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Design, Deployment, and Monitoring of video services on cBR-8 Platform

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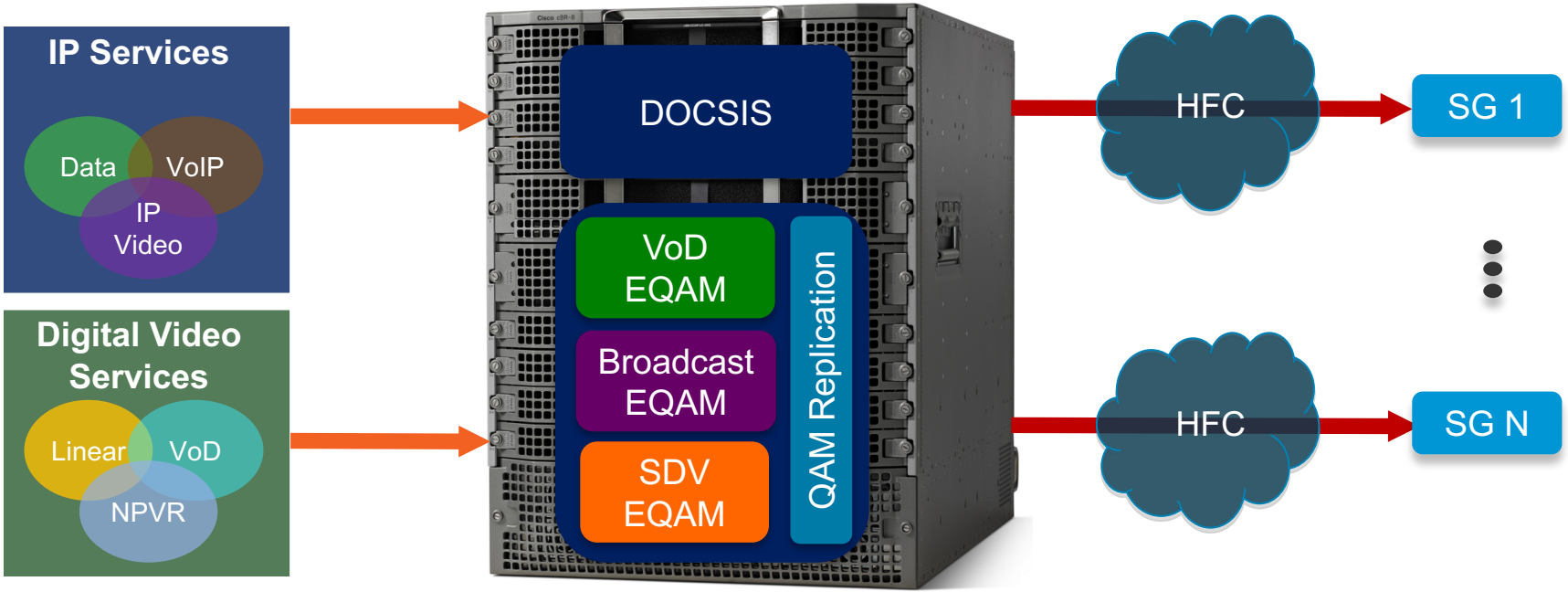
BRKSPV-2300

Agenda

- cBR-8 Platform For Video
- MPEG Video Services deployment over cBR8
- DEMO - MPEG Video Services deployment over cBR8
- IP Video implementation over cBR8
- DEMO – IP Video implementation over cBR8
- Conclusions

cBR8 Platform for Video

cBR-8 – Integrated CCAP Architecture



Reduce rack space and power consumption significantly

cBR-8 – Video Capacity and Scalability

- Video Service Group Capacity
  - 48 narrowcast Video and 64 broadcast Video QAMs/port
- Resources - Dedicated FPGA and CPU Resources for Video Processing
- Services - VOD, Pre-Encrypted Broadcast and SDV
- Sessions – user-defined or remote
- Encryption - Integrated PKEY, VPME and DVB-CA
- Video QAM Replication
- Video High Availability Architecture
- Role-Based Access – Allows control of Video features

Basic Video Configuration Constructs

Integrated Cable Controller – type VIDEO

- RF channels are designated for video under the Integrated-Cable controller configuration:

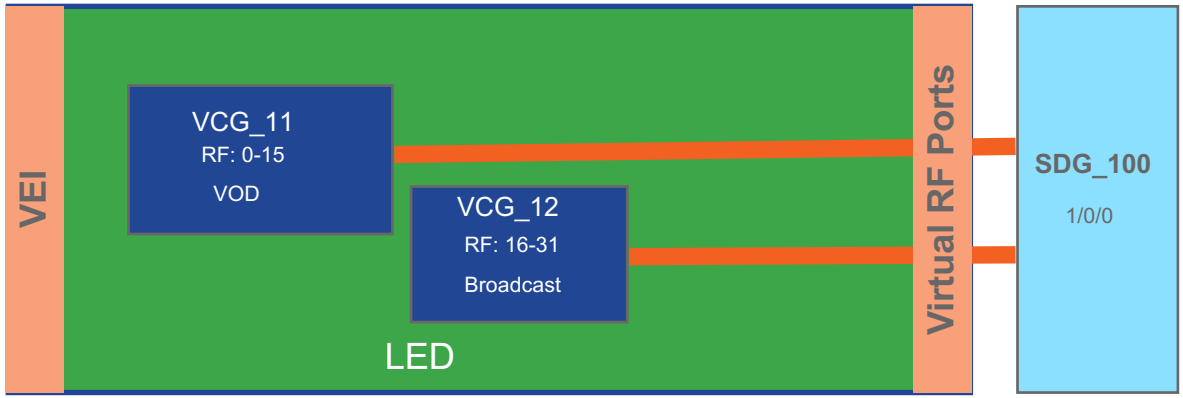
```
<config t>

controller Integrated-Cable 3/0/0
 max-carrier 48
 base-channel-power 40
 rf-chan 0 23
  type DOCSIS
  frequency 603000000
  <snip>
 rf-chan 24 31
  type VIDEO
  frequency 747000000
  rf-output NORMAL
  power-adjust 0
  qam-profile 20
```

```
<config t>
cable downstream qam-profile 20
  annex A
  modulation 256
  interleaver-depth I12-J17
  symbol-rate <SYMBOL-RATE>
  spectrum-inversion on
  description video-annex-a-256-qam
```

- "shut" video RF channels if still combined from other QAMs

Video Provisioning Constructs

- **Logical Edge Device (LED)**
- **Virtual Carrier Group (VCG)**
- **Virtual Edge Input (VEI)**
- **Service Distribution Group (SDG)**



Cable Video

Cable Video

- Almost all Video configuration under ‘cable video’ configuration level
  - **[no] cable video**
- Facilitate role based access implementation

default-onid
default-psi-interval
reserve-pid-range
. . .

```
cable video
 < global configuration >
 encryption
  <snip>
 service-distribution-group SDG_100 id 100
  <snip>
 virtual-carrier-group VCG_100 id 100
  <snip>
 bind-vcg
  <snip>
 logical-edge-device LED_10 id 10
  <snip>
 table-based
  <snip>
```

Virtual Carrier Groups (VCG)

- Set of RF channels and corresponding TSIDs & output port numbers for a video service group
- RF channel numbers need to match the ***Integrated-Cable controller*** configuration
- Narrowcast or Broadcast Service
- (Optional) Enable encryption
- (Optional) VEI

```
virtual-carrier-group vcg_100 id 100
 encrypt
 virtual-edge-input-ip  13.135.70.1 input-port-number 1
 service-type narrowcast
 rf-channel 24-31 tsid 1024-1031 output-port-number 1024-1031
```

Service Distribution Groups (SDG)

- Represents a group of RF ports defined for a video service
- If multiple RF ports defined; QAM replication is applied (acts as an internal RF splitter)
- Ensure frequencies are the same for all replicated carriers
- (Optional) ONID and psi-interval

```
service-distribution-group SDG_1000 id 1000
 rf-port integrated-cable 1/0/0
 rf-port integrated-cable 1/0/1
```

```
service-distribution-group SDG_100 id 100
 onid 10
 psi-interval 200
 rf-port integrated-cable 1/0/0
```

Virtual Port Group and Virtual Edge Input

Virtual Port Group

- IP address group used for cable video management
- cBR-8 uses this IP subnet as a source when reaching Video Mgmt or Encryption Mgmt servers

```
<config t>
interface VirtualPortGroup 0
 ip address 13.135.69.1 255.255.255.0
```

```
cable video
  mgmt-intf VirtualPortGroup 0
```

Virtual Edge Input

- Each LED or VCG can be assigned an IP address to receive video traffic
- Each VEI will have unique associated input-port-number.

```
logical-edge-device LED_1 id 1
 virtual-edge-input-ip 13.135.70.10
input-port-number 1
```

```
virtual-carrier-group VCG_101 id 101
  virtual-edge-input-ip 13.135.70.11
input-port-number 1
```

Logical Edge Device (LED)

