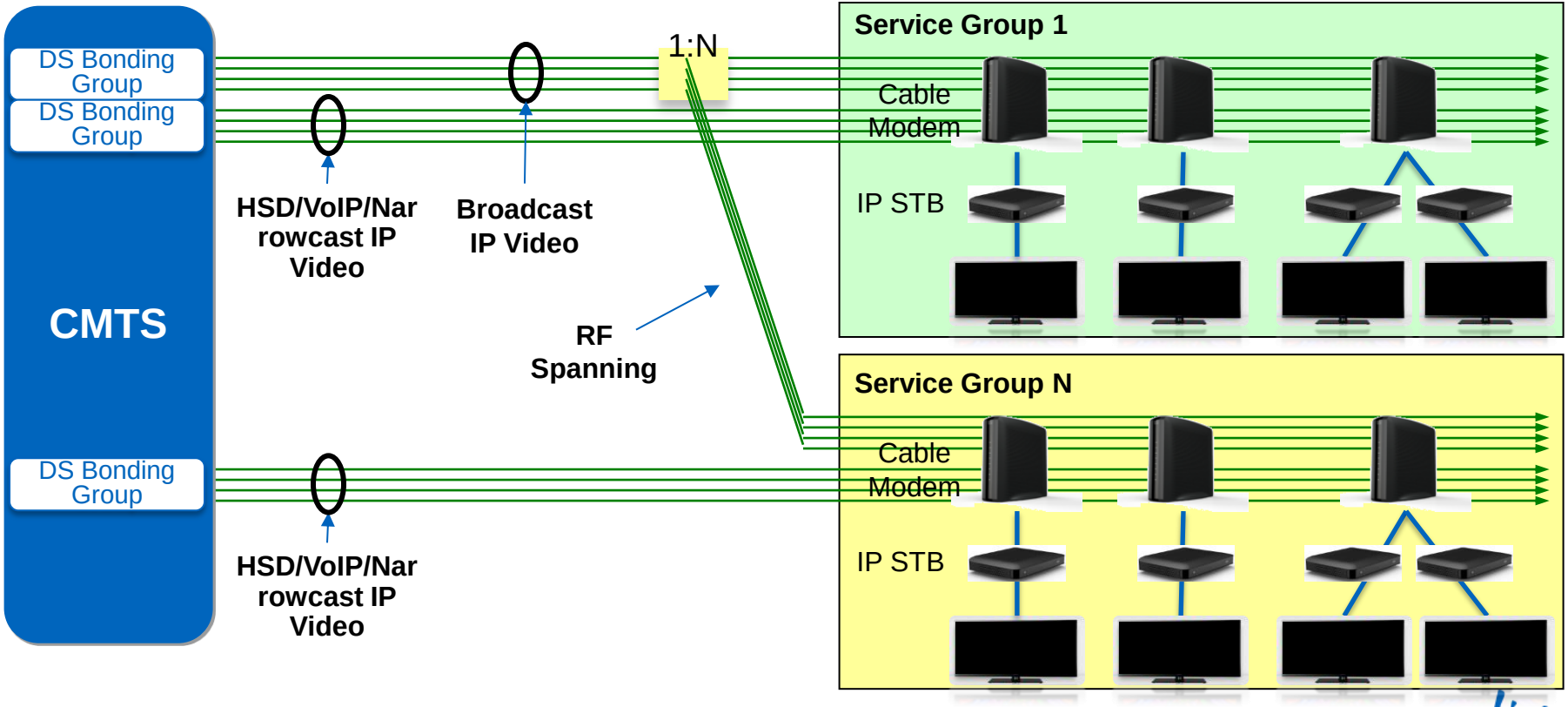
Delivery of IP Services over DOCSIS



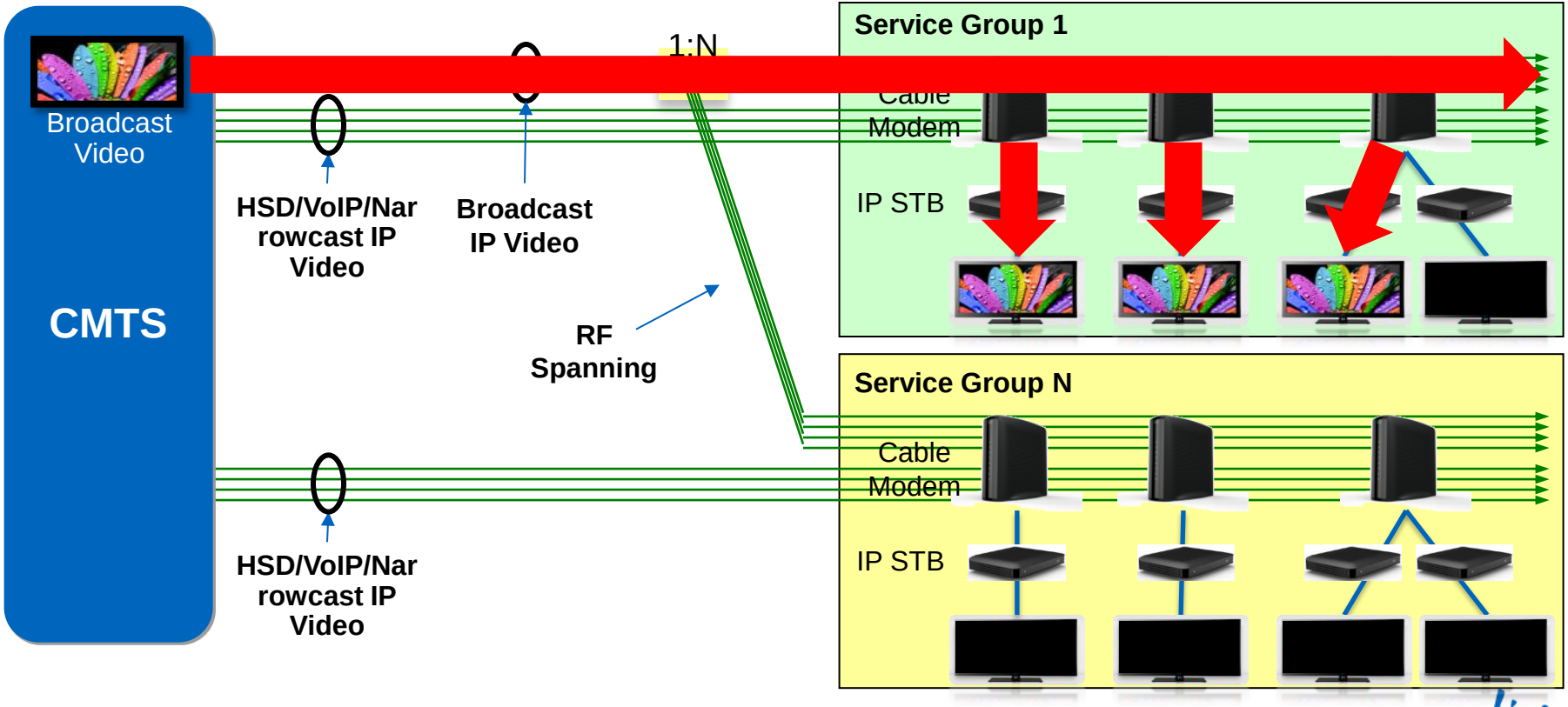
