
cisco
You make possible

IP Video services on cBR-8 and Remote-Phy platforms

Design and Implementation

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BRKSPV-2303

cisco Live!
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Cisco Webex Teams

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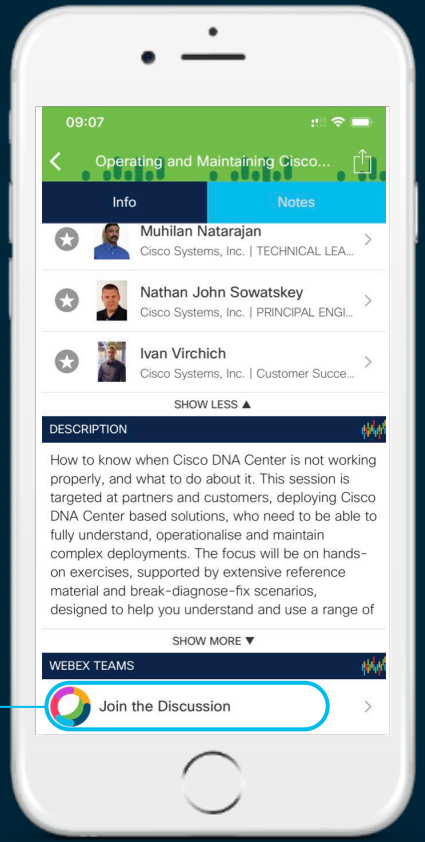
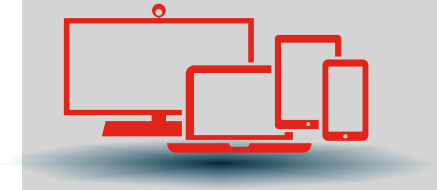


Agenda

- IP Video Migration Background
- Design concepts
- Configuration examples – Docsis 3.0 / Demo
- Docsis 3.1 design options
- Configuration examples – Docsis 3.1 / Demo
- Key Takeaways

IP Video Migration Background

Video Consumption Shifting to IP and Mobile



Millennials view 70% of TV online

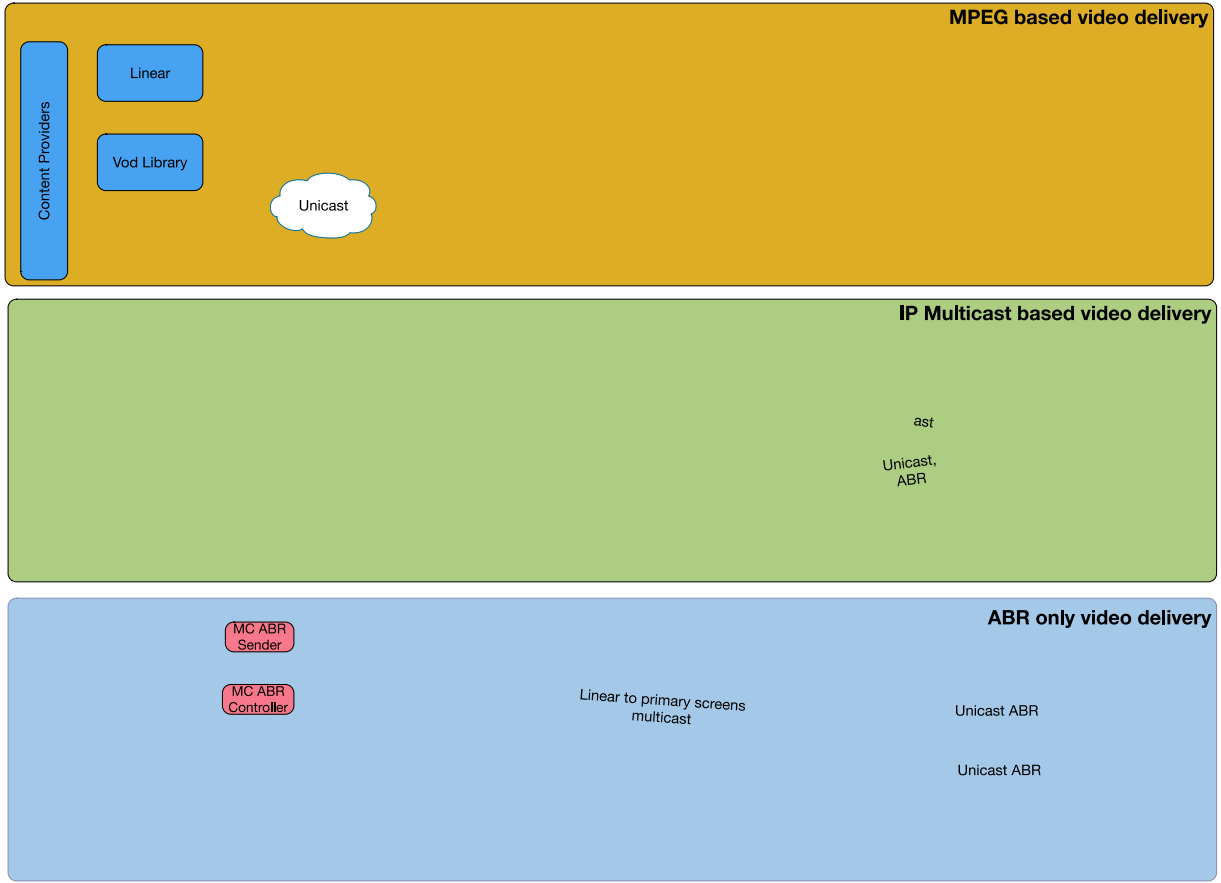
Millennials consume 2x more mobile video than 25-39 year olds

IP Video → 82% of IP traffic
Live IP Video 5% → 17%
IP Video to TV → 3x increase

Wired vs mobile traffic 48/52 vs 29/71

Source Cisco VNI 2017-2022

Video Delivery Architectures Evolution



Frequency Spectrum Offload

- Always-on channels reduction by implementing SDV concept over IP
  - Short Tail (popular channels) remain always-on
  - Long Tail (less popular channels) require one viewer in order to be broadcasted
- Utilize network resources efficiently for all services
  - Multiplex IP VoD / Data / Live TV (long tail) on common set of channels
- Analog reclamation
  - Use of IP STB instead of Digital STB for analog only customers

Other drivers for IP Video migration

- CAPEX and OPEX efficiency
  - Provide a unified portal to all video content
  - One common video content backend driven by ABR
  - One access network for all services
  - One STB for all access networks
- Targeted advertising and per user recommendations
- Introduce niche content in selected regions (switched video)
- OTT based “skinny bundles”
  - BYOD based, no STB dependency
  - Incentivizes higher data tiers adoption

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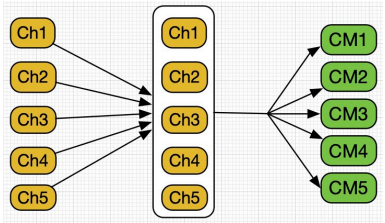
  - One STB f
- Targe
- Introdu regions (switched video)
- OTT ba "skinny bundles"
  - BYOD based, no STB dependency
  - Incentivizes higher data tiers adoption

Deliver any type of video service to any IP video device via an efficient, cost-effective, all-IP network

Design concepts

IP Video Delivery Methods

Broadcast

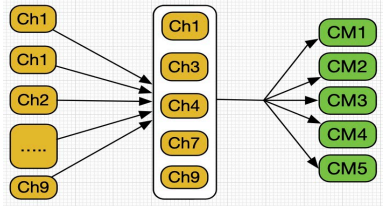


Linear TV delivered to all subs all the time (independent of usage)

Due to always-on nature, requires more spectrum than switched

Most suitable for dense service groups and popular programming

Switched

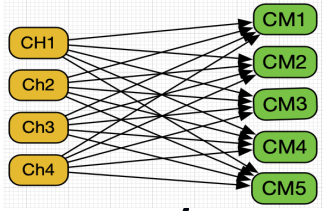


Linear TV delivered only to active viewers

Most efficient use of spectrum

Network sizing based on viewership statistics

Unicast



Personalized linear TV and VoD delivered to each subscriber

Highest CMTS DS capacity/cost and spectrum requirements

Alleviates multicast requirements on end-to-end IP Video system

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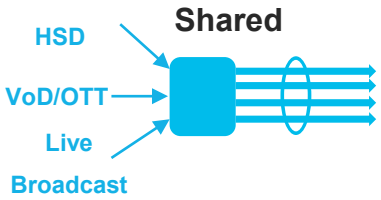
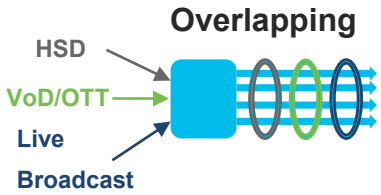
Service Separation – Downstream Service Flows

- Service Flow (SF) = stream of IP packets receiving the same QoS treatment
  - Traffic priority (0-7)
  - Minimum reserved rate
  - Priority Queueing
- Unicast vs multicast
- Best effort (BE) vs committed information rate (CIR)
- Static (pre-defined) vs dynamic (on-demand) SF establishment