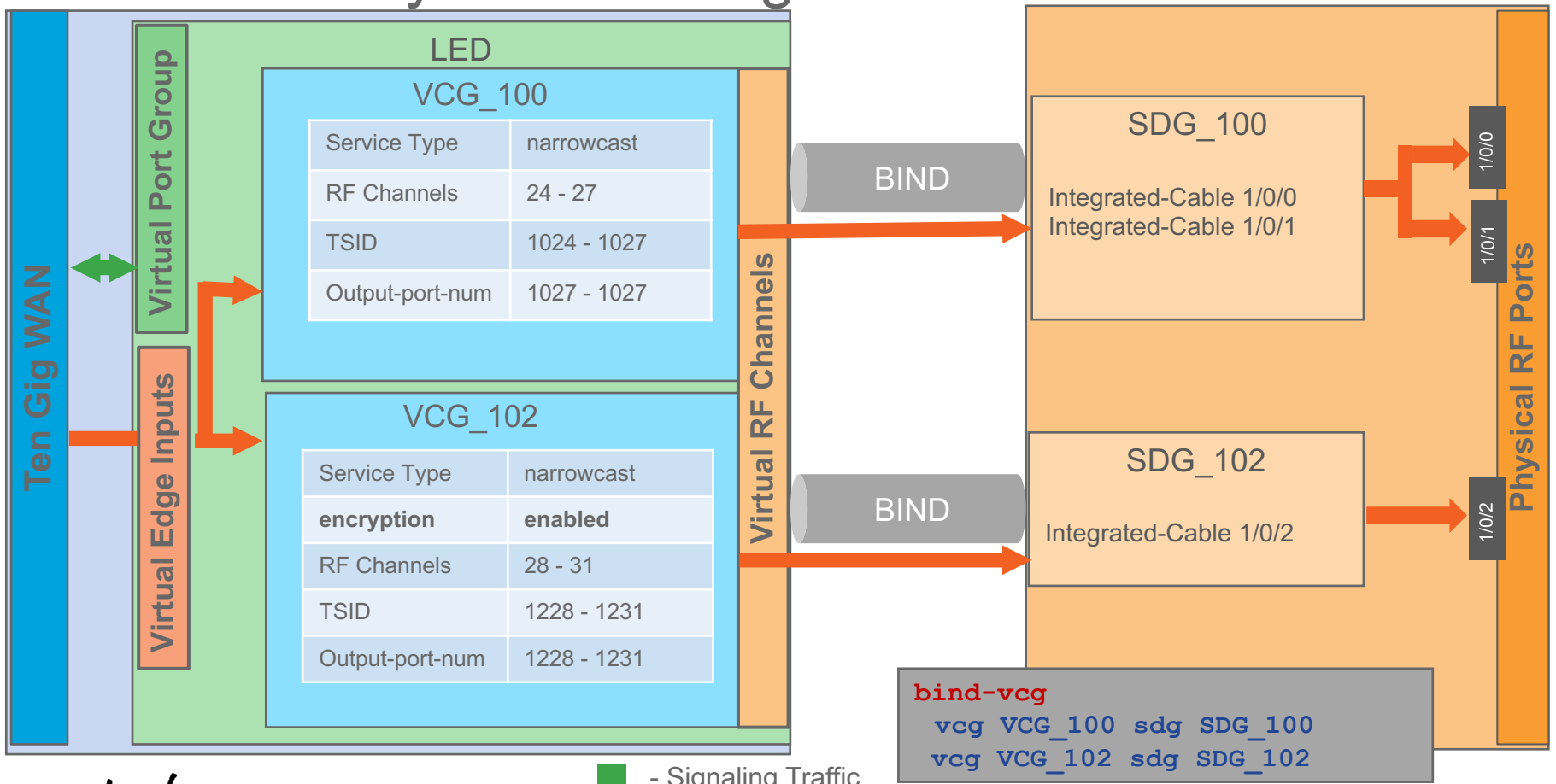
- Configured for static (table based) or dynamic (GQI) sessions for a set of VCGs
- Maximum of 32 LEDs; each LED has **configurable activation state**
- (GQI or Optional TB) – VEI (IP address & input port number) for receiving video traffic

```
logical-edge-device LED_1 id 1
 protocol table-based
   virtual-edge-input-ip 13.135.70.1 input-port-number 10
   vcg vcg_100
   vcg vcg_101
   <snip>
   vcg vcg_107
   active
```

Protocol: gqi or table-based

```
logical-edge-device LED_1_GQI id 10
 protocol gqi
 mgmt-ip 13.135.69.2
 mac-address a46c.2ab0.2c02
 server 10.225.198.88
 keepalive retry 3 interval 10
 virtual-edge-input-ip 13.135.70.10 input-port-number 1
 vcg vcg_gqi_1-0
 active
```

Virtual to Physical Binding



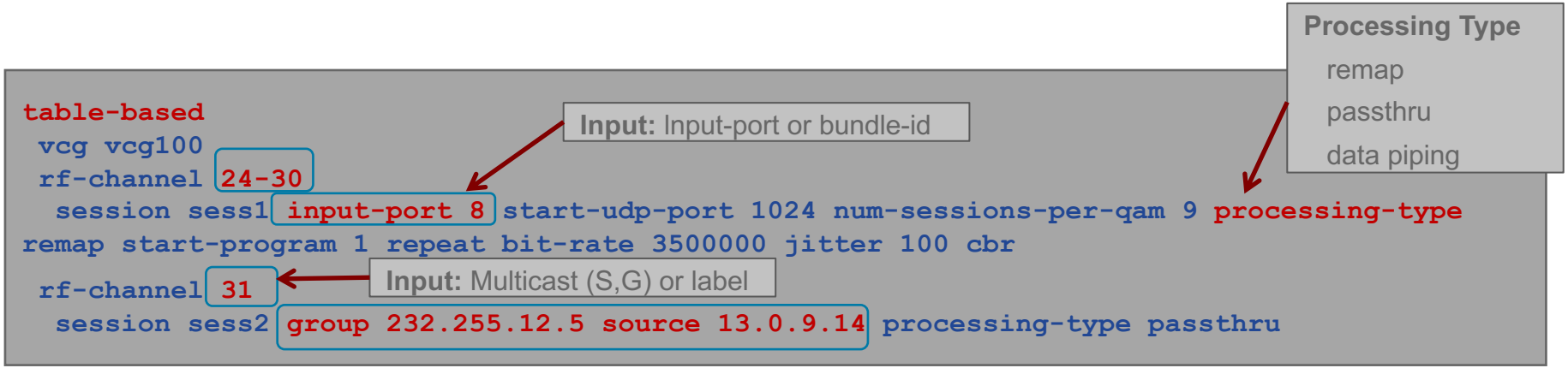
- Signaling Traffic
- Video Traffic

Show LED output

```
cBR8#show cable video logical-edge-device id 1
Logical Edge Device: LED_1
Id: 1
Protocol: Table-based
Service State: Active
<snip>
Discovery State: Disable
Number of Virtual Carrier Groups: 1
Number of Share Virtual Edge Input: 1
<snip>
Virtual Edge Input:
Input Port   VEI                 Slot/Bay     Bundle       Gateway
ID           IP                                ID           IP
-------------------------------------------------------------
10           13.135.70.12        1/0          -            -

Virtual Carrier Group:
ID    Name                          Total      Total      Service-Distribution-Group       Service-Distribution-Group
                                    VEI        RF-channel Name                             ID
-------------------------------------------------------------------------------------------------------------------
100   VCG_100                       0          8          SDG_100                          100

Integrated      Physical   Admin      Operational  TSID        ONID        Output       VCG          SDG         Encryption
Cable           QAM ID     State      State                                Port         ID           ID          Capable
-------------------------------------------------------------------------------------------------------------------------
1/0/0:24        57         ON         UP           1024        0           1024         100          100           dvb
1/0/0:25        58         ON         UP           1025        0           1025         100          100           dvb
<snip>
```

Table-based sessions

- Statically configured via CLI
- Used for VOD or Broadcast video services
- Unicast or multicast
- Configured as a range of sessions or as an individual session



Video Configuration Sequence

- Create a **VCG** with appropriate name
  - Identify the QAM carriers and configure them in VCGs.
  - Identify & Configure Virtual Edge Input (VEI) for QAM carriers in VCG
  - Configure service-type
- Create **SDG** with appropriate name
  - Identify & configure ONID (optional) in SDG
  - Identify & configure rf ports in SDG
  - If there is a requirement for replication, then configure the replicated port as well in SDG.
- **Bind** VCG to SDG
- Create **LED**
  - Configure protocol (GQI or Table based)
  - VEI (optional)
  - Associate VCG to LED and activate LED
- Create **table_based** configuration if Table based protocol is used

Video Provisioning and Capacity Restrictions

For Your Reference

Item	Limitation
LEDs per chassis	32
VCGs per LED	158
SDGs per chassis	64
VEIs per LED	5
VEIs per VCG	5
Sessions per QAM	80
Sessions per Linecard	6720
Active encrypted sessions per Linecard	1920
Narrowcast Video QAMs per Port	48
Broadcast Video QAMs per Port	64