Delivery of IP Services over DOCSIS



Delivering IP Video via Broadcast



Delivering IP Video via Broadcast



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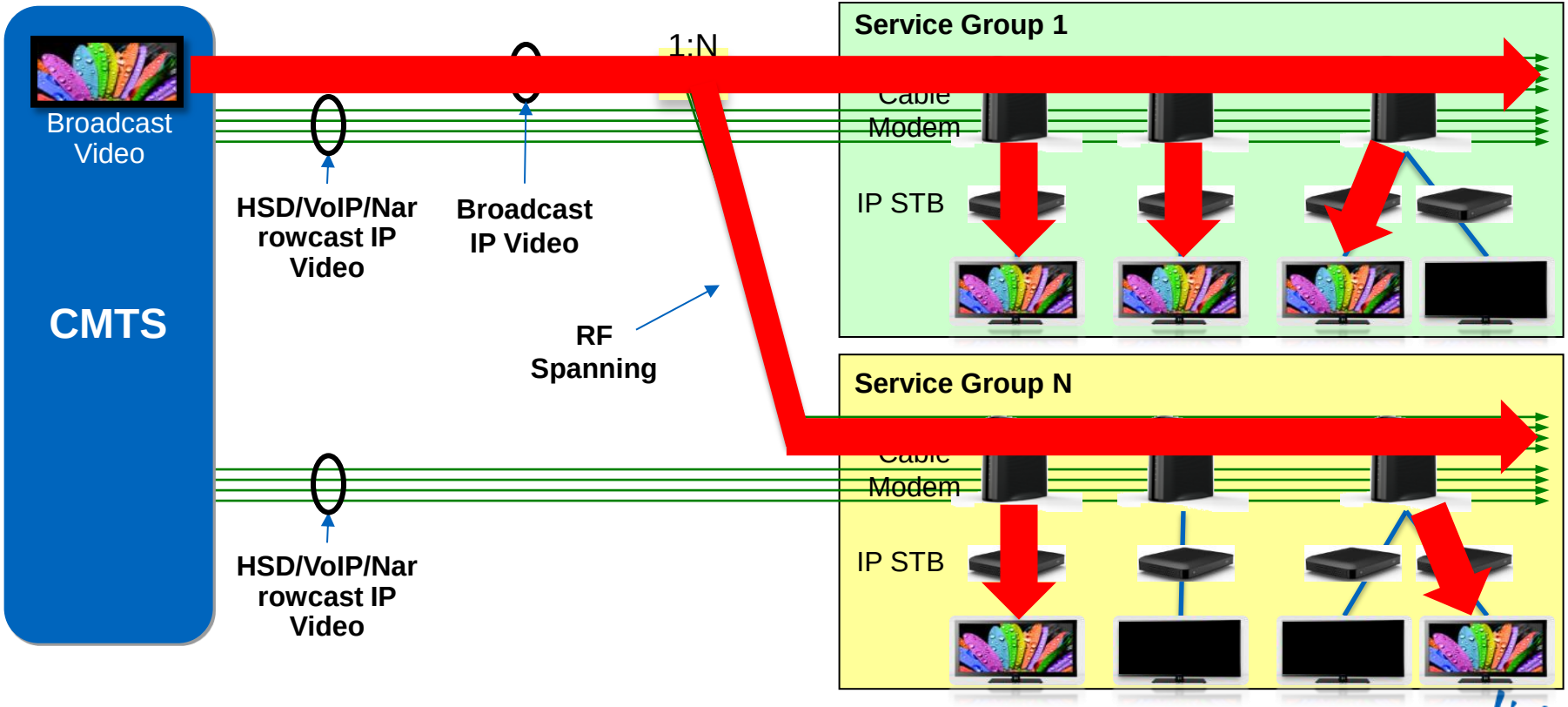