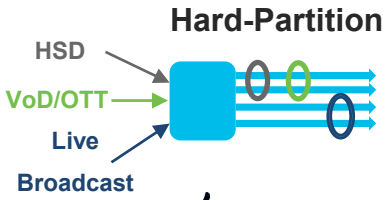
Service Separation – Bonding Groups



Common set of downstream channels, one bonding group



Common set of downstream channels, multiple (overlapping) bonding groups



Different sets of downstream channels, one or several bonding group

Unused bandwidth from one service cannot be used by another service

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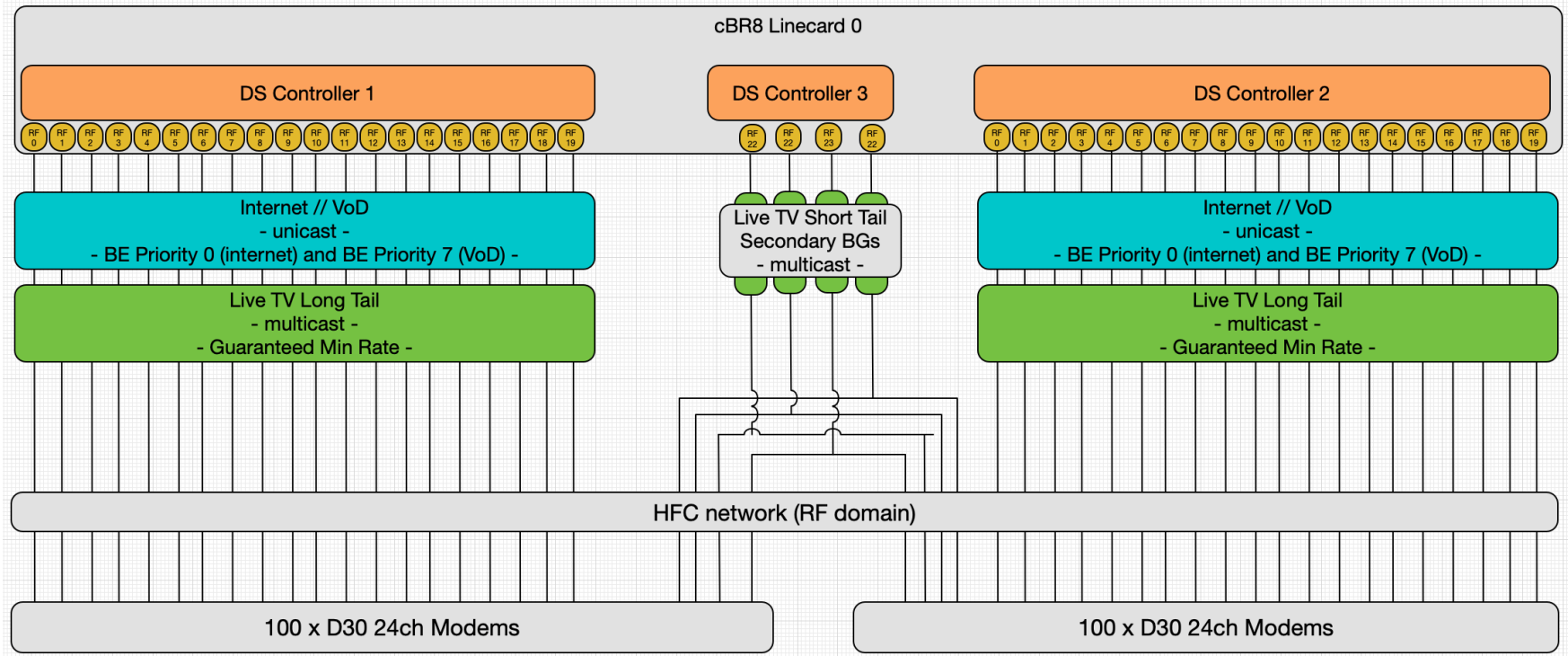
Traffic Steering

- Map IP packets to DOCSIS Service Flows (SF)
  - Static SF classifiers can use L2/L3/L4 fields for matching packets
  - Dynamic SF classifier signaled at session setup time
- Steer DOCSIS SFs to Bonding Groups (BG) via attributes
  - Attributes configured on Bonding Groups, service classes and modem configuration file
- Modems can receive traffic from multiple Bonding Groups
  - Ex. BG1 for Data and VoD (unicast), BG2 for Short Tail Live TV (multicast) and BG3 for Long Tail Live TV (multicast)
  - Receive Channel Set is not equivalent to a Bonding Group

BG Design Docsis 3.0 (cBR8 iCCAP)



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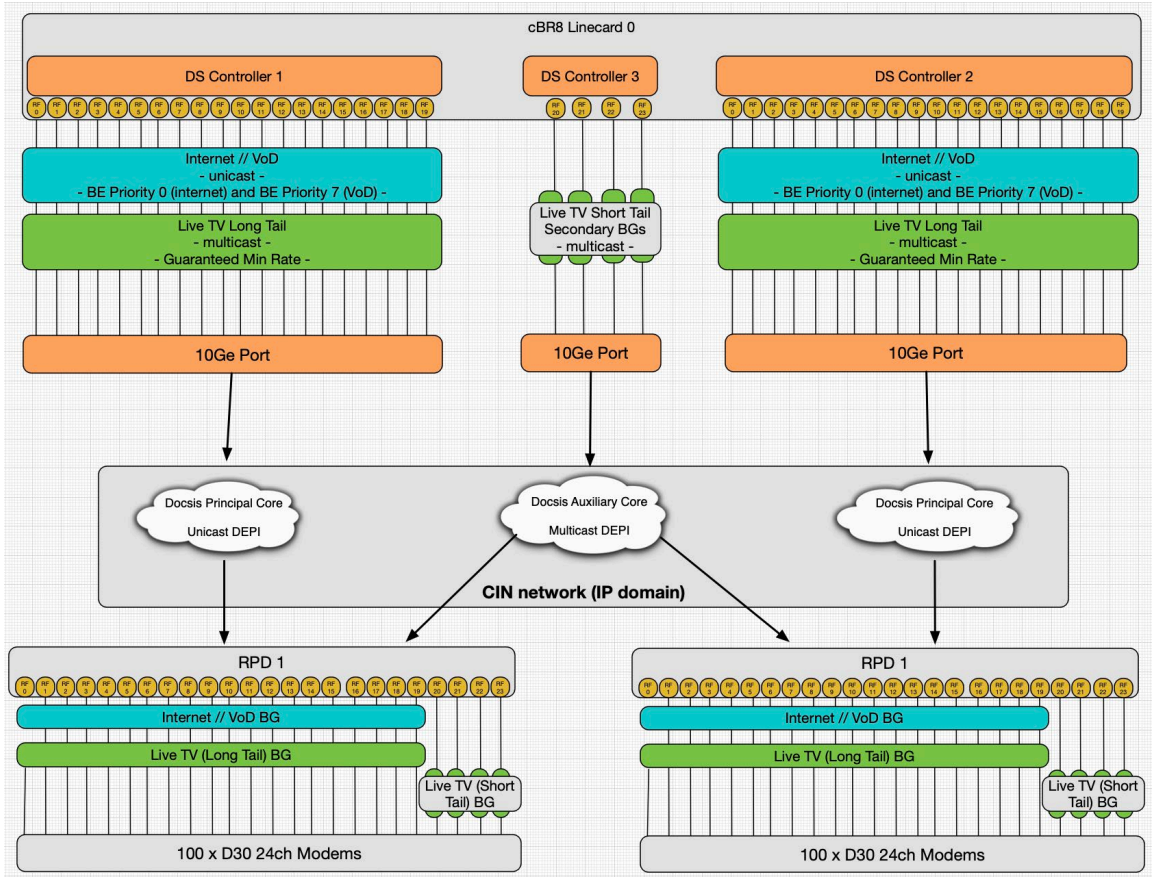
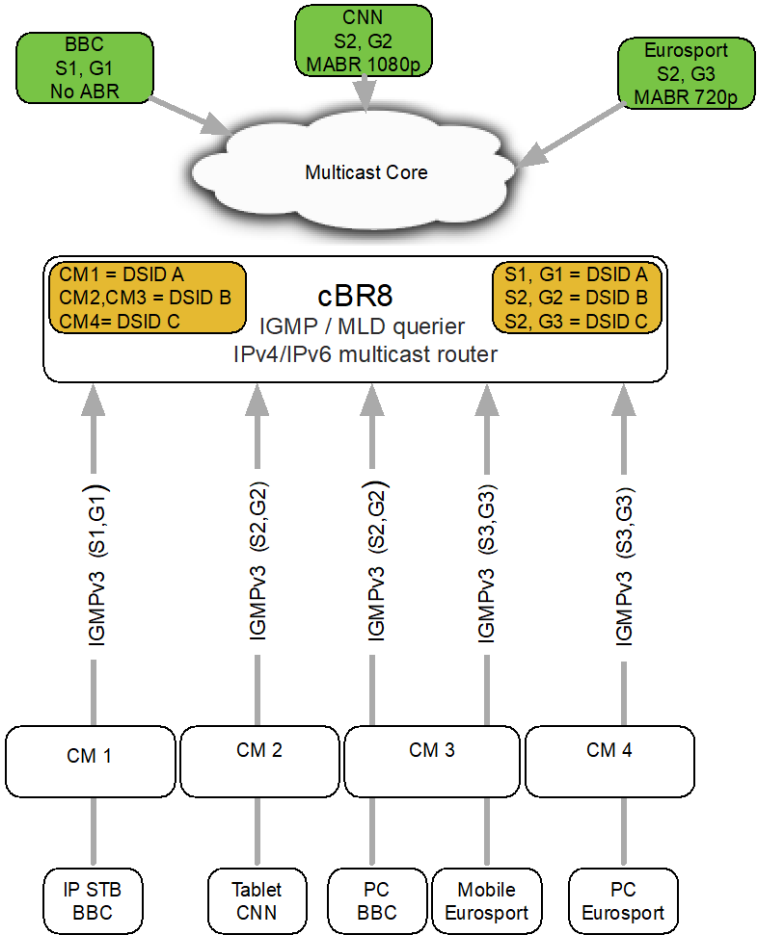