Video Routing Configuration

- Configure IGP on cBR-8
- Advertise Virtual Port Group (VPG) and Virtual Edge Input (VEI) IP subnets
- OSPF example:

```
<config t>
router ospf 100
 router-id 13.10.0.204
 nsf cisco
 area 8 nssa
 redistribute connected subnets
 redistribute static subnets
 passive-interface default
 no passive-interface Port-char
 no passive-interface Port-char
 network 13.13.0.142 0.0.0.0 ar
 network 13.13.0.146 0.0.0.0 ar
```

Redistribute VPG IP subnet

Redistribute VEI IP subnet

```
cbr8#show ip route static
<snip>
S        13.135.70.1/32 [1/0] via 10.101.2.2, Video1/0/0
```

```
cBR8#show cable video routing status
< snip >
SLOT: 1 ---- CLC is INSERTED
  Routing Status = Enabled
  LCRED Mode = Primary, Role: Active, Peer: Slot 0
  Video Interface count     = 2,  VRF Name = Mgmt-MPEG-video-intf
    Video 1/0/0 Primary Subnet IP and Mask = 10.100.0.129 255.255.255.192
    Video 1/0/0 Gateway Subnet IP and Mask = 10.101.2.1 255.255.255.0
< snip >
```

QOS for Video Traffic

- Separate Queues for Video and DOCSIS traffic
- Separate shapers with a ratio 1:1 for Video and DOCSIS traffic
- Guarantees half the Linecard backplane bandwidth for video traffic
- Optionally prioritize downstream and upstream service flows for video control (ex: RTSP) traffic

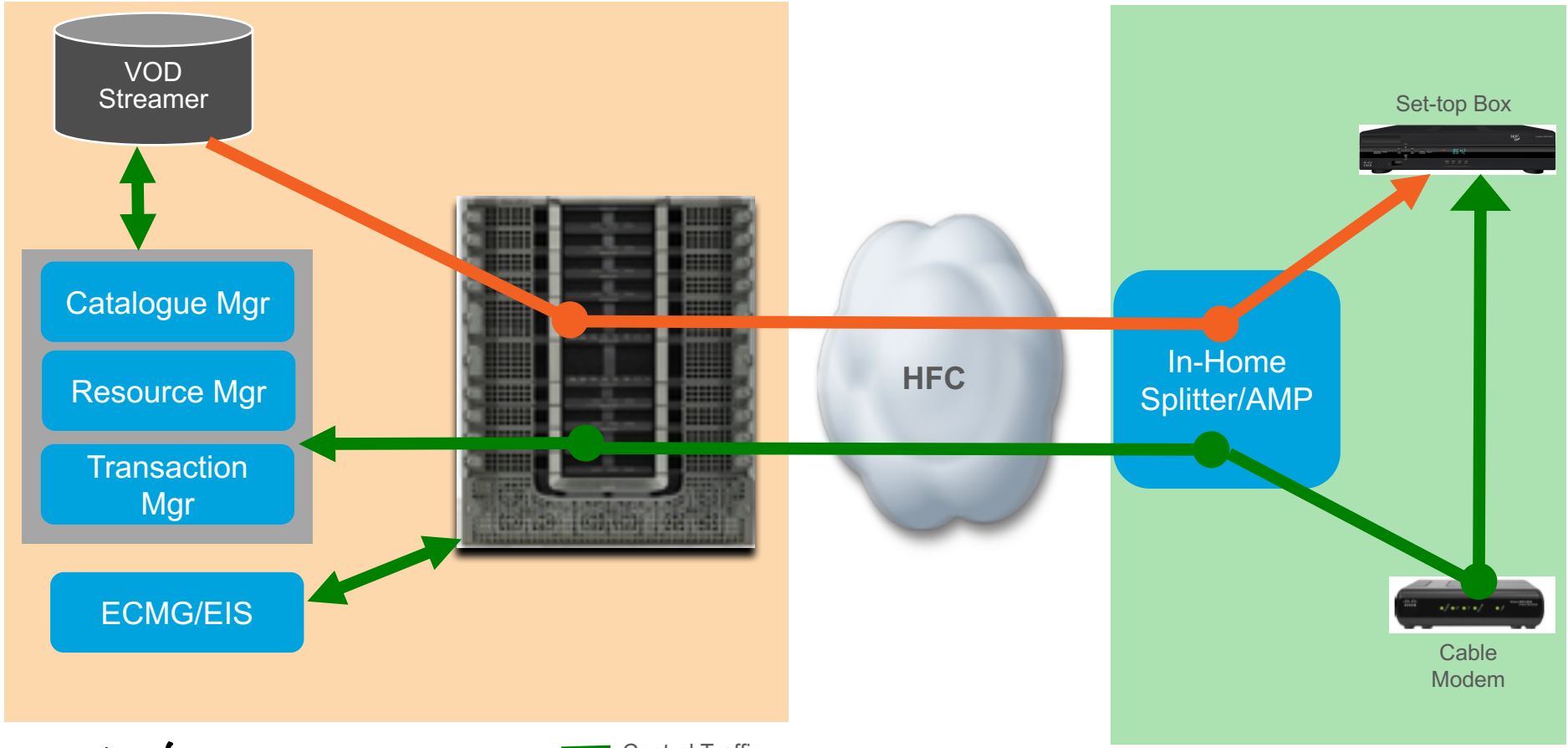
Video - Licensing

- Smart Licensing feature with trusted pool model similar to DOCSIS licenses
- Narrowcast Video Licenses consumed when VCG is bind to SDG
- All licenses are counted per QAM basis
- Type of Licenses
  - Narrowcast Video
  - Narrowcast Video Replication
  - Narrowcast Video Encryption
  - Broadcast Video – Same license for pilot and replicate QAMs

```
cBR8#show license summary | inc NC_|BC_
  CBR8 VOD/SDV Downstr... (NC_License)                    29 AUTHORIZED
  CBR8 VOD DVB QAM Enc... (NC_DVB_License)                 4 AUTHORIZED
  CBR- DOWNSTREAM BROA... (BC_License)                    12 AUTHORIZED
  CBR8 VOD / SDV Repli... (NC_RPL_License)                 1 AUTHORIZED
```

MPEG Video Services
Video On Demand (VOD)

cBR-8 – VOD traffic flow



Configuration – SDG, VCG, Bind, LED, Table-based

```
cable video
  service-distribution-group SDG_200 id 200
    onid 20
    rf-port integrated-cable 2/0/0
```

```
virtual-carrier-group VCG_200 id 200
   service-type narrowcast
     rf-channel 24-27 tsid 2024-2027 output-port-number 2024-2027
```

Narrowcast VCG

```
bind-vcg
    vcg VCG_200 sdg SDG_200
```

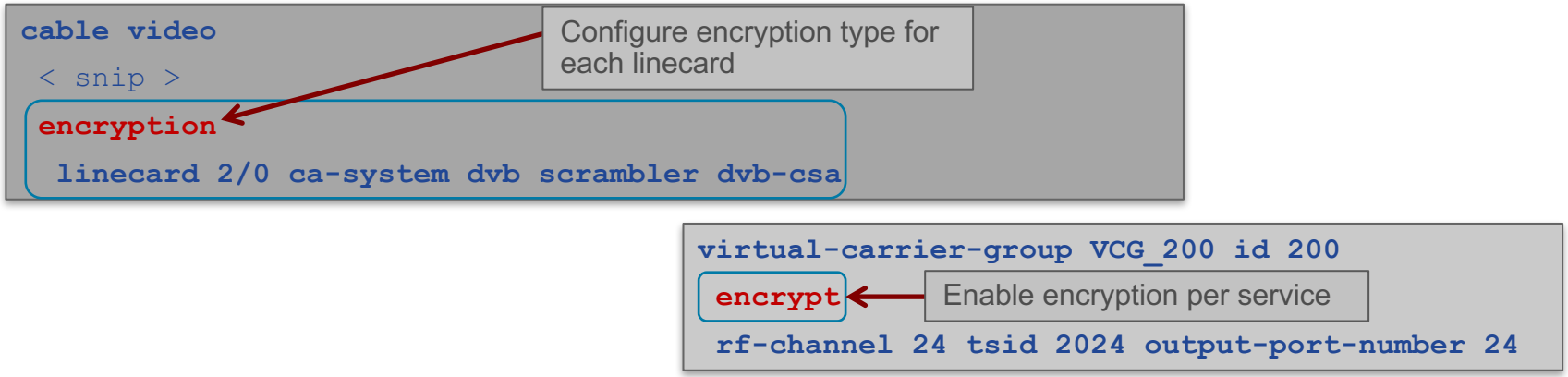
```
logical-edge-device LED_2
 protocol table-based
  virtual-edge-input-ip 13.135.70.2 input-port-number 2
  vcg VCG_200
```

```
table-based
 vcg VCG_200
  rf-channel 24-27
   session S_200 input-port 2 start-udp-port 2024 num-sessions-per-qam 2 processing-
type remap start-program 1 cbr
```