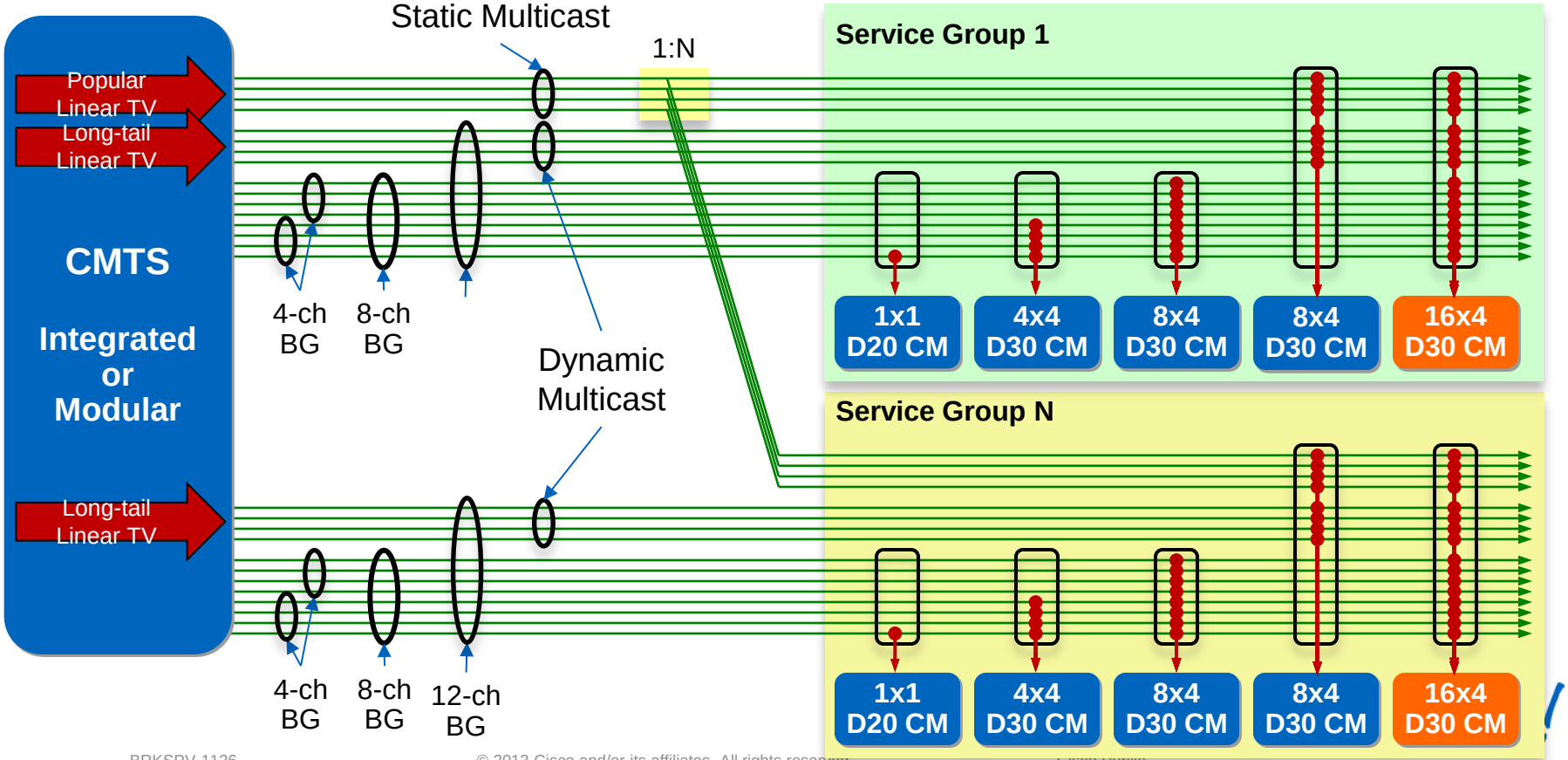
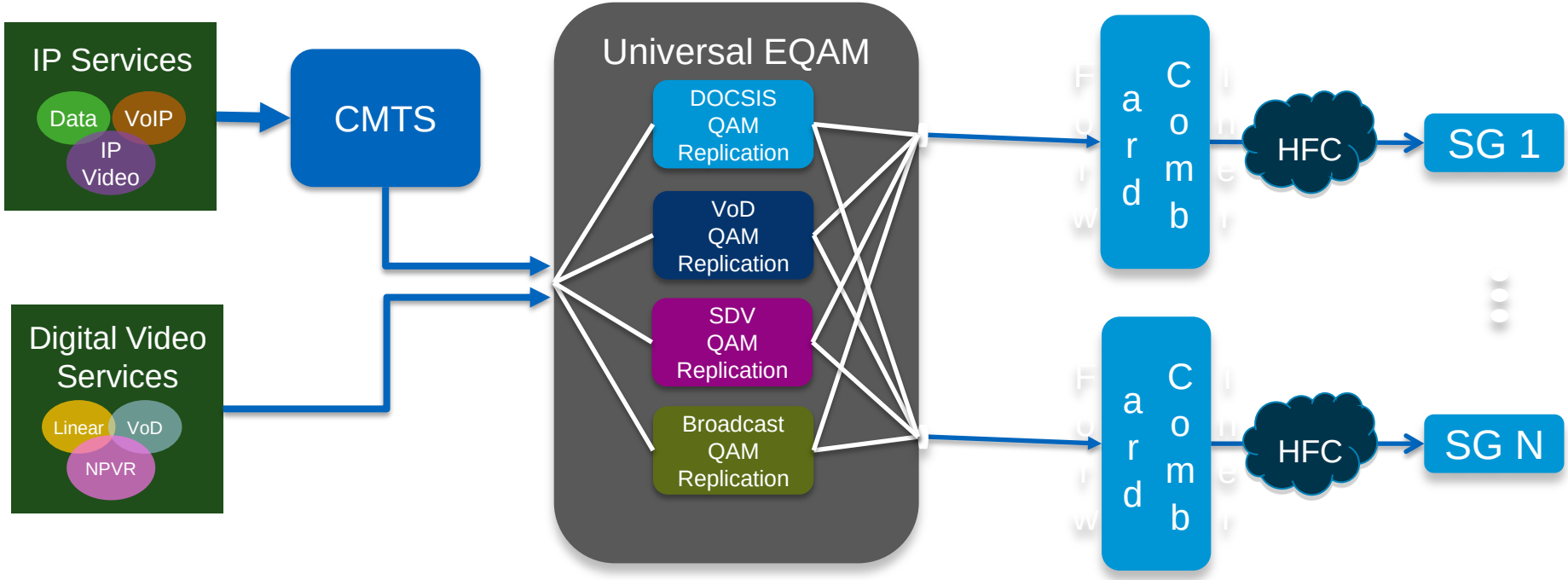