Multicast in DOCSIS

- Each (S,G) represents a multicast service flow and is assigned a DSID by the CMTS
- Multicast packets will have DSIDs appended to their headers
- DSIDs are distributed to modems based on IGMP requests initiated by CPEs
- DSIDs enable modems to do multicast traffic filtering (shared medium causes all modems to receive multicast traffic)



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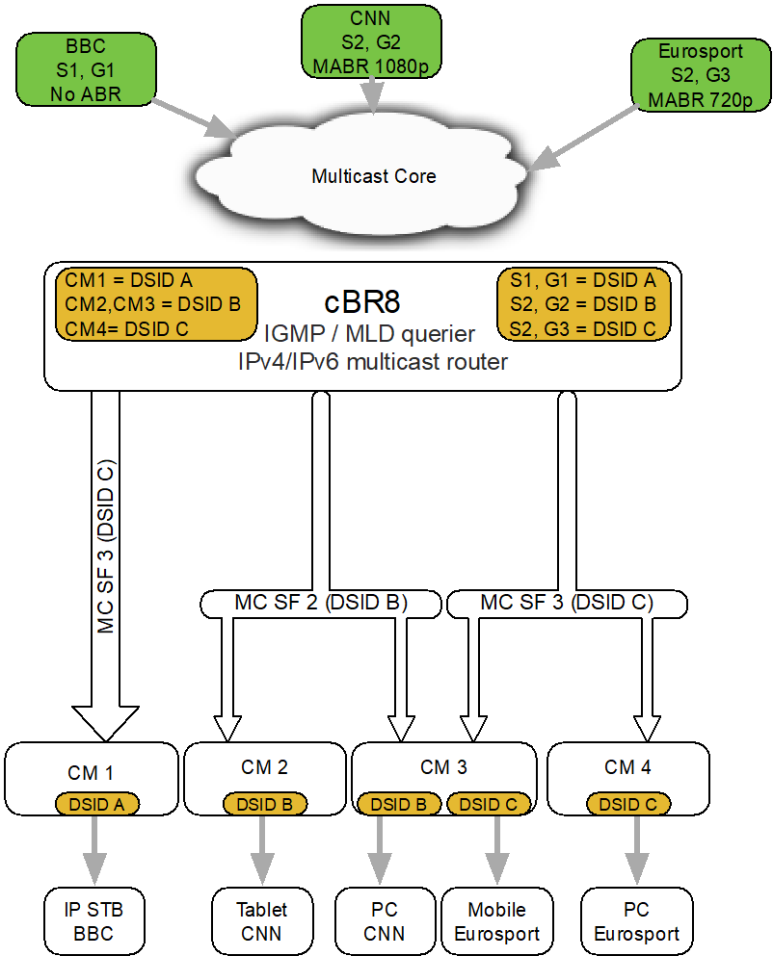
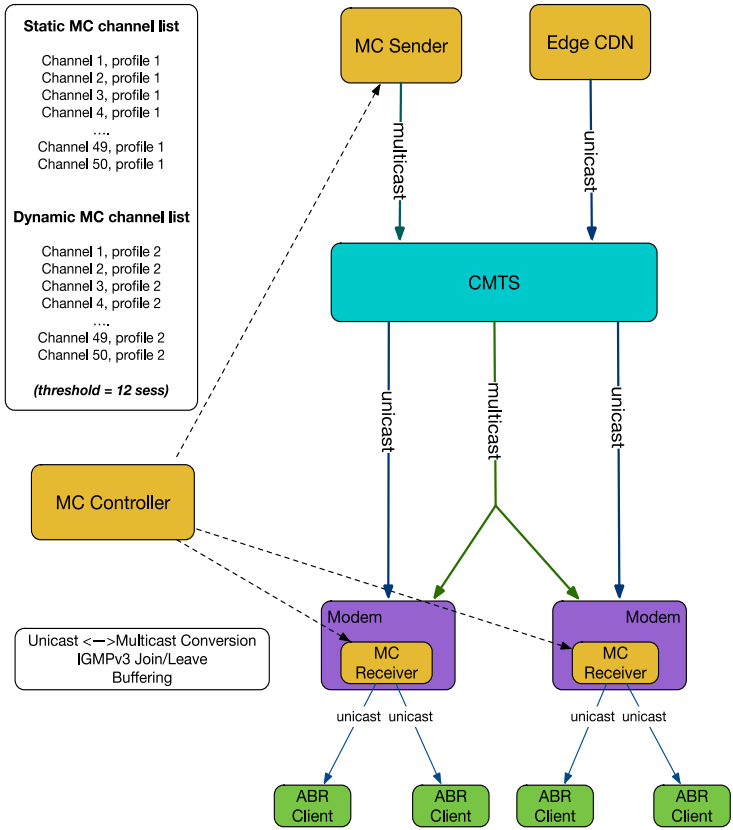


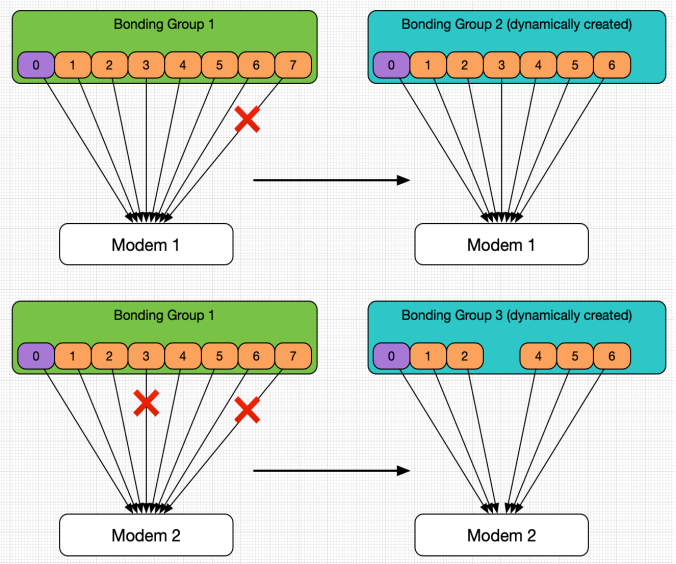
Multicast ABR

- Transparent to CMTS if multicast traffic is ABR or not
- Requires Controller, Sender and Receiver
- Multicast (S,G) per ABR profile
- Enhances CMTS multicast functionality:
  - Switched multicast (min n viewers vs min 1 viewer)
  - Fallback to unicast in case of multicast failures
- Multicast <--> Unicast traffic conversion performed by Receiver



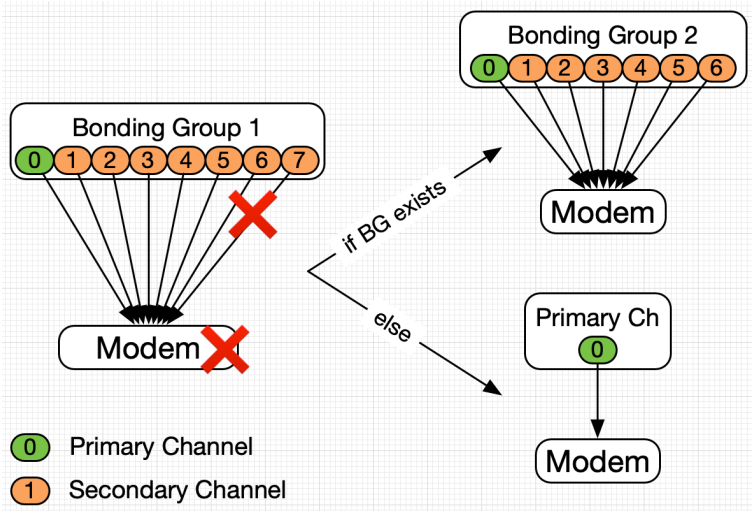
Downstream Resiliency

- Avoid modem reboot caused by DS RF channel impairment
- At RF impairement → creates new BG composed of working channels subset
- If larger number of modems (threshold) report issue with same channel → remove RF for all modems
- Reverts to original state when RF is healthy
- Applicable only to unicast SFs hosted by primary BG
- ✅ Maintains best service quality while providing a tool to detect RF issues



Downstream Resiliency & VDoC

- DS Resiliency feature not to be enabled with VDoC without STB being able to fallback from multicast to unicast in case of issues
- Without DS resiliency
  - ⚠ Modem reboots at any RF impairment
  - Re-register on the biggest available BG excluding the impaired RF or to primary channel if no BG is available
  - ⚠ Does not revert to original BG until modem reboot
- Options:
  - STB ability to monitor multicast streams and fallback to unicast in case of issues
  - Enable as many channels as primary to avoid congestion in case of impairment



Multicast running over available RF(s) after modem reload

QoS – unicast SFs (Data, VoD, other)