Input-port should match

Video Encryption support on cBR-8

- Encryption enables service provider to scramble video sessions
- Supported encryptions
  - PK (PowerKEY Encryption) – proprietary - Cisco
  - PME (Privacy Mode Encryption) – proprietary - Arris
  - **DVB Simulcrypt – ETSI standard - NAGRA CA and Videoguard CA certification**



DVB Simulcrypt Encryption

- cBR-8 need to establish communication to Entitlement Control Message Generator (ECMG) server and Event Information Scheduler (EIS) establish communication to cBR-8
- EIS and ECMG server connection is via Virtual Port Group IP to cBR-8 SUP
- Two modes
  - Session based – Different Entitlement Control Message for each session. Requires a route to ECMG server from the Linecard.
  - Tier based – Same Entitlement Control Message for all sessions
- Applicable to only remapped table-based sessions (VOD/ SDV)

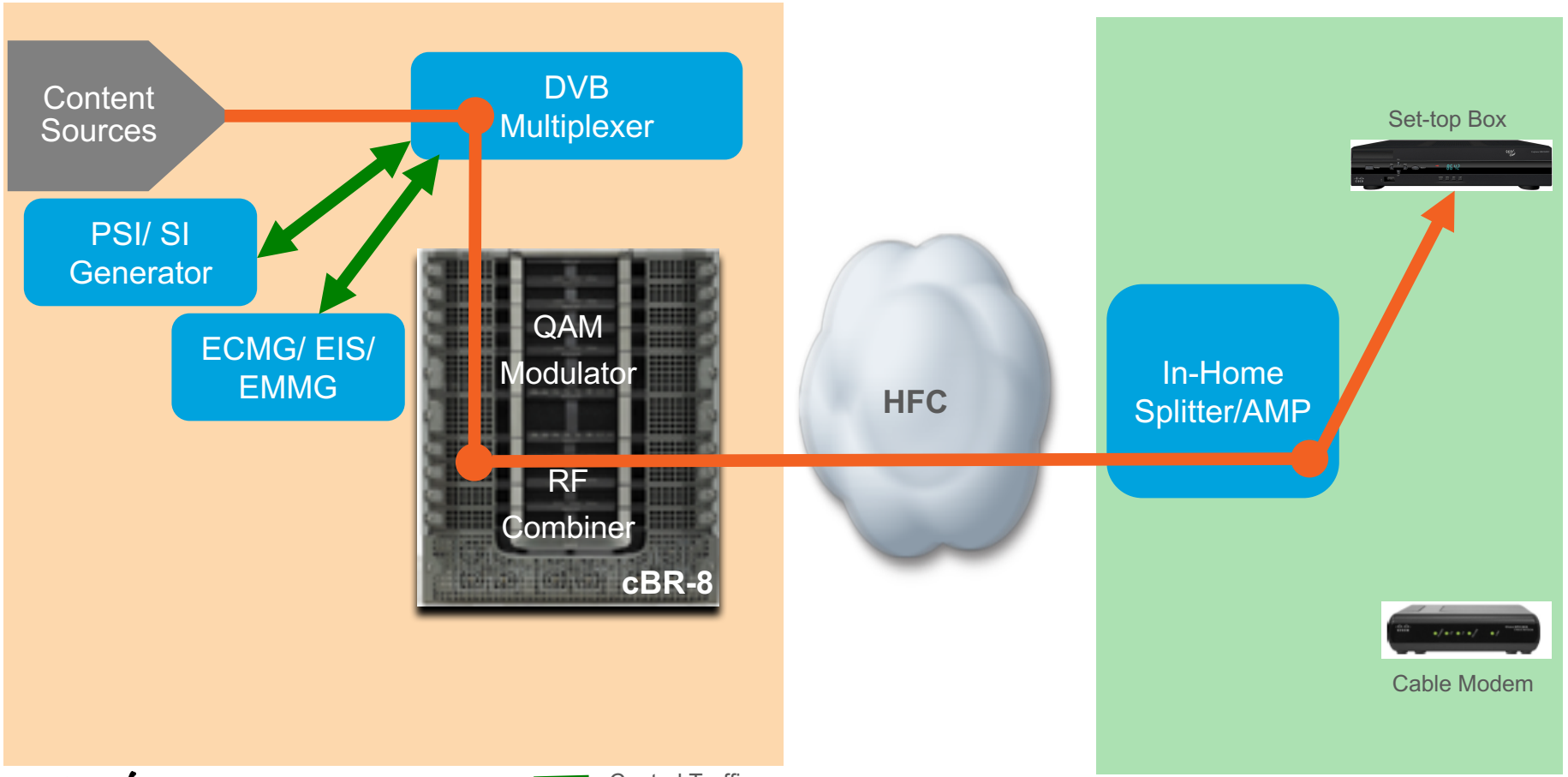
Configuration – DVB – Session vs Tier based

```
cable video
 <snip>
 encryption
  <snip>
  dvb
   route-ecmg <SUBNET> <MASK> <FRWD_IF> <IP_ADDR>
   eis <EIS_NAME> id <EIS_ID>
    listening-port <PORT-NUMBER>
    ca-interface linecard <SLOT> <IP>

   ecmg <ECMG_NAME> id <ECMG_ID>
    mode vod linecard <SLOT>
    type <standard/hitachi/irdeto/nagra/pkey>
    ca-system-id <CA_SYSTEM_ID> <CA_SUBSYSTEM_ID>
    auto-channel-id
    ecm-pid-source <sid/auto/ecm-id>
    connection id <ID> priority <PRIO> <IP_ADDR> <PORT>
```

```
cable video
 <snip>
 encryption
  <snip>
  dvb
   ecmg <ECMG_NAME> id <ECMG_ID>
    mode tier-based
    type <standard/hitachi/irdeto/nagra/pkey>
    ca-system-id <CA_SYSTEM_ID> <CA_SUBSYSTEM_ID>
    ecm-pid-source <sid/auto/ecm-id>
    auto-channel-id
    connection id <ID> priority <PRIO> <IP_ADDR> <PORT>
   tier-based
    ecmg id <ECMG_ID> access-criteria <HEX>
    enable
```

MPEG Video Services Broadcast

cBR-8 – Broadcast Video traffic flow



Configuration – SDG, VCG, LED and Replication

```
cable video
  service-distribution-group SDG_BC id 1000
    <snip>
    rf-port integrated-cable 2/0/0
    rf-port integrated-cable 2/0/1
    rf-port integrated-cable 2/0/2
    rf-port integrated-cable 2/0/3
    rf-port integrated-cable 3/0/0
```

Dedicated SDG for Broadcast Service

Pilot QAM

Replicated QAMs

Pilot QAM

```
virtual-carrier-group VCG_BC id 1000
    service-type broadcast
    rf-channel 28-31 tsid 28-31 output-port-number 28-31
```

Dedicated VCG for Broadcast Service

```
bind-vcg
    vcg VCG_BC sdg SDG_BC
```

```
logical-edge-device LED_BC id 32
 protocol table-based
 vcg VCG_BC
 active
```

Configuration – Multicast

```
<config t>
ip multicast-routing distributed
interface Loopback0
 ip address 13.10.0.204 255.255.255.255
interface Port-channel1
 ip pim sparse-dense-mode
interface Port-channel2
 ip pim sparse-dense-mode
```

```
<config t>
ip access-list standard SSMrange
  permit 239.255.0.0 0.0.255.255
  permit 232.0.0.0 0.255.255.255
```

```
interface video2/0/0
 vrf forwarding Mgmt-MPEG-video-intf
 ip address 10.100.1.1 255.255.255.192
 ip address 10.101.4.1 255.255.255.0 secondary
 ip pim passive
 ip igmp version 3
```

```
cable video
 multicast-uplink Loopback0 access-list SSMrange
```

```
ip multicast-routing vrf Mgmt-MPEG-video-intf distributed
ip pim vrf Mgmt-MPEG-video-intf rp-address 13.10.0.204
ip pim vrf Mgmt-MPEG-video-intf ssm range SSMrange
ip multicast vrf Mgmt-MPEG-video-intf rpf select global group-list SSMrange
ip route vrf Mgmt-MPEG-video-intf 0.0.0.0 0.0.0.0 Looback0 13.10.0.204
ip mroute vrf Mgmt-MPEG-video-intf 0.0.0.0 0.0.0.0 fallback-lookup global
```

Configuration generated automatically

Redundant multicast sources

- Multicast label can be used when more than one multicast source [S, G] is used as backup for the sessions
- Can configure up to 4 sources
- Multicast group can be associated to only one label
- When the active source fails, another source is chosen automatically

```
table-based
  multicast-label bc1 group 239.255.12.1 source 13.0.9.12 source2 13.0.9.19
  multicast-label bc2 group 239.255.12.2 source 13.0.9.12 source2 13.0.9.19
  multicast-label bc3 group 239.255.12.3 source 13.0.9.12 source2 13.0.9.19
  multicast-label bc4 group 239.255.12.4 source 13.0.9.12 source2 13.0.9.19
```

```
cBR8(config-video)#?
Cable Video Configuration Commands:
source-switch-delay  Delay used for performance management of Multicast Source-Switching (default = 4 msec)
```