Broadcast & Switched Delivery of Linear TV



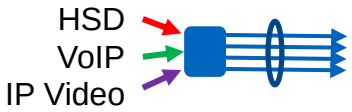
CCAP with Modular Headend Architecture (MHA-CCAP)



Maximize ROI, reduce OPEX, optimize UEQAM utilization, simplify combining networks

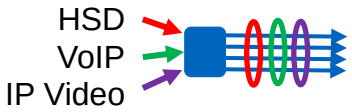
Service Separation

Shared



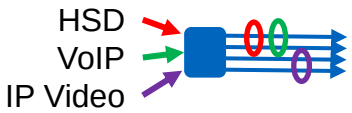
- All services share bandwidth dynamically
- Application-based admission control can reserve different amounts of bandwidth for CIR flows of different applications (SFAC)
- No guarantees for aggregate bandwidth of each service's best effort traffic

Soft Partition



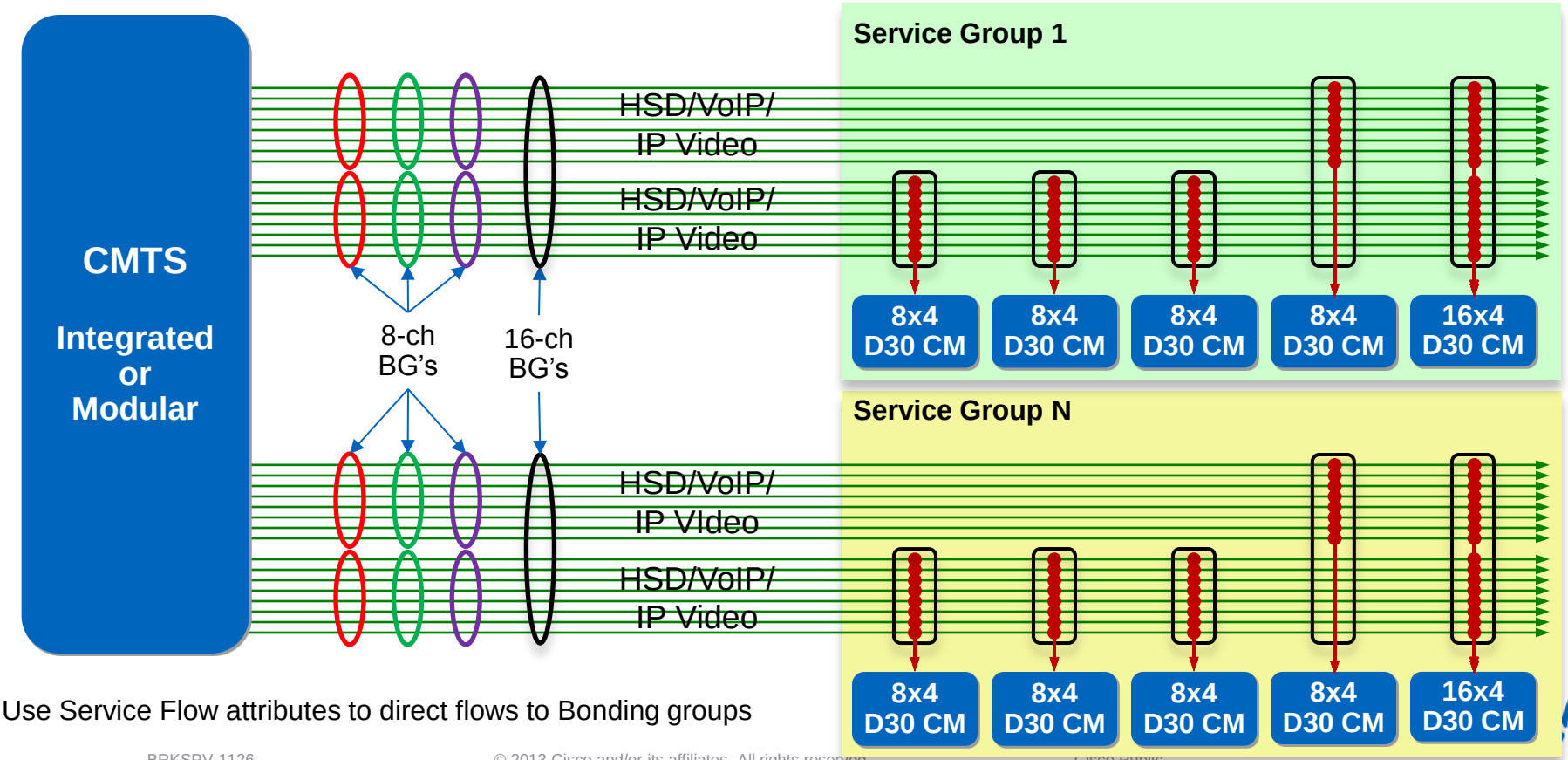
- Overlapping BGs for different services across same set of DSs
- Ability to provide guaranteed amount of bandwidth per service even for best effort traffic
- Dynamic Bandwidth Sharing capability. Any unused bandwidth from one service's BG is made available for another service's BG

Hard Partition



- RF channels are dedicated for specific services
- No dynamic bandwidth sharing.
- Unused bandwidth from one service cannot be used by another service

Overlapping Bonding Groups



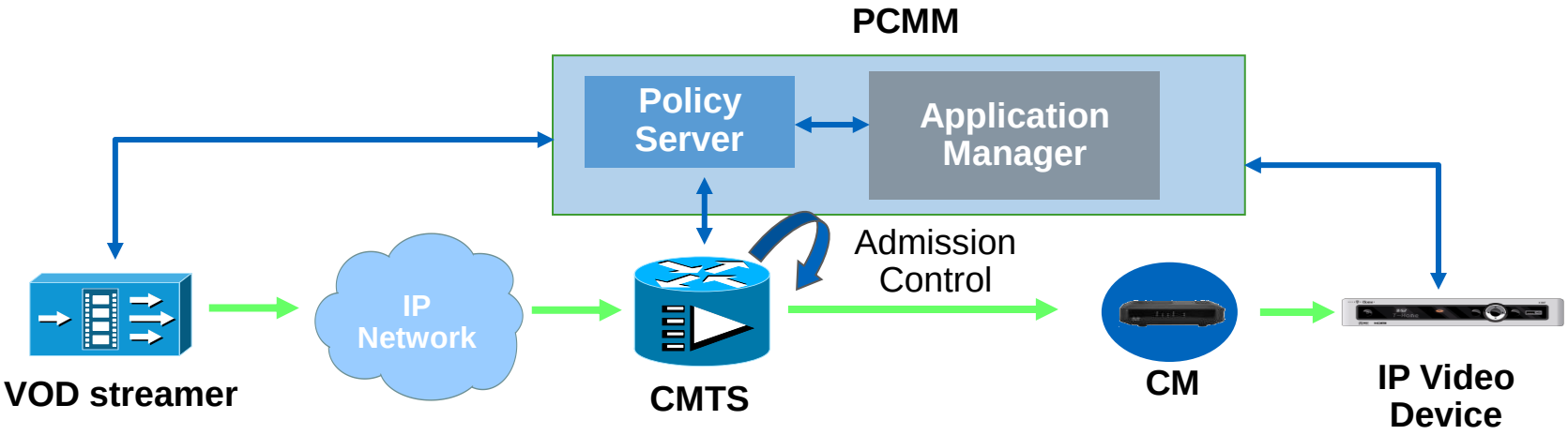
Use Service Flow attributes to direct flows to Bonding groups