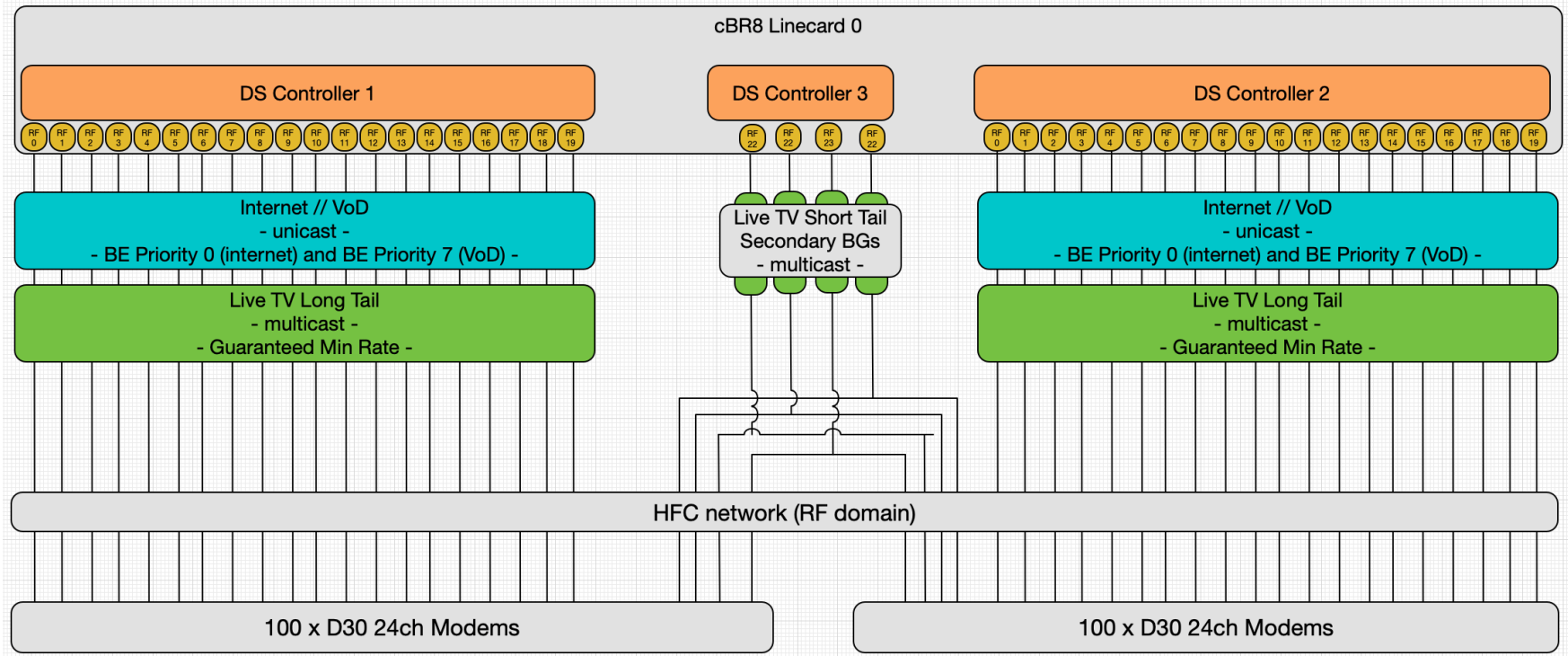
- Splitting vs aggregating services in SFs
- Best effort (BE) unicast SFs
  - BE SFs bandwidth allocation based on Docsis priority (0-7)
  - Per-BG guaranteed bandwidth proportional to the “aggregated active flow count weighted by DOCSIS priority plus 1
  - Prone to packet drop– ABR might help
- CIR unicast SFs (minimum rate guaranteed)
  - Limited number of CIR SFs in a given BG
  - Risk of SF being rejected, while new BE SFs will always be accepted
  - BE SFs still able to consume BW if CIR flows not utilised

QoS – multicast SFs (Live TV)

- Dedicated RF channels – overprovisioning vs fixed planning
- Minimum/Maximum Reserved Rate
- Service bundling over same group of RF-channels implies careful BW reservation planning
- Multiple ABR profiles for same content treated as different content
- Service Group admission control allows fine control over CIR SFs establishment based on application type

Configuration Examples (Docsis 3.0)

cBR8 iCCAP



Bonding Groups

- Primary bonding groups
  - Overlapping BGs for Data/VoD and Long Tail
  - Traffic steering required
  - Example includes only 24ch modem setup
- Secondary bonding group
  - Multiple 1ch BGs (due to resiliency)
  - Used for static multicast (short tail)

```
interface Wideband-Cable2/0/0:0
 description VdoC Data and VoD
 cable rf-channels channel-list 0-19 bandwidth-percent 1

interface Wideband-Cable2/0/0:11
 description VDOC Long Tail Multicast over D30
 cable rf-channels channel-list 0-19 bandwidth-percent 1
```

```
interface Wideband-Cable2/0/6:15
 description VDOC Short Tail Multicast over D30
 cable rf-channels channel-list 20 bandwidth-percent 1
 cable bonding-group-secondary

interface Wideband-Cable2/0/6:16
 description VDOC Short Tail Multicast over D30
 cable rf-channels channel-list 21 bandwidth-percent 1
 cable bonding-group-secondary

interface Wideband-Cable2/0/6:17
 description VDOC Short Tail Multicast over D30
 cable rf-channels channel-list 22 bandwidth-percent 1
 cable bonding-group-secondary

interface Wideband-Cable2/0/6:18
 description VDOC Short Tail Multicast over D30
 cable rf-channels channel-list 23 bandwidth-percent 1
 cable bonding-group-secondary
```

Service Flow Steering

- SF Steering to BGs done via:
  - Attribute masks (on service classes & BGs)
  - IGMP static statements (if secondary BG)
- Logical AND between required and configured attribute masks

```
cable service class 173 name Long_Tail_2M
cable service class 173 min-rate 2000000
cable service class 173 req-attr-mask 8000000A

cable service class 174 name Long_Tail_5M
cable service class 174 min-rate 5000000
cable service class 174 req-attr-mask 8000000A

cable service class 3 name Data
cable service class 3 req-attr-mask 80000010

cable service class 4 name VoD/OTT
cable service class 4 priority 7
cable service class 4 req-attr-mask 80000010
```

```
interface Wideband-Cable2/0/0:0.   → Data/OTT (20ch)
 cable downstream attribute-mask 80000090

interface Wideband-Cable2/0/0:11   → Long Tail(20ch)
 cable downstream attribute-mask 8000008A

interface Wideband-Cable2/0/6:15   → Short Tail(1ch)
 cable igmp static-group 234.8.8.237 1
 cable igmp static-group 234.8.8.236 1
 cable igmp static-group 234.8.8.235 1

interface Wideband-Cable2/0/6:16   → Short Tail(1ch)
 cable igmp static-group 234.8.8.233 1
 cable igmp static-group 234.8.8.232 1
 cable igmp static-group 234.8.8.231 1

interface Wideband-Cable2/0/6:17   → Short Tail(1ch)
 cable igmp static-group 234.8.8.230 1
 cable igmp static-group 234.8.8.229 1

interface Wideband-Cable2/0/6:18   → Short Tail(1ch)
 cable igmp static-group 234.8.8.228 1
 cable igmp static-group 234.8.8.227 1
 cable igmp static-group 234.8.8.226 1
```

Multicast & MQoS

- Multicast routing and PIM enabled
- IGMPv3 and PIM enabled on Bundle
- Assigns QoS to multicast groups as defined in service classes
- Default multicast class for any undefined groups

```
cable service class 70 name MQOS_DEFAULT
cable service class 70 priority 2

cable service class 173 name Long_Tail_2M
cable service class 173 min-rate 2000000
cable service class 173 req-attr-mask 8000000A

cable service class 173 name Long_Tail_5M
cable service class 173 min-rate 5000000
cable service class 173 req-attr-mask 8000000A

cable service class 171 name Short Tail

ip multicast-routing distributed

interface TenGigabitEthernet4/1/4
 ip pim sparse-mode
```

```
interface Bundle20
 ip igmp version 3
 ip pim sparse-mode
 cable multicast-qos group 102
 cable multicast-qos group 103
 cable multicast-qos group 104

cable multicast group-qos default scn MQOS_DEFAULT aggregate
cable multicast group-qos 12 scn Short Tail single
cable multicast group-qos 13 scn Long_Tail_2M single
cable multicast group-qos 14 scn Long_Tail_2M single

cable multicast qos group 102 priority 1
 session-range 232.8.8.128 255.255.255.192 172.30.210.40 255.255.255.255
group-qos 12

cable multicast qos group 103 priority 1
 session-range 232.8.8.0 255.255.255.192 172.30.210.40 255.255.255.255
group-qos 13

cable multicast qos group 104 priority 1
 session-range 232.8.8.64 255.255.255.192 172.30.210.40 255.255.255.255
group-qos 14
```