Broadcast sessions configuration

```
table-based
  vcg VCG_BC
    rf-channel 28
      session BC_28 multicast-label bc1 processing-type passthru
    rf-channel 29
      session BC_29 multicast-label bc2 processing-type passthru
    rf-channel 30
      session BC_30 multicast-label bc3 processing-type passthru
```

Label based definition with multiple sources

```
table-based
    vcg VCG_BC
      rf-channel 31
       session BC_31 group 232.255.12.5 source 13.0.9.14 processing-type passthru
```

(S,G) definition with single source

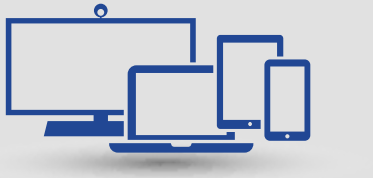
Demo – MPEG Video Services implementation over cBR8

Best Practices

- A separate subnet for all VEIs on cBR-8.
- VEI IPs can be placed in dedicated VRF to segregate video traffic.
- In-bound ACLs can be applied on WAN interface to restrict traffic to VEI IPs
- One LED per Linecard for backwards compatibility to rfgw10
- If architecture allows, use VEI bundle feature for Video traffic path redundancy
- When doing port expansion - un-shut newly added channels after complete configuration
- Up front WAN capacity planning for HSD+Video uplink connectivity
- Activate LEDs after configuration of all video configuration constructs.
- Apply security to CLI – video and DOCSIS separation

Drivers for IP Video Migration

Video Consumption Shifting to IP and Mobile



Millennials view 70% of TV online

Millennials consume 2x more mobile video than 25-39 year olds

Video will drive 82% of IP traffic by 2020

Mobile video traffic will increase 11x by 2020

Source: Cisco VNI, Nielsen, Deloitte

Frequency Spectrum Offload

- Analog reclamation
  - Use of IP STB instead of Digital STB for analog only customers
  - Extend digital services to other outlets in the home with IP STB
- Always-on channels reduction by implementing SDV concept over IP
  - Break down TV line-up into popular (always-on) vs less popular (switched)
  - Use static multicast for the first and dynamic multicast for the latter
- VoD over IP
  - Can benefit from more efficient use of spectrum by bundling VOD with HSD traffic

IP Video on any device – Unicast & Multicast ABR

Unicast ABR

- Enables IP Video on any device
- Dynamically adapts streaming rate based on bandwidth availability
- Increased video latency compared to multicast based delivery

Multicast ABR

- Deliver live content over ABR to primary screens
- Bandwidth efficiency and improved latency compared to unicast
- Faster channel change as well as retransmission capabilities compared to traditional multicast

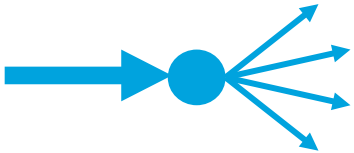
Other drivers

- Understanding of consumer behavior
  - Enabled by the 2 way nature of IP
  - Targeted advertising and per user recommendations
- Make use of SDV concept to introduce niche content in selected regions
- OTT based “skinny bundles”
  - BYOD based, no STB dependency
  - Incentivizes higher data tiers adoption
- CAPEX and OPEX efficiency – one network for all services

IP Video Delivery over cBR8

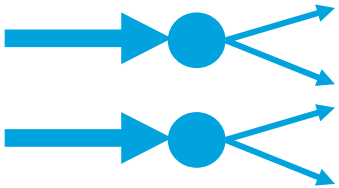
IP Video Delivery Methods

Broadcast



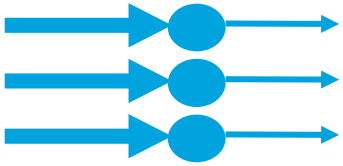
- Linear TV delivered to all subs all the time (independent of viewership)
- Lowest CMTS DS capacity/cost; typically requires more spectrum than switched
- Most suitable for large number of subs and popular programming

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 subscriber
- Highest CMTS DS capacity/cost and spectrum requirement for linear TV
- Alleviates multicast requirements on end-to-end IP Video system

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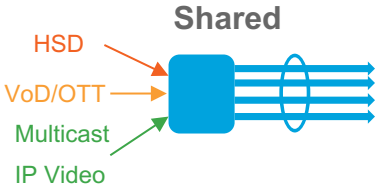
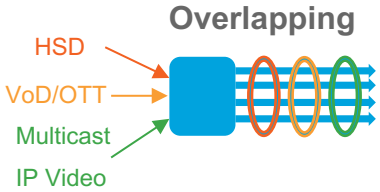
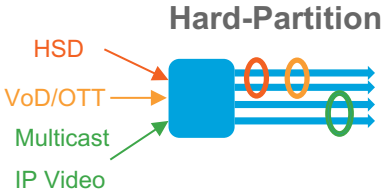
Service Separation



- All services share bandwidth dynamically
- Can reserve different amounts of bandwidth for CIR flows of different applications (SGAC) for admission control purposes
- Limited control for aggregate bandwidth of each service's best effort traffic

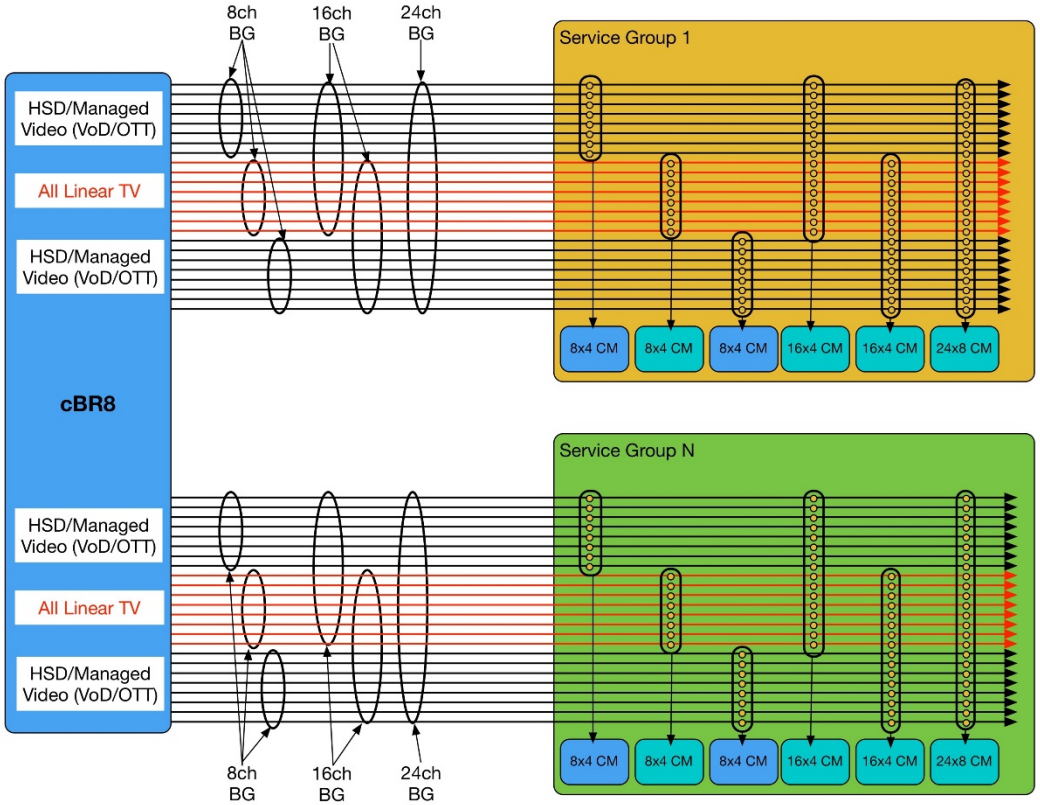


- Overlapping BGs for different services across same set of DSs
- Ability to provide guaranteed amount of bandwidth per service even for best effort traffic
- Dynamic Bandwidth Sharing capability (DBS and ACFE). Any unused bandwidth from one service's BG is made available for another service's BG