Traffic Steering

- **Map flows to DOCSIS Service Flows**
  - Service Flows can be static or dynamic
  - Static Service Flows can use DSCP or Video Server IP address for classifier
  - MQoS used to assign Service Flow attributes per (S,G)
  - Dynamic Service Flow classifier signaled at session setup time
- **Steer DOCSIS Service Flows to Bonding Groups via SF attributes**
  - Attributes configured on Bonding Groups
- **Single IP flow per DOCSIS Service Flow**
  - Fine grained control
  - Protects flows from other misbehaving flows behind same CM
  - Typically used with dynamic Service Flows
- **Multiple IP flows per DOCSIS Service Flow**
  - Lack of fine control per flow
  - Typically used with static Service Flows

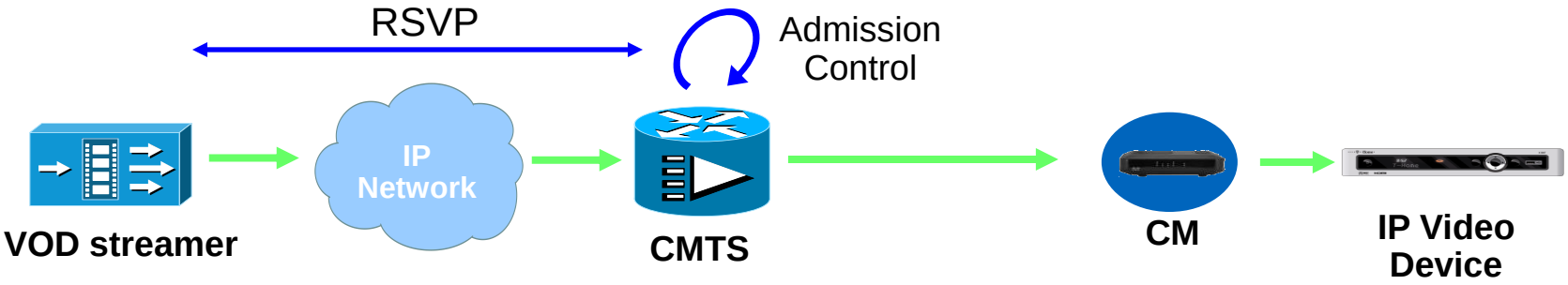
Admission Control and QoS

Admission Control and QoS
VoD: PCMM



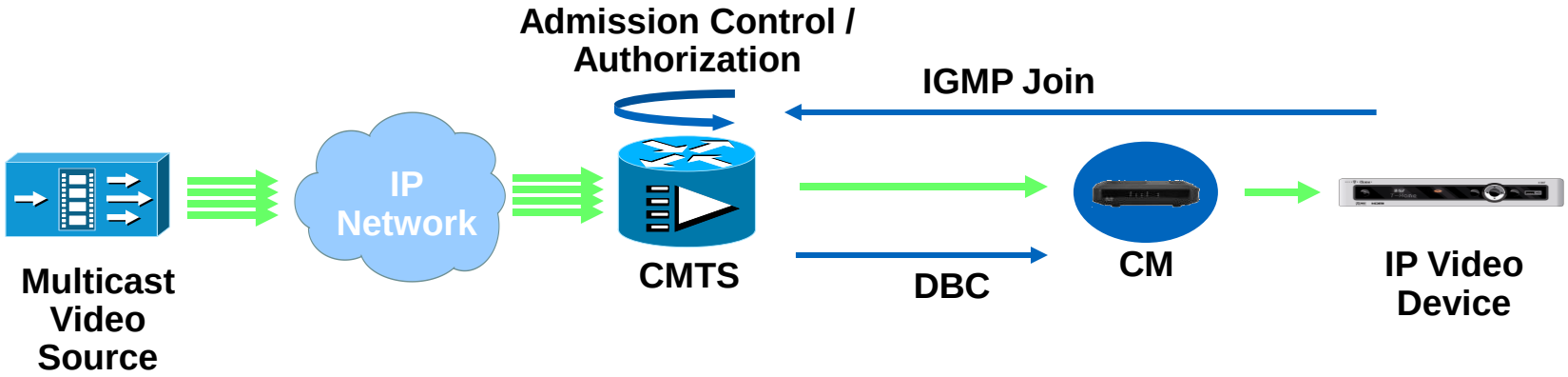
- CMTS forwards unicast video streams based on PCMM signaling
- Policy Server performs authorization checks and signals CMTS with QoS requirements
- Upon receipt of Gate-Set, CMTS creates classifier and service flow and reserves bandwidth
- Flexible forwarding to cable interface based on service flow attributes