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cable service class 70 priority 2

cable service class 173 name Long_Tail_2M
cable service class 173 min-rate 2000000
cable service class 173 req-attr-mask 8000000A

cable service class 173 name Long_Tail_5M
cable service class 173 min-rate 5000000
cable service class 173 req-attr-mask 8000000A

cable service class 171 name Short Tail

ip multicast-routing distributed

interface TenGigabitEthernet4/1/4
 ip pim sparse-mode
```

```
interface Bundle20.1
 ip igmp version 3
 ip pim sparse-mode
 ip igmp explicit-tracking
 ip igmp static-group 234.8.8.237
 ip igmp static-group 234.8.8.233
 ip igmp static-group 234.8.8.230
 ip igmp static-group 234.8.8.228
[…]

interface Wideband-Cable2/0/0:11    → Long Tail(20ch)
 cable multicast-qos group 102
 cable multicast-qos group 103


interface Wideband-Cable2/0/6:15    → Short Tail(1ch)
 cable igmp static-group 234.8.8.237 1
 […]
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 cable igmp static-group 234.8.8.230 1
 […]
interface Wideband-Cable2/0/6:18    → Short Tail(1ch)
 cable igmp static-group 234.8.8.228 1
 […]
```

RCC Templates

- RCC Templates required for modems to use all available RF channels
- Standard RCP-ID can be used if frequency band is contiguous
- Custom RCC Templates can be defined if using modem supported RCP-ID

- ☑ For reference – example of custom 8ch RCC template with common module

```
cable rcc-templates frequency-based 1
 rcp-id 00 10 00 10 18
 common-module 1 channel 1-24 start-frequency 282000000
 rcc-template 1

interface Cable2/0/0
 cable rcc-templates frequency-based 1
```

RCC Templates

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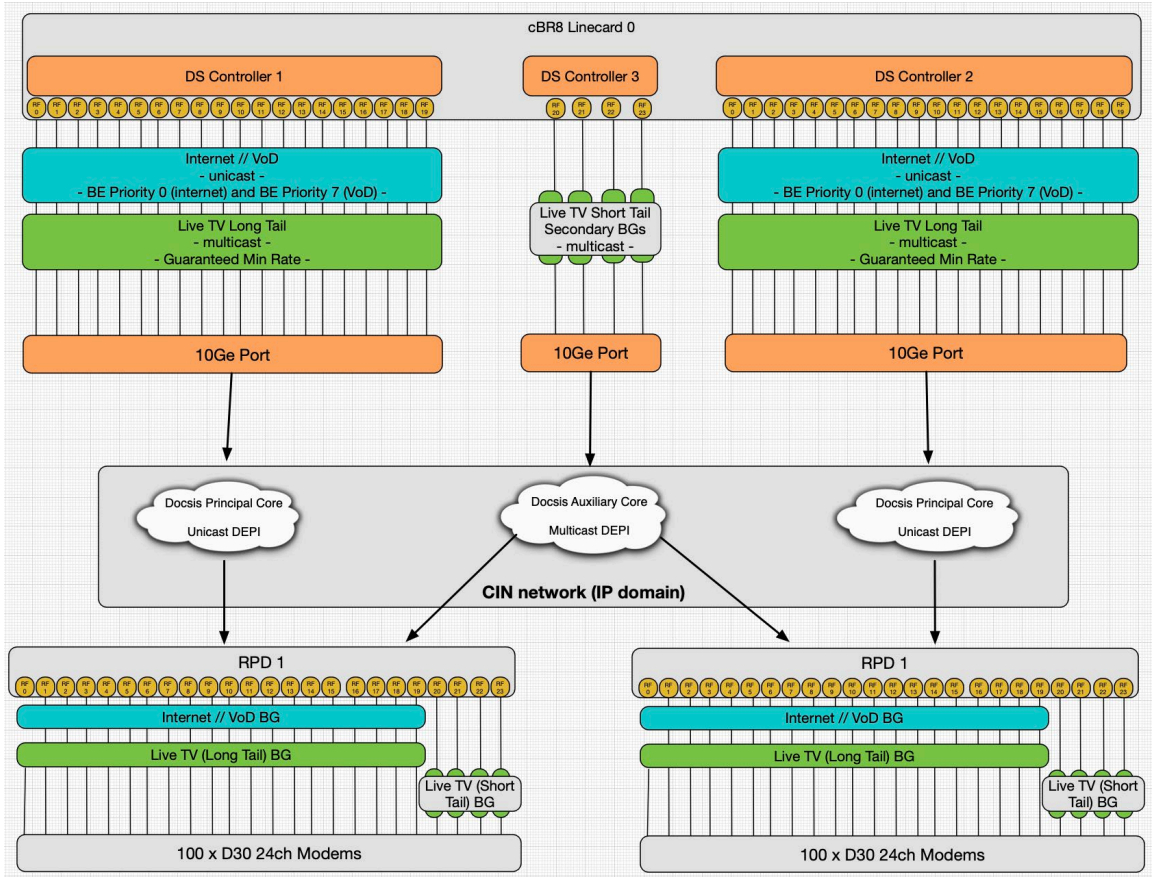
- Custom RCC Templates can be defined if using modem supported RCP-ID

- ☑ For reference – example of custom 8ch RCC template with common module

```
cable rcp-id 00 10 18 80 81
 name Custom_8ch_2modules
 center-frequency-spacing 8
 number-of-channels 8
 primary-capable-channels 1
 module 1 minimum-center-frequency 112000000 maximum-
center-frequency 999000000
 module 1 number-of-adjacent-channels 4
 module 1 connected-module 1
 module 2 minimum-center-frequency 112000000 maximum-
center-frequency 999000000
 module 2 number-of-adjacent-channels 4
 module 2 connected-module 2

cable rcc-templates frequency-based 3
 rcp-id 00 10 18 80 81
 common-module 2 channel 5-8 start-frequency 442000000
 rcc-template 1
  module 1 channel 1-4 start-frequency 282000000
 rcc-template 2
  module 1 channel 1-4 start-frequency 314000000
 rcc-template 3
  module 1 channel 1-4 start-frequency 346000000
 rcc-template 4
  module 1 channel 1-4 start-frequency 378000000
 rcc-template 5
  module 1 channel 1-4 start-frequency 410000000
```

cBR8 + Remote-Phy



Configuration

- Docsis config identical to iCCAP
  - BG Design
  - RCC Templates
  - Traffic Steering
  - Multicast and QoS
- Primary Core – Data/VoD + Long Tail
- Auxiliary Core – Short Tail
- Short Tail replication performed in CIN

```
cable downstream controller-profile 1
rf-chan 0 19
  type DOCSIS
  qam-profile 1
  frequency 282000000
```

```
cable downstream controller-profile 2
 multicast-pool 1
 rf-chan 20 23
  type DOCSIS
  qam-profile 1
  frequency 442000000

cable rpd RPD-1
identifier badb.ad14.14e4
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/16 profile 1
  rpd-us 0 upstream-cable 6/0/16 profile 10
 core-interface Te6/1/7                  → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2