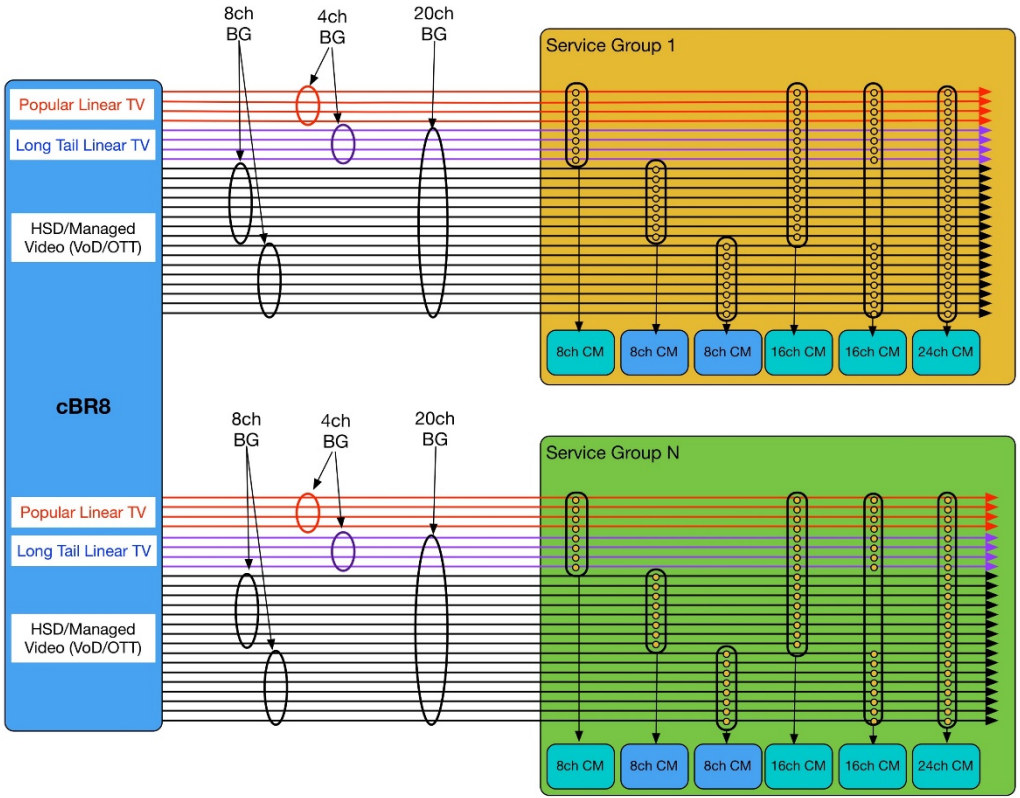


- RF channels are dedicated for specific services
- No dynamic bandwidth sharing
- Unused bandwidth from one service cannot be used by another service

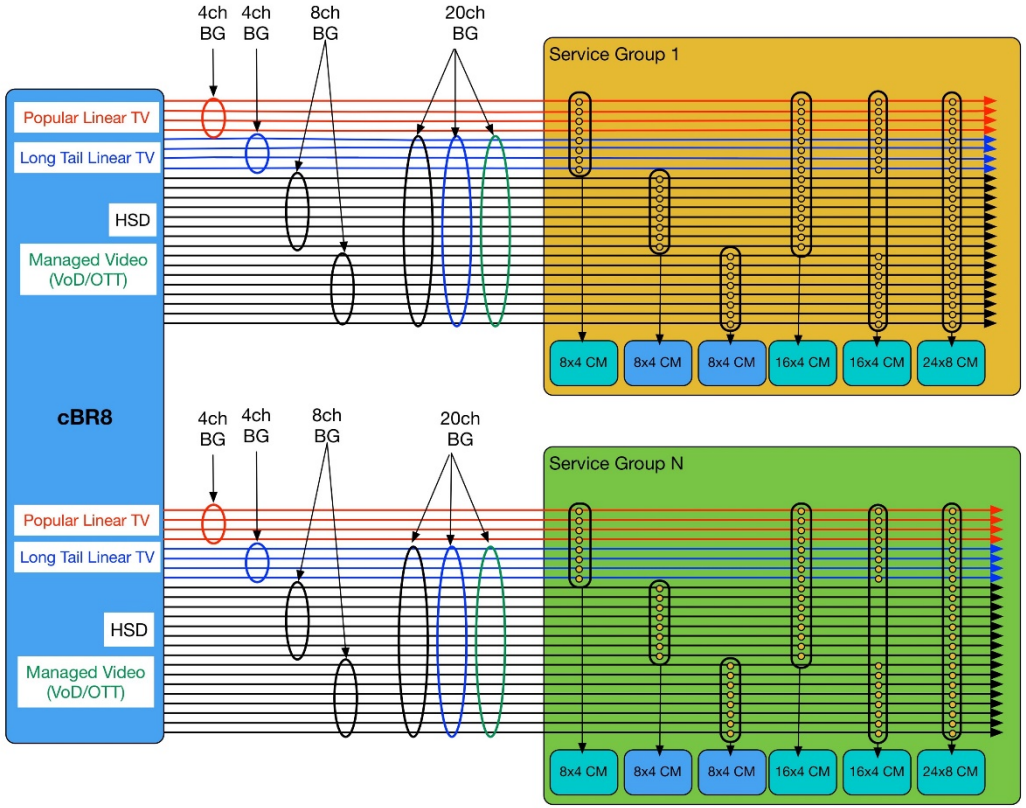
Bonding group design #1: All video in one BG



Bonding group design #2: Broadcast and SDV



Bonding group design #3: Overlapping BGs



Traffic Steering

- Modems can receive traffic from multiple Bonding Groups
  - RCC Templates used for modem assignment to receive channels sets
- Steer DOCSIS Service Flows to Bonding Groups via SF attributes
  - Attributes configured on Bonding Groups, service classes and modem configuration file
- Map IP flows to DOCSIS Service Flows
  - Static Service Flows can use DSCP or Video Server IP address for classifier
  - Dynamic Service Flow classifier signaled at session setup time
  - MQoS used to assign Service Flow attributes per (S,G)

QoS Tools

- Single IP flow per DOCSIS Service Flow
- Dynamic service flow establishment (PCMM)
- Best effort service flow prioritization
- Per service flow minimum rate guaranteed
- Best effort service flow fairness
- Adaptive CIR
- Service group admission control

Configuration Example Description

- Service Group composed of 24 channels and 24x8 modems only
- Services offered are:
  - Live TV – split between popular (short tail) and long tail content
  - Managed Video (VoD)
  - High Speed Data
- Popular content using dedicated resources (4 rf-channels)
- Overlapping BGs for long tail content, managed video and data spanning 20 rf-channels
- Managed video is prioritized over HSD

Bonding Groups - Overlapping

- Primary bonding groups
  - Multiple same size BGs, one for each application, traffic steering required
  - Bandwidth control DBS or ACFE
- Secondary bonding group
  - Used for static multicast (popular TV)
  - Traffic steering required

```
interface Wideband-Cable2/0/0:40
 description BC Short Tail Static
 cable bundle 20
 cable rf-channels channel-list 20-23 bandwidth-percent 1
 cable downstream attribute-mask 80000002
 cable bonding-group-secondary
```

```
interface Wideband-Cable2/0/0:20
 description Data BG
 cable bundle 20
 cable rf-channels channel-list 0-19 bandwidth-percent 1
 cable downstream attribute-mask 80000010

interface Wideband-Cable2/0/0:30
 description BC Long-Tail Dynamic
 cable bundle 20
 cable rf-channels channel-list 0-19 bandwidth-percent 20
 cable downstream attribute-mask 80000001

interface Wideband-Cable2/0/0:50
 description Managed Video
 cable bundle 20
 cable rf-channels channel-list 0-19 bandwidth-percent 1
 cable downstream attribute-mask 80000003
```

Multicast & IGMP

- Multicast routing enabled globally
- PIM sparse-mode enabled on the Bundle and WAN interfaces
- IGMPv3 and IGMP static group definition on Bundle interface as well as on the secondary BG
- IGMPv2 and SSM definition if IGMPv3 not used

```
ip multicast-routing distributed

interface Wideband-Cable2/0/0:40
 description BC Short Tail Static
 cable igmp static-group 232.8.8.1 source 192.168.1.14 1
 cable igmp static-group 232.8.8.65 source 192.168.1.14 1

interface TenGigabitEthernet4/1/4
  ip pim sparse-mode

interface Bundle20.1
 ip pim sparse-mode
 ip igmp static-group 232.8.8.65 source 192.168.1.14
 ip igmp static-group 232.8.8.1 source 192.168.1.14
 ip igmp version 3
```

Multicast QoS & Traffic Steering

- Service Classes
- Multicast group-qos
  - Link to service classes
  - (S,G) definition
- Link to Bundle Interface and dynamic multicast bonding-group

```
cable service class 70 name MQOS_DEFAULT
cable service class 70 downstream
cable service class 70 min-rate 0
cable service class 70 priority 2
cable service class 71 name Data
cable service class 71 downstream
cable service class 71 req-attr-mask 80000010
cable service class 72 name MQOS_Dynamic
cable service class 72 downstream
cable service class 72 min-rate 4000000
cable service class 72 req-attr-mask 80000001
cable service class 73 downstream
cable service class 73 min-rate 4000000
cable service class 73 req-attr-mask 80000002
cable service class 73 name MQOS_Static
```

```
cable service class 74 name Mngd_Video
cable service class 74 downstream
cable service class 74 priority 7
cable service class 74 req-attr-mask 80000003

cable multicast group-qos default scn MQOS_DEFAULT aggregate
cable multicast group-qos 1 scn MQOS_Dynamic single
cable multicast group-qos 2 scn MQOS_Static single

cable multicast qos group 1 priority 1
 session-range 232.8.8.128 255.255.255.192 192.168.1.14 255.255.255.255
 group-qos 1
cable multicast qos group 2 priority 1
 session-range 232.8.8.0 255.255.255.192 192.168.1.14 255.255.255.255
 group-qos 2

interface Bundle20
 cable multicast-qos group 1
 cable multicast-qos group 2

interface Wideband-Cable2/0/0:30
 cable multicast-qos group 1
```