Admission Control and QoS
VoD: RSVP



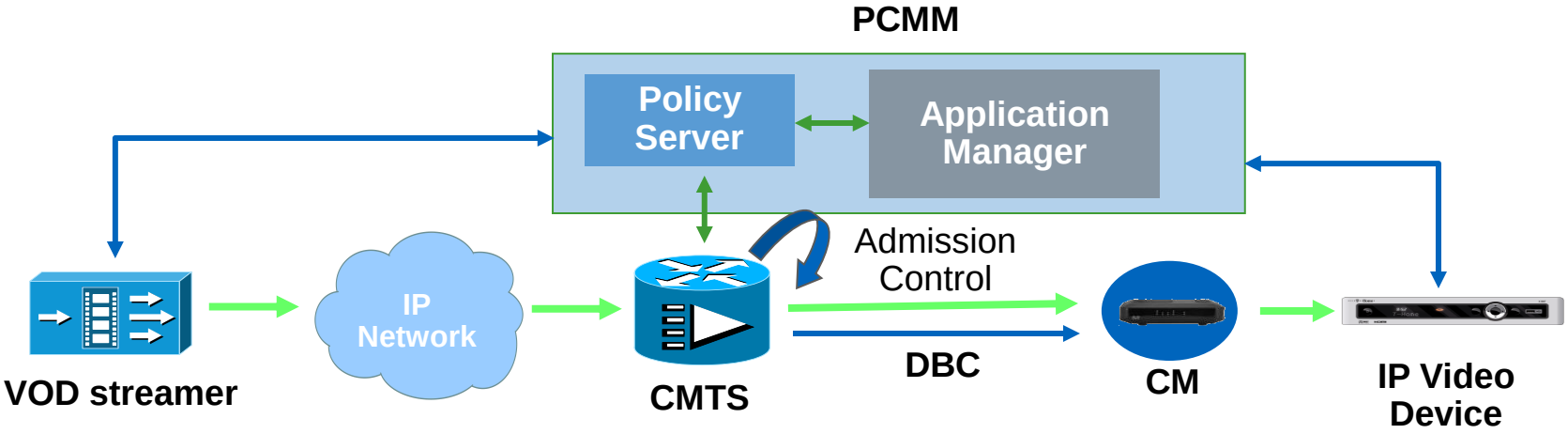
- Entitlement performed prior to initiating bandwidth reservation request
- CMTS pre-configured with video service class
- Upon receipt of RSVP, CMTS creates classifier and service flow and reserves bandwidth
- Flexible forwarding to cable interface based on service flow attributes

Admission Control and QoS
Multicast: IGMP



- CMTS forwards multicast video streams based on IGMP traffic from IP Video Device
- CMTS pre-configured with video service class
- CMTS performs admission control and multicast authorization

Admission Control and QoS
Multicast: PCMM



- Multicast extensions included in PCMM IO5
- CMTS dynamically forwards multicast video streams based on PCMM signaling
- Policy Server performs authorization checks and signals CMTS with QoS requirements

Optimizing for Adaptive Bit Rate Video

How does ABR impact Video over DOCSIS solution?

- Most features described are applicable to ABR or RTP delivered video
  - Channel bonding, RF spanning, VBR and load balancing applicable
  - ABR delivered via multicast can leverage IGMP, PCMM for session signaling, use RF spanning for efficiency
  - VoD can use PCMM even for ABR
- Admission Control
  - Admit flows at desired profile, and use rate-shifting to handle in-home issues
  - Admit flows at minimum acceptable profile and allow clients to up-shift when additional bandwidth is available

ABR and QoS

- With ABR is QoS needed for managed video?
  - Can't client simply downshift till it finds a stable point
- Without QoS:
  - Clients "fight it out"
  - Operators lose control over what stream gets what QoS
- With QoS
  - Operators can apply policies based on type of content, device, and subscriber