cable rpd RPD-2
identifier badb.ad14.14f0
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/17 profile 1
  rpd-us 0 upstream-cable 6/0/17 profile 10
 core-interface Te6/1/7                  → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2
```

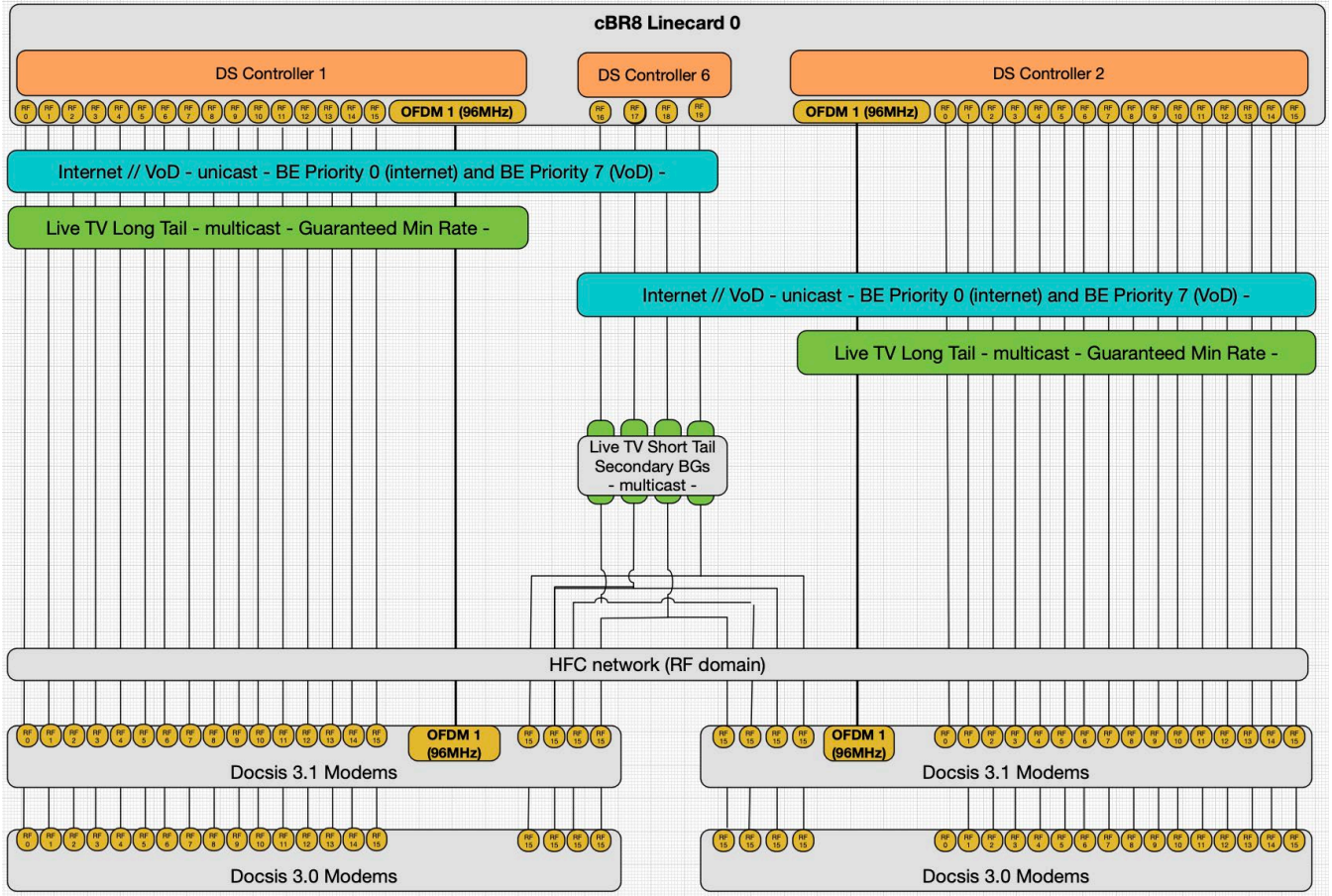
Demo

Design options (Docsis 3.1)

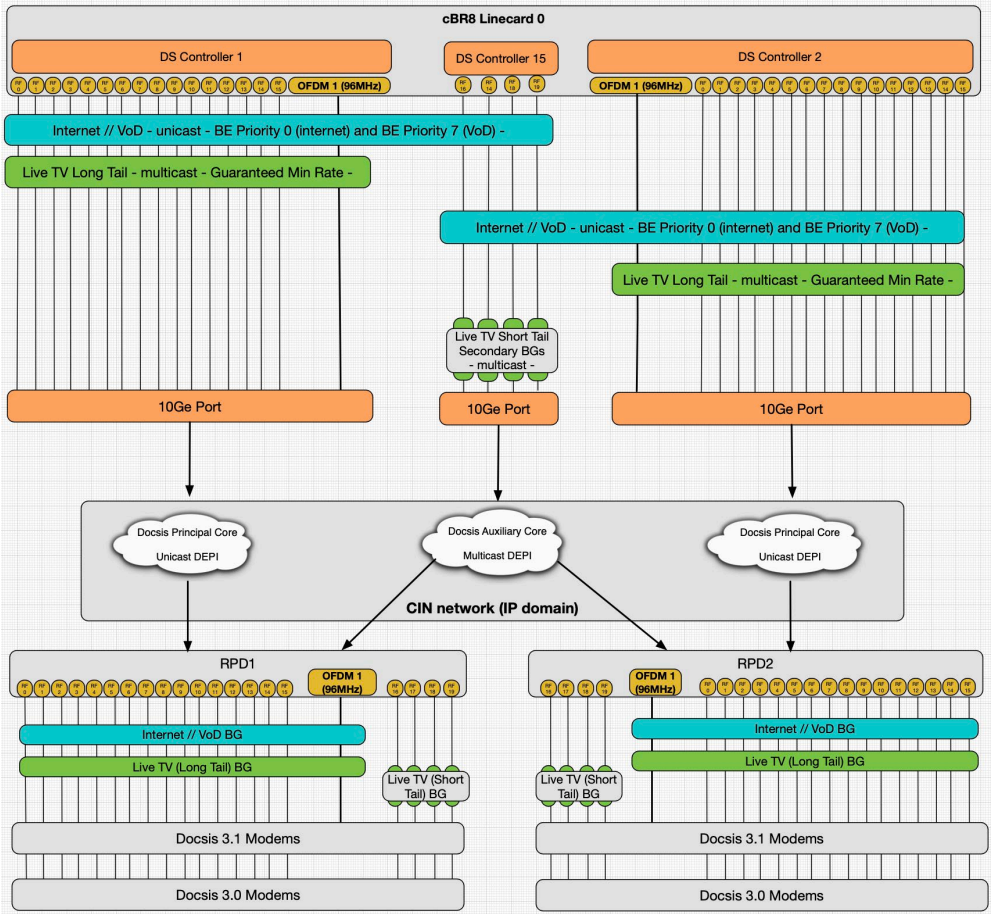
D31 VDoC considerations

- D3.1 → Multicast Traffic sent over OFDM profile 0 (control profile)
- RCC Templates not used for D31 modems
- Flexibility to allow multicast to be sent over OFDM or over D30 channels
- Multicast traffic always uses OFDM profile 0 → extra capacity can be used by other services
- No easy DS Resiliency solution → rely on STB to deal with multicast packet loss by unicast fallback (complex workarounds possible)

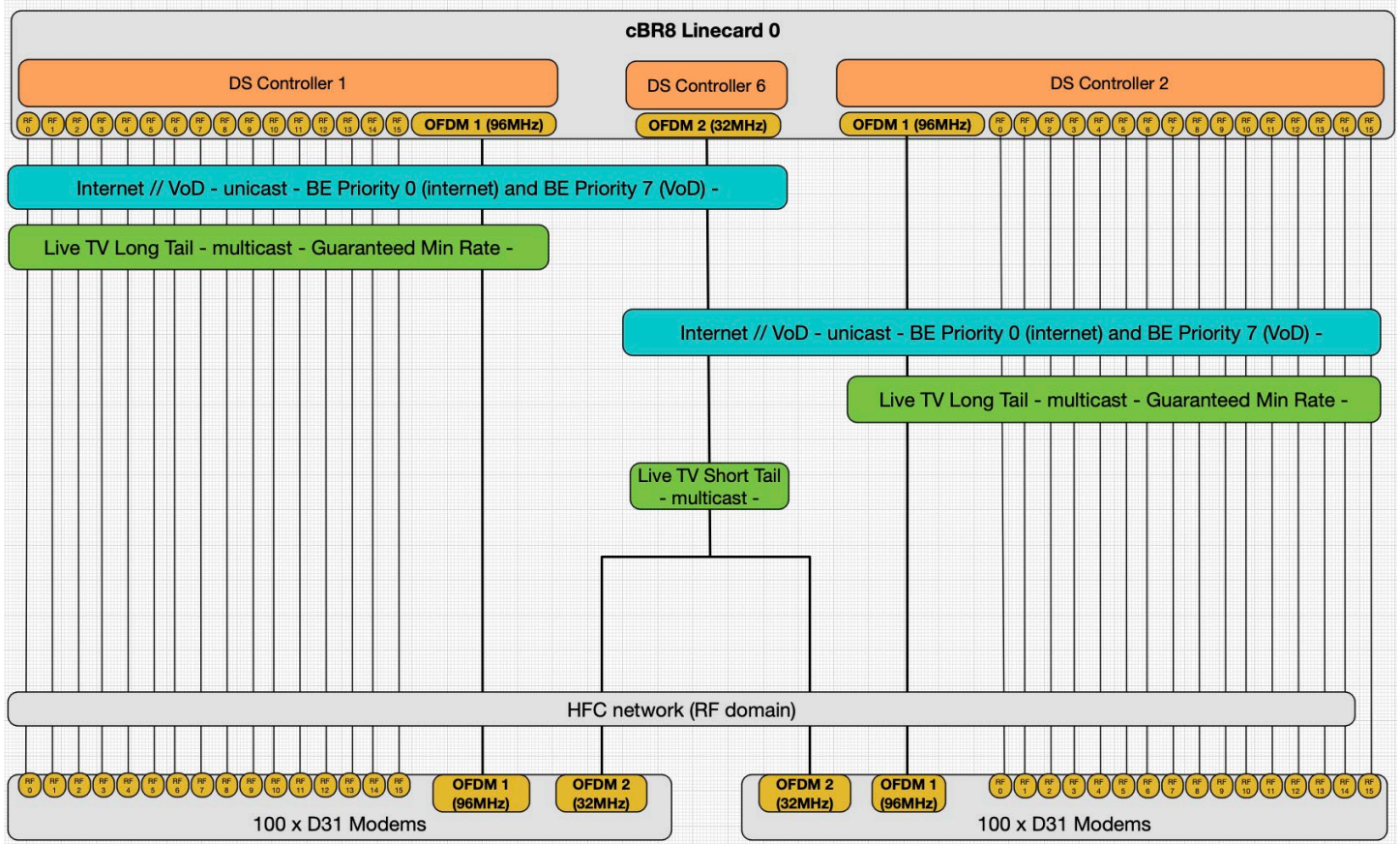
cBR8 (Short Tail over SC-QAM)



Remote-Phy (Short Tail over SC-QAM)



cBR8 (Short Tail over OFDM)



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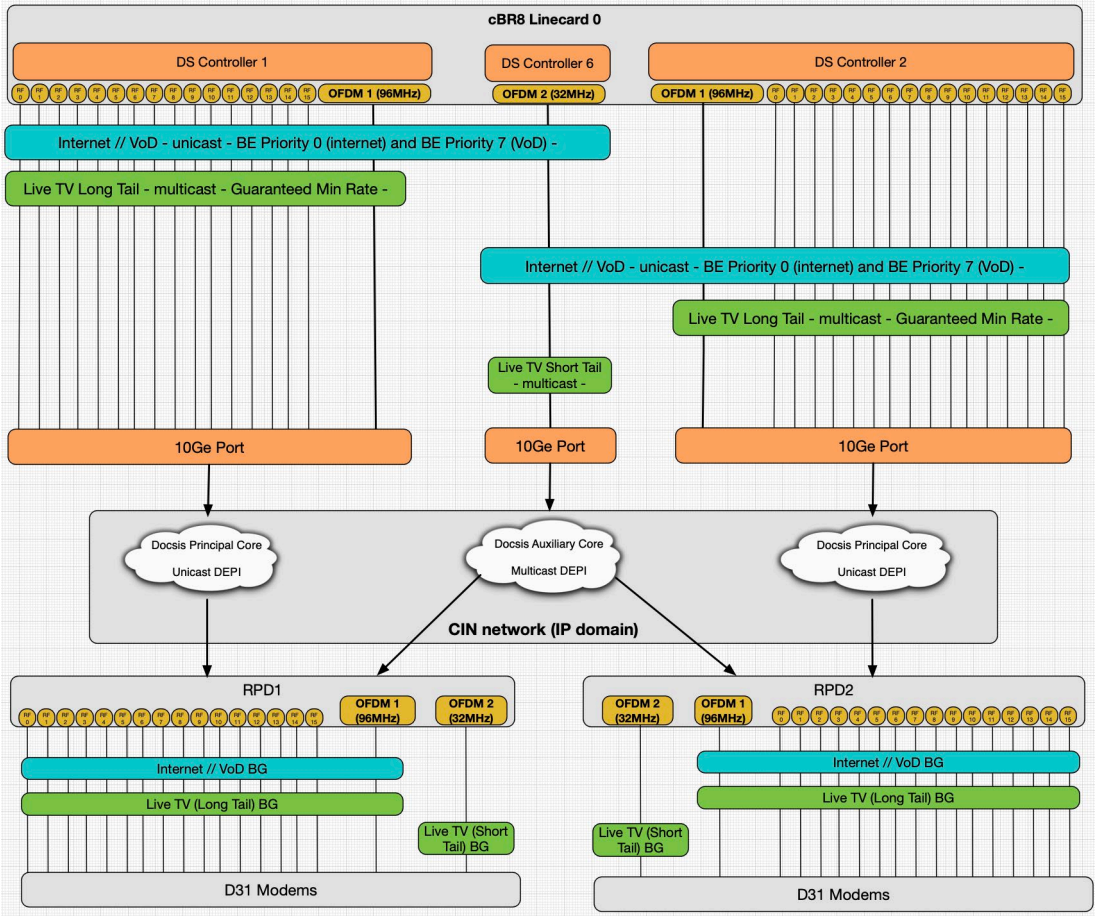
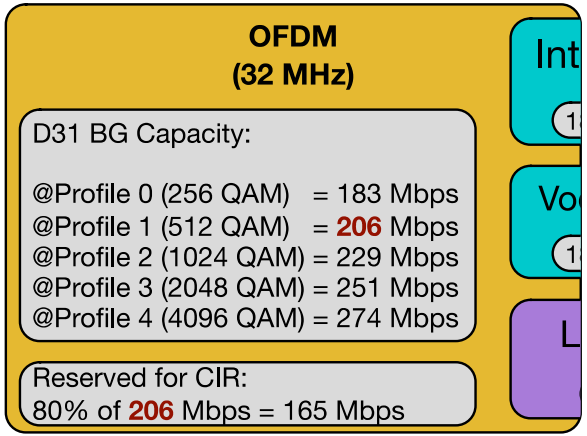


D31 Bandwidth scheduling considerations

- How to dedicate as much OFDM BW to static multicast?
- Traffic scheduled on OFDM before D30 channels
- OFDM total capacity calculated based on the modulation profile
- Max 80% of OFDM can be reserved for CIR flows (calculated at profile 1)
- Multicast SFs always using the control profile (0)

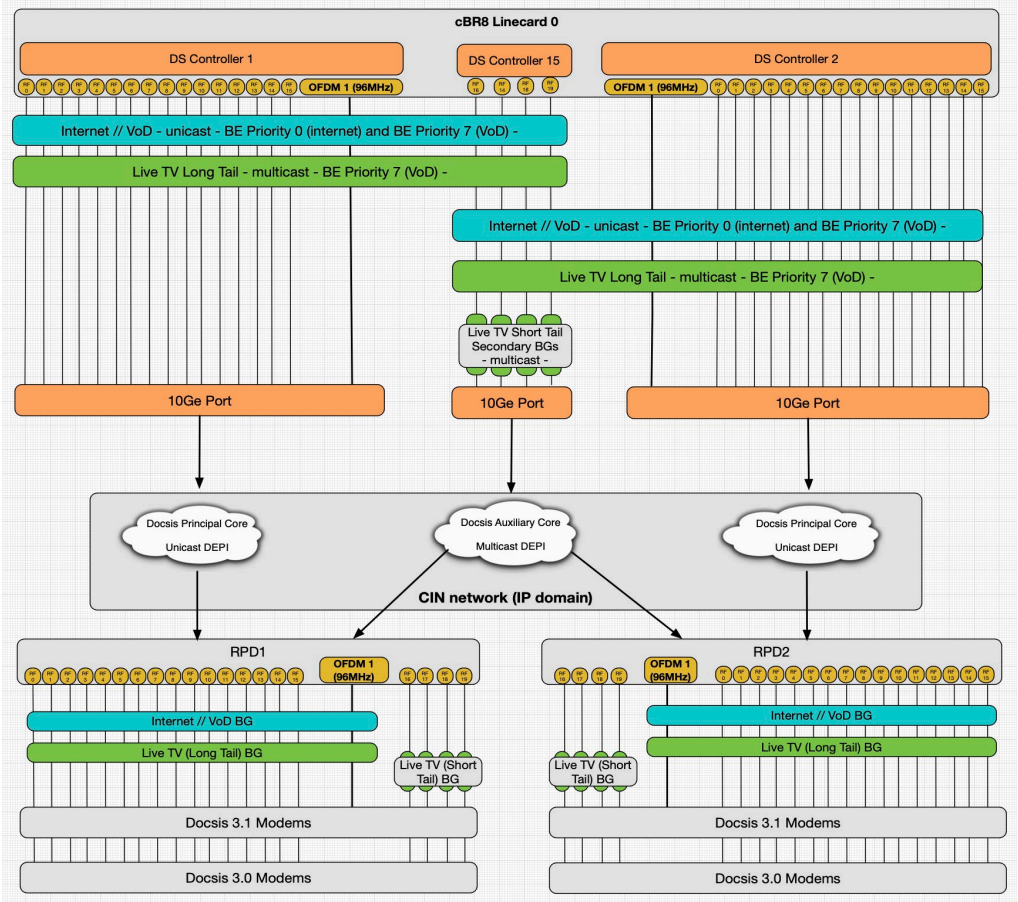
👍 CIR Reservation > 80% by increasing OFDM profile 1 modulation order



s (prof 0)

Configuration Examples (Docsis 3.1)

Remote-Phy (Short Tail over SC-QAM)



Bonding Groups

- Short tail live BC contained to pre-configured D30 spectrum and rate guaranteed
- Short Tail content established at configuration time and persistent
- Data, VOD and Long Tail using D30 + OFDM resources