ACFE, SGAC & RCC Templates

- ACFE used for BE SF fairness and Adaptive CIR
- SGAC allows strict admission control of CIR based SFs
- RCC Templates required for modems to use all available RF channels

```
cable acfe enable

cable application-type 1 name BCast_App
cable application-type 1 include service-class MQOS_Dynamic

cable fiber-node 200
 admission-control application-type 1 ds-bandwidth 25

cable rcc-templates frequency-based 12
 rcp-id 00 10 00 00 18
 rcc-template 1
  module 1 channel 1-24 start-frequency 400000000

interface Cable2/0/0
 cable rcc-templates frequency-based 12
```

Demo – IP Video Services implementation over cBR8

Key Takeaways

- MPEG Video delivery on cBR-8
  - Implementation and configuration of video services
- IP Video implementation over cBR8
  - Drivers for IP Video migration
  - Different IP Video design options
  - IP Video Configurations
- Practical content will enable you to evaluate, design and test MPEG and IP based Video implementation on cBR8

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- Please complete your Online Session Evaluations after each session
- Complete 4 Session Evaluations & the Overall Conference Evaluation (available from Thursday) to receive your Cisco Live T-shirt
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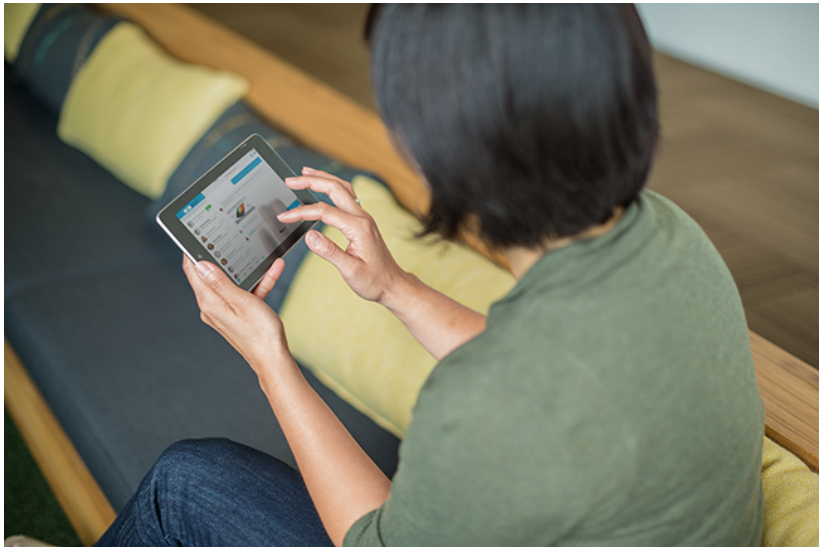

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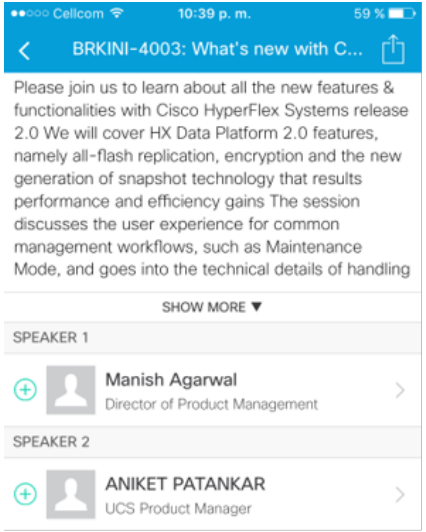

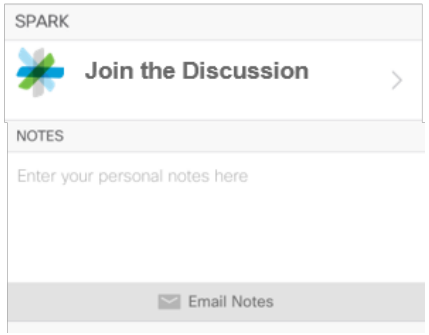

Recommended Sessions

Session ID	Speaker(s)	Title
BRKSPG-2505	Jeff Riddel	cBR-8 Technical Overview and Deployment Considerations
BRKSPG-2006	John Knox	Evolution of Cable Architectures
BRKSPG-2501	Tejal Patel	Troubleshooting Cisco cBR8/CCAP Based Services
BRKSPG-2061	Sreeni Inukoti	IPv6 Deployment Best Practices for the Cable Access Network
BRKSPV-1257	Ken Morse	IP Video Evolution
BRKSPV-2999	Gareth Bowen	ABR streaming and your network; a match made in heaven?

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Thank You

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Appendix - Backup Slides

Video Provisioning checklist

- Complete RF spectrum plan for HSD and Video
- VirtualPort Group subnet, VirtualProtGroup IP address and subnet
- VEI subnet (unique for each LED), VEI IP address
- EIS IP address and port
- ECMG mgmt IP address and port
- SDG names and ids
- VCG names and ids
- TSIDs
- VCG to SDG bindings
- UDP port mappings for table-based video sessions

VEI - Bundle

- Multiple VEIs can be bundled using input port numbers
- UDP Port numbers must be unique across the VEIs with-in the bundle
- To use VEI bundle feature, sessions must be created with bundle rather than input-number

```
logical-edge-device led_10 id 10
 virtual-edge-input-ip 10.251.111.101 input-port-number 1
 virtual-edge-input-ip 10.251.111.102 input-port-number 2
 virtual-edge-input-ip 10.251.111.103 input-port-number 3
 vcg 100
 vei-bundle 10 input-port-number 1,3
```

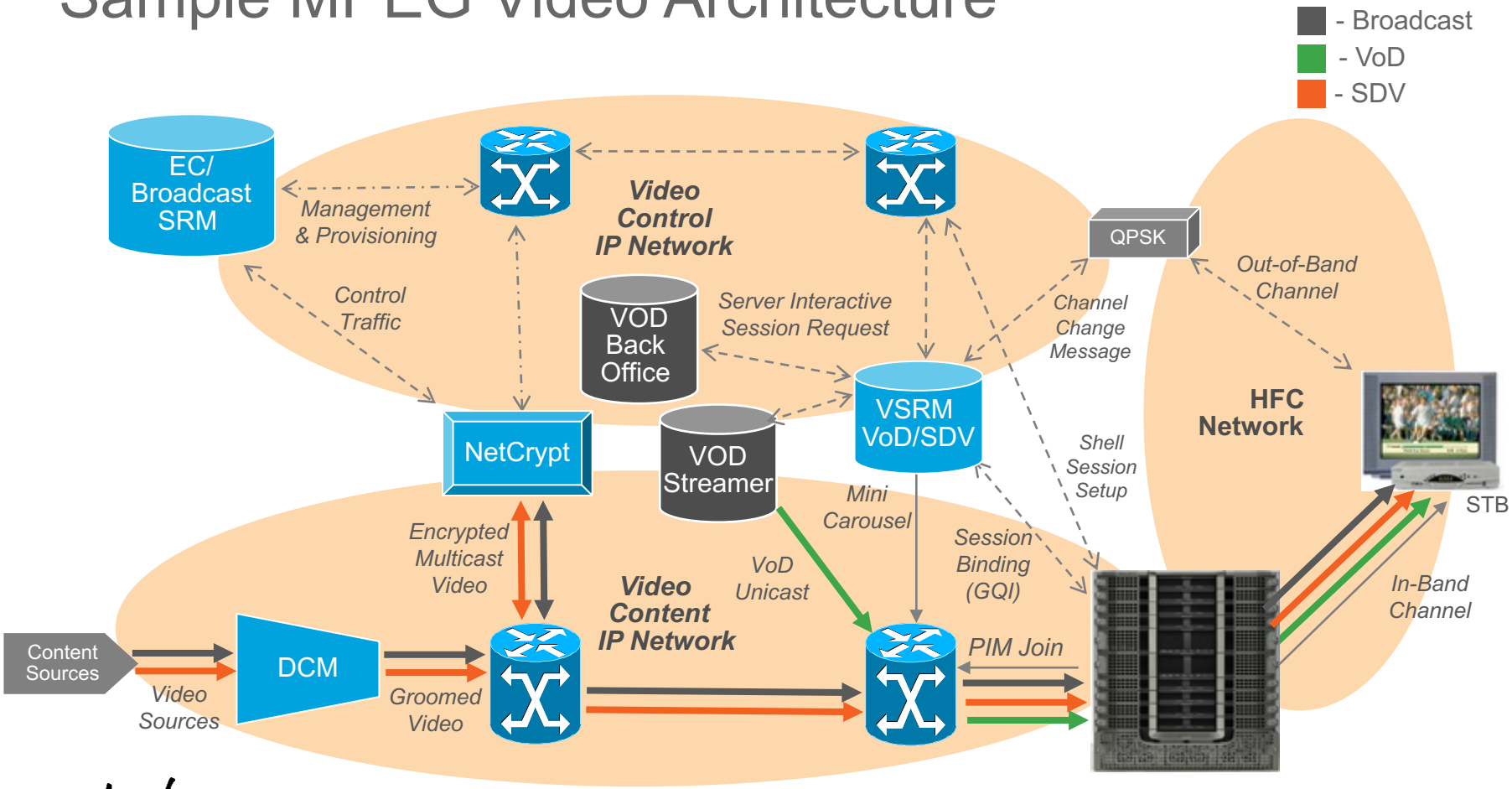
```
table-based
 vcg 100
  rf-channel 24-30
   session SESS1 bundle-id 10 start-udp-port 1024 processing-type remap vbr
  rf-channel 31
   session SESS2 input-port 2 start-udp-port 1031 processing-type remap vbr
```