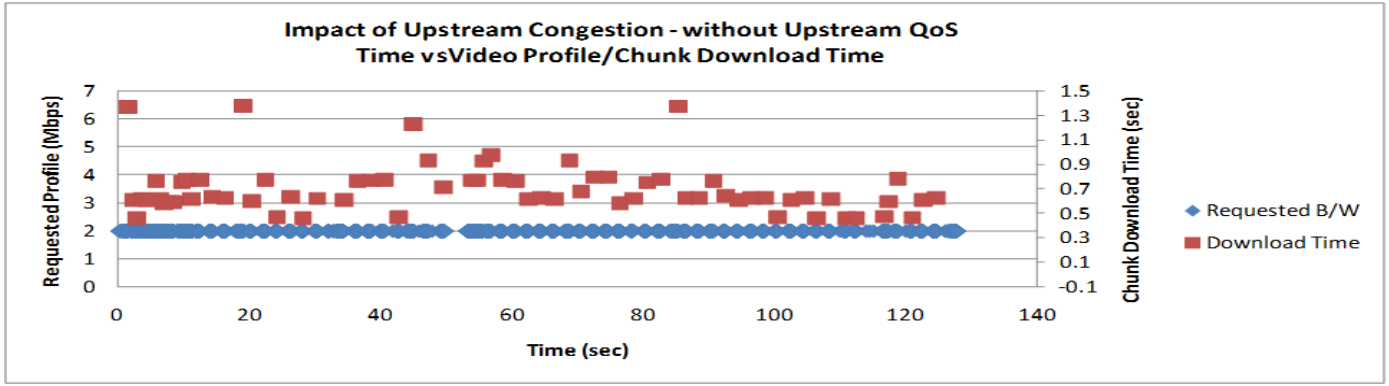
IP Video Business Policies

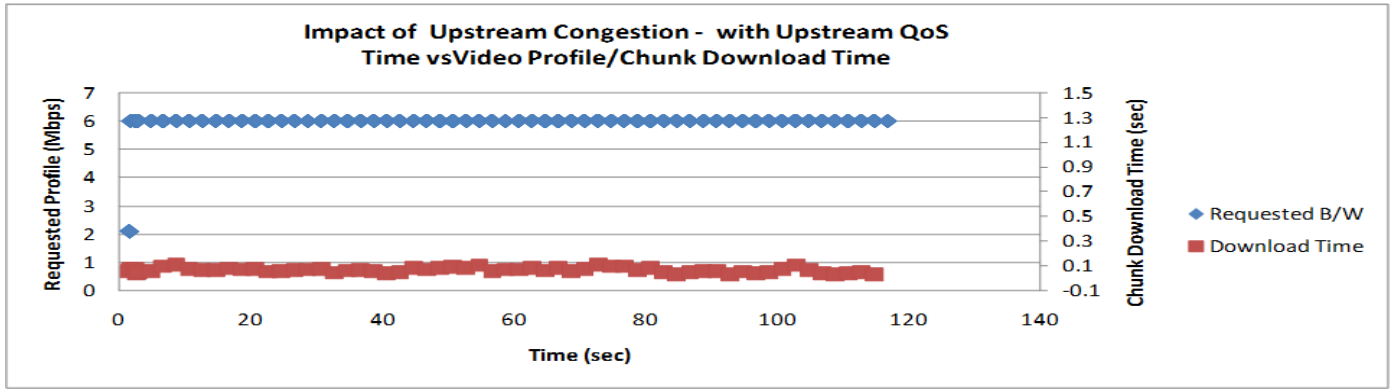
- Service Level
  - Premiere vs Basic
- Content
  - Pay vs Free
  - Preferred Partner
- IP Video Device
  - 60” HDTV vs iPad

Adaptive Streaming Challenges

- Adaptive Streaming Key Differences
  - One-way UDP based to two-way TCP based
  - Fixed bandwidth to self-adapting bandwidth
- Bandwidth Efficiency
  - Upstream and downstream
- Bitrate Adaptation
  - Upstream congestion impact to downstream streaming
  - Simultaneous adaptive streaming sessions

QoS for ABR streaming








Bandwidth Requirement Examples

Factors that influence bandwidth requirements

- Type of service
  - Linear or VoD or both
  - Target devices
- Bitrate of streams
  - Resolution: HD vs SD
  - Codec: MPEG4 vs MPEG2
  - VBR/CBR/ABR
- Multicast or Unicast delivery of linear services
  - Cloud DVR vs Home DVR
- Service Group Size

Illustrative Example of Broadcast vs Switched Delivery

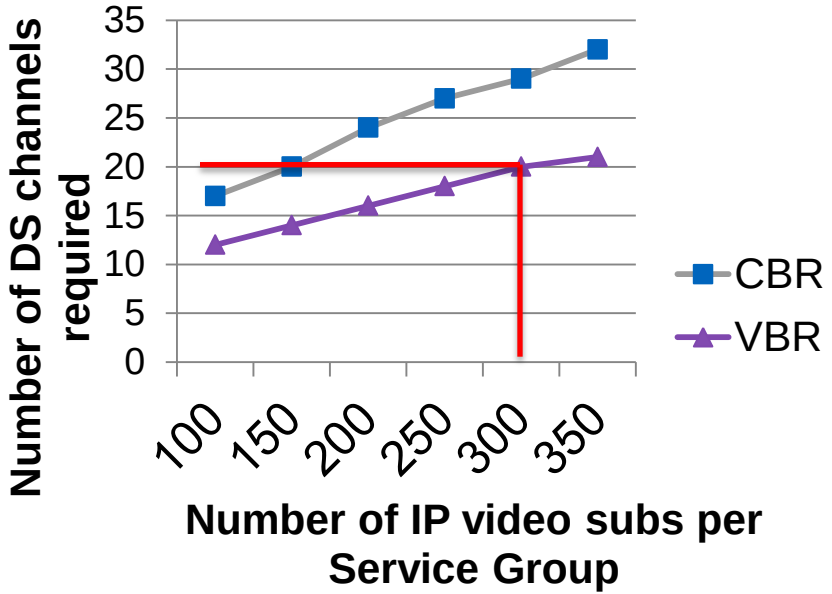
	All Broadcast	All Switched	Broadcast & Switched
Broadcast Lineup	65	0	20
Broadcast DS per CMTS	12	0	4
Switched Lineup	0	65	45
Peak Switched Channels per SG	0	40	20
Switched DS per SG	0	8	4
Total Switched DS per CMTS	0	280	140
Total DS per CMTS	12	280	144
RF channels per SG	12	8	8

Assumptions:

1. Average bitrate of each broadcast TV channel = 6.5 Mbps
2. 35 SG's per uBR10012
3. DS channel capacity = 37 Mbps

Bandwidth requirements for full-service IPTV

- Modeled capacity for linear and on-demand services
- SG size:100-350 subs
- Multicast for linear
- Multicast gains increase with SG size
- VoD concurrency 20%
- MPEG4
- 50% HD, 50% SD



For more details see: "HFC Capacity planning for IP Video", SCTE 2011

Summary

Cisco's Video over DOCSIS solution:

- Supports a wide range of IP Video use cases
- Multicast options for efficient Linear TV delivery
- Can be optimized for ABR Video
- Cost-effective and scalable
- Field-tested in large-scale deployments

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