```
interface Wideband-Cable6/0/3:40 (Data and VoD)
 cable rf-channels channel-list 0-7
 cable rf-channels controller 15 channel-list 8-11

interface Wideband-Cable6/0/3:41 (Long Tail Mcast)
 cable rf-channels channel-list 0-7 bandwidth-percent 50
 cable multicast-qos group 102
 cable multicast-qos group 103
```

```
interface Wideband-Cable6/0/15:0
 cable rf-channels channel-list 8 bandwidth-percent 96
 cable igmp static-group 235.200.1.1 source 10.62.157.175 1
 […]

interface Wideband-Cable6/0/15:1
 cable rf-channels channel-list 9 bandwidth-percent 96
 cable igmp static-group 235.200.1.8 source 10.62.157.175 1
[…]

interface Wideband-Cable6/0/15:2
 cable rf-channels channel-list 10 bandwidth-percent 96
 cable igmp static-group 235.200.1.13 source 10.62.157.175 1
[…]

interface Wideband-Cable6/0/15:3
 cable rf-channels channel-list 11 bandwidth-percent 96
 igmp static-group 235.200.1.17 source 10.62.157.175 1
[…]
```

Bonding Groups

- Short tail live BC contained to pre-configured D30 spectrum and rate guaranteed
- Short Tail content established at configuration time and persistent
- Data, VOD and Long Tail using D30 + OFDM resources

```
interface Wideband-Cable6/0/3:40 (Data and VoD)
 cable rf-channels channel-list 0-7
 cable rf-channels controller 15 channel-list 8-11
```

```
interface Wideband-Cable6/0/3:50 (Data and VoD D31)
 cable rf-channels channel-list 0-7 158
 cable rf-channels controller 15 channel-list 8-11

interface Wideband-Cable6/0/3:51 (Long Tail Mcast D31)
 cable rf-channels channel-list 0-7 158
 cable multicast-qos group 102
 cable multicast-qos group 103
```

```
interface Wideband-Cable6/0/15:0
 cable rf-channels channel-list 8 bandwidth-percent 96
 cable igmp static-group 235.200.1.1 source 10.62.157.175 1
 […]

interface Wideband-Cable6/0/15:1
 cable rf-channels channel-list 9 bandwidth-percent 96
 cable igmp static-group 235.200.1.8 source 10.62.157.175 1
[…]

interface Wideband-Cable6/0/15:2
 cable rf-channels channel-list 10 bandwidth-percent 96
 cable igmp static-group 235.200.1.13 source 10.62.157.175 1
[…]

interface Wideband-Cable6/0/15:3
 cable rf-channels channel-list 11 bandwidth-percent 96
 igmp static-group 235.200.1.17 source 10.62.157.175 1
[…]
```

Service Flow Steering

- SF Steering to BGs done via:
  - Attribute masks (on service classes & BGs)
  - ⚠ IGMP static statements no longer used as steering option as in D30
- Logical AND between required and configured attribute masks