Routing – IP Addressing Plan

- Tier based DVB Simulcrypt
  - Virtual Port Group IP subnet
  - Virtual Edge Input IP subnet
    - one VEI IP per LC
    - VRF (option)
  - IP address for ECMG server connection
    - Auto generated by cBR-8
  - ECMG server IP

- Additional IP addresses for Session based DVB Simulcrypt
  - EIS server IP
  - EIS TCP port

Sample MPEG Video Architecture



Cable Video Demo Configuration

```
cable video
  multicast-uplink Loopback0 access-list SSMrange
  mgmt-intf VirtualPortGroup 0
  service-distribution-group SDG_100 id 100
    rf-port integrated-cable 1/0/0
  service-distribution-group SDG_200 id 200
    rf-port integrated-cable 2/0/0
  service-distribution-group SDG_201 id 201
    rf-port integrated-cable 2/0/1
  service-distribution-group SDG_300 id 300
    rf-port integrated-cable 3/0/0
  service-distribution-group SDG_302 id 302
    rf-port integrated-cable 3/0/2
  service-distribution-group SDG_BC id 1000
    rf-port integrated-cable 2/0/0-1
    rf-port integrated-cable 3/0/0
  service-distribution-group SDG_NCR id 2000
    rf-port integrated-cable 3/0/0
    rf-port integrated-cable 3/0/2
```

```
bind-vcg
   vcg vcg_gqi_1-0 sdg SDG_100
   vcg VCG_200 sdg SDG_200
   vcg VCG_201 sdg SDG_201
   vcg VCG_300 sdg SDG_300
   vcg VCG_310 sdg SDG_NCR
   vcg VCG_BC sdg SDG_BC
```

```
virtual-carrier-group vcg_gqi_1-0 id 1
  service-type narrowcast
virtual-carrier-group vcg_gqi_1-0 id 1
  service-type narrowcast
  rf-channel 48-63 tsid 10048-10063 output-port-number 1-16
virtual-carrier-group VCG_200 id 200
  encrypt
  service-type narrowcast
  rf-channel 24-27 tsid 2024-2027 output-port-number 2024-2027
virtual-carrier-group VCG_201 id 201
  service-type narrowcast
  rf-channel 24-27 tsid 2124-2127 output-port-number 2124-2127
virtual-carrier-group VCG_300 id 300
  service-type narrowcast
  rf-channel 24-27 tsid 3024-3027 output-port-number 3024-3027
virtual-carrier-group VCG_302 id 302
  service-type narrowcast
  rf-channel 32 tsid 322 output-port-number 3232
virtual-carrier-group VCG_310 id 310
  service-type narrowcast
  rf-channel 32 tsid 32 output-port-number 3032
virtual-carrier-group VCG_BC id 10000
  service-type broadcast
  rf-channel 28-31 tsid 28-31 output-port-number 28-31
```

Cable Video Demo Configuration

```
logical-edge-device LED_2 id 2
  protocol table-based
    virtual-edge-input-ip 13.135.70.2 input-port-number 2
    vcg VCG_200
    vcg VCG_201
    active
logical-edge-device LED_3 id 3
  protocol table-based
    virtual-edge-input-ip 13.135.70.3 input-port-number 3
    vcg VCG_300
    active
logical-edge-device LED_BC id 32
  protocol table-based
    vcg VCG_BC
    active
```

```
  table-based
    multicast-label bc1 group 239.255.12.1 source 13.0.9.12 source2 13.0.9.19
    multicast-label bc2 group 239.255.12.2 source 13.0.9.12 source2 13.0.9.19
    multicast-label bc3 group 239.255.12.3 source 13.0.9.12 source2 13.0.9.19
    multicast-label bc4 group 239.255.12.4 source 13.0.9.12 source2 13.0.9.19
    vcg VCG_200
      rf-channel 24-25
        session S_200 input-port 2 start-udp-port 2024 num-sessions-per-qam 2 processing-type
remap start-program 1 cbr
    vcg VCG_201
      rf-channel 26-27
        session S_201 input-port 2 start-udp-port 2126 num-sessions-per-qam 2 processing-type
remap start-program 1 cbr
    vcg VCG_300
      rf-channel 24-25
        session S_300 input-port 3 start-udp-port 3024 num-sessions-per-qam 2 processing-type
remap start-program 1 cbr
    vcg VCG_BC
      rf-channel 28
        session bc1 multicast-label bc1 processing-type passthru
      rf-channel 29
        session bc2 multicast-label bc2 processing-type passthru
      rf-channel 30
        session bc3 multicast-label bc3 processing-type passthru
      rf-channel 31
        session bc4 multicast-label bc4 processing-type passthru
```

Configuration Example Description

- Service Group composed of 24 channels and 24x8 modems only
- Services offered are:
  - Live TV – split between popular (short tail) and long tail content
  - Managed Video (VoD)
  - High Speed Data
- Popular content using dedicated resources (4 rf-channels)
- Shared BGs for long tail content, managed video and data spanning 20 rf-channels
- Managed video is prioritized over HSD

Bonding Groups - Shared

- Primary bonding groups
  - All applications using the same BGs, no traffic steering required
  - Bandwidth control via ACFE and SGAC
- Secondary bonding group
  - Used for static multicast (popular TV)
  - Traffic steering required

```
interface Wideband-Cable2/0/0:20
 description Shared BG for Data,VoD,MC
 cable bundle 20
 cable rf-channels channel-list 0-19 bandwidth-percent 30

interface Wideband-Cable2/0/0:40
 description BC Short Tail Static
 cable bundle 20
 cable rf-channels channel-list 20-23 bandwidth-percent 1
 cable downstream attribute-mask 80000002
 cable igmp static-group 232.8.8.1 source 192.168.1.14 1
 cable igmp static-group 232.8.8.65 source 192.168.1.14 1
 cable bonding-group-secondary
```

Multicast & IGMP

- Multicast routing enabled globally
- PIM sparse-mode enabled on the Bundle and WAN interfaces
- IGMPv3 and IGMP static group definition on Bundle interface
- IGMPv2 and SSM definition if IGMPv3 not used

```
ip multicast-routing distributed

interface Wideband-Cable2/0/0:40
 cable igmp static-group 232.8.8.1 source 192.168.1.14 1
 cable igmp static-group 232.8.8.65 source 192.168.1.14 1

interface TenGigabitEthernet4/1/1
  ip pim sparse-mode

interface Bundle20.1
 ip pim sparse-mode
 ip igmp static-group 232.8.8.65 source 192.168.1.14
 ip igmp static-group 232.8.8.1 source 192.168.1.14
 ip igmp version 3
```

Multicast QoS

- Service Classes
- Multicast group-qos
  - Link to service classes
  - (S,G) definition
- Link to Bundle Interface and dynamic multicast bonding-group

```
cable service class 70 name MQOS_DEFAULT
cable service class 70 downstream
cable service class 70 min-rate 0
cable service class 70 priority 2
cable service class 71 name Data
cable service class 71 downstream
cable service class 72 name MQOS_Dynamic
cable service class 72 downstream
cable service class 72 min-rate 4000000
cable service class 73 downstream
cable service class 73 min-rate 4000000
cable service class 73 req-attr-mask 80000002
cable service class 73 name MQOS_Static
```

```
cable service class 74 name Mngd_Video
cable service class 74 downstream
cable service class 74 priority 7
cable service class 74 req-attr-mask 80000003

cable multicast group-qos default scn MQOS_DEFAULT aggregate
cable multicast group-qos 1 scn MQOS_Dynamic single
cable multicast group-qos 2 scn MQOS_Static single

cable multicast qos group 1 priority 1
 session-range 232.8.8.128 255.255.255.192 192.168.1.14 255.255.255.255
 group-qos 1
cable multicast qos group 2 priority 1
 session-range 232.8.8.0 255.255.255.192 192.168.1.14 255.255.255.255
 group-qos 2

interface Bundle20
 cable multicast-qos group 1
 cable multicast-qos group 2
interface Wideband-Cable2/0/0:20
 cable multicast-qos group 1
```

ACFE, SGAC & RCC Templates

- ACFE used for BE SF fairness and Adaptive CIR
- SGAC not needed in this use case
- RCC Templates required for modems to use all available RF channels

```
cable acfe enable

cable rcc-templates frequency-based 12
 rcp-id 00 10 00 00 18
 rcc-template 1
  module 1 channel 1-24 start-frequency 400000000

interface Cable2/0/0
 cable rcc-templates frequency-based 12
```

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