```
cable service class 3 name Data
cable service class 3 req-attr-mask 80000010

cable service class 4 name VoD/OTT
cable service class 4 priority 7
cable service class 4 req-attr-mask 80000010

cable service class 173 name Long_Tail_2M
cable service class 173 min-rate 2000000
cable service class 173 req-attr-mask 8000000A

cable service class 174 name Long_Tail_5M
cable service class 174 min-rate 5000000
cable service class 174 req-attr-mask 8000000A
```

```
cable service class 172 name Short_Tail
cable service class 172 min-rate 5000000
cable service class 172 req-attr-mask 80000009

interface Wideband-Cable6/0/3:40     → Data/OTT
 cable downstream attribute-mask 80000090
interface Wideband-Cable6/0/3:50     → Data/OTT
 cable downstream attribute-mask 80000090

interface Wideband-Cable6/0/3:41     → Long Tail
 cable downstream attribute-mask 80000090
interface Wideband-Cable6/0/3:51     → Long Tail
 cable downstream attribute-mask 80000090

interface Wideband-Cable6/0/15:0     → Short Tail
  cable downstream attribute-mask 80000089
interface Wideband-Cable6/0/15:1     → Short Tail
  cable downstream attribute-mask 80000089
interface Wideband-Cable6/0/15:2     → Short Tail
  cable downstream attribute-mask 80000089
interface Wideband-Cable6/0/15:3     → Short Tail
  cable downstream attribute-mask 80000089
```

RPD Configuration

- Docsis config identical to iCCAP
  - BG Design
  - RCC Templates (for D30 only)
  - Traffic Steering
  - Multicast and QoS
- Primary Core – Data/VoD + Long Tail
- Auxiliary Core – Short Tail
- Short Tail replication performed in CIN

```
cable downstream controller-profile 1
 rf-chan 0 15
  type DOCSIS
  qam-profile 1
  frequency 282000000
 rf-chan 158
  ofdm channel-profile 77 start-frequency 600000000
width 96000000 plc 610000000
```

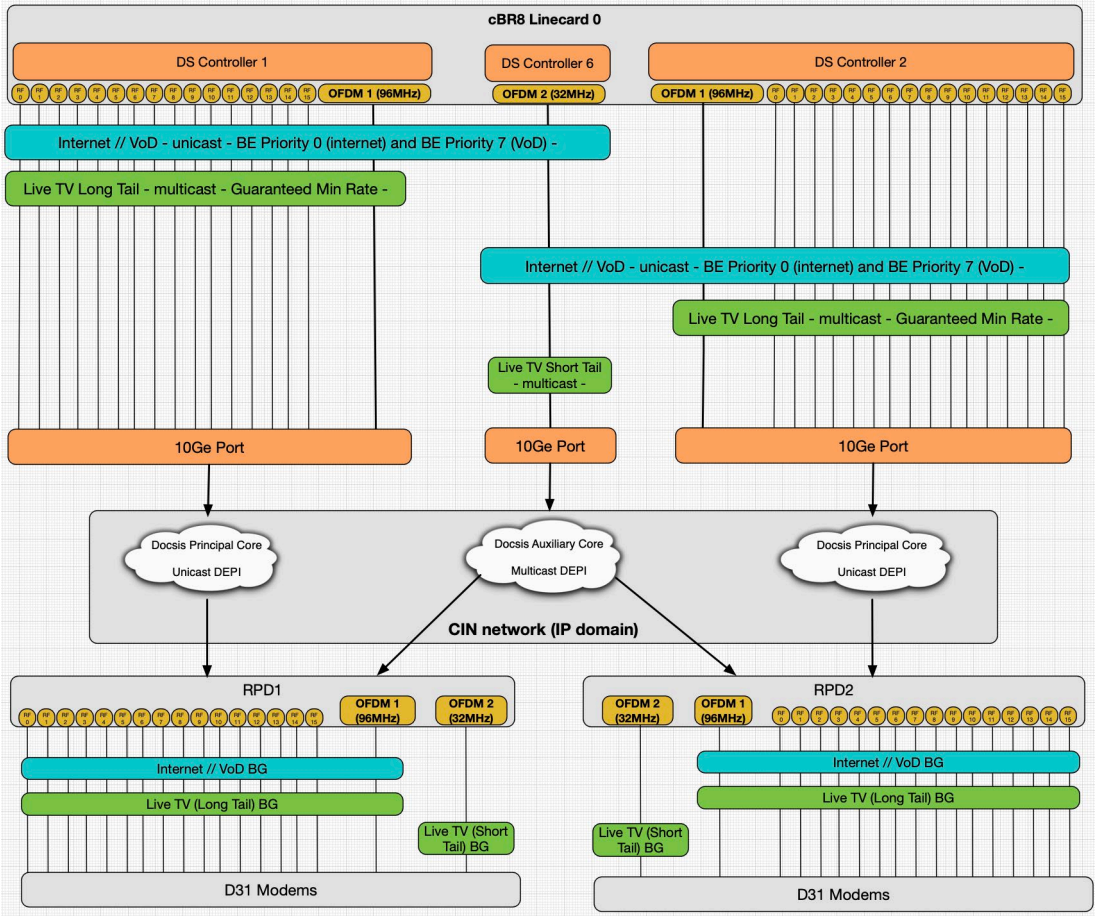
```
cable downstream controller-profile 2
 multicast-pool 1
 rf-chan 16 19
  type DOCSIS
  qam-profile 1
  frequency 442000000

cable rpd RPD-1
identifier badb.ad14.14e4
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/16 profile 1
  rpd-us 0 upstream-cable 6/0/16 profile 10
 core-interface Te6/1/7                  → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2

cable rpd RPD-2
identifier badb.ad14.14f0
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/17 profile 1
  rpd-us 0 upstream-cable 6/0/17 profile 10
 core-interface Te6/1/7                  → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2
```

Demo

Remote-Phy (Short Tail over OFDM)



Bonding Groups & Steering

- Short tail live BC contained to pre-configured D31 spectrum and rate guaranteed
- Data, VOD and Long Tail using D30 + OFDM resources
- ⚠ IGMP static statements no longer used as steering option as in D30

```
cable service class 3 name Data
cable service class 3 req-attr-mask 80000010

cable service class 4 name VoD/OTT
cable service class 4 priority 7
cable service class 4 req-attr-mask 80000010

cable service class 173 name Long_Tail_2M
cable service class 173 min-rate 2000000
cable service class 173 req-attr-mask 8000000A

cable service class 174 name Long_Tail_5M
cable service class 174 min-rate 5000000
cable service class 174 req-attr-mask 8000000A
```

```
interface Wideband-Cable6/0/3:60 (Data and VoD)
 cable rf-channels channel-list 0-7 158
 cable rf-channels controller 15 channel-list 159
 cable downstream attribute-mask 80000090

interface Wideband-Cable6/0/3:61 (Long Tail Mcast)
 cable rf-channels channel-list 0-7 158 bandwidth-percent 50
 cable multicast-qos group 102
 cable multicast-qos group 103
 cable downstream attribute-mask 8000008A

interface Wideband-Cable6/0/3:61 (Short Tail Mcast)
 cable rf-channels channel-list 159 bandwidth-percent 95
 cable downstream attribute-mask 80000089
 cable igmp static-group 235.200.1.1 source 10.62.157.175 1
 cable igmp static-group 235.200.1.2 source 10.62.157.175 1
 cable igmp static-group 235.200.1.3 source 10.62.157.175 1
 cable igmp static-group 235.200.1.4 source 10.62.157.175 1
 cable igmp static-group 235.200.1.5 source 10.62.157.175 1
[…]
```

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RPD Configuration

- Docsis config identical to iCCAP
  - BG Design
  - Traffic Steering
  - Multicast and QoS
- Primary Core – Data/VoD + Long Tail
- Auxiliary Core – Short Tail
- Short Tail replication performed in CIN

```
cable downstream controller-profile 1
 rf-chan 0 15
  type DOCSIS
  qam-profile 1
  frequency 282000000
 rf-chan 158
  ofdm channel-profile 77 start-frequency 600000000
width 96000000 plc 610000000
```

```
cable downstream controller-profile 2
 multicast-pool 1
 rf-chan 159
 ofdm channel-profile 178 start-frequency 800000000 width
32000000 plc 810000000

cable rpd RPD-1
identifier badb.ad14.14e4
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/16 profile 1
  rpd-us 0 upstream-cable 6/0/16 profile 10
 core-interface Te6/1/7        → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2

cable rpd RPD-2
identifier badb.ad14.14f0
 core-interface Te6/1/4        → Data/VoD + Long Tail
  principal
  rpd-ds 0 downstream-cable 6/0/17 profile 1
  rpd-us 0 upstream-cable 6/0/17 profile 10
 core-interface Te6/1/7        → Short Tail
  rpd-ds 0 downstream-cable 6/0/30 profile 2
```

Demo

Key Takeaways

- Video shifting to IP and mobile
- IP Video enables spectrum offload, one delivery network and new services
- IP Video can be delivered as broadcast, switched or unicast
- Design elements – Overlapping BGs, traffic steering, QoS, DOCSIS multicast
- IP Video over Docsis3.1 and R-Phy is possible today
- Configurations and demos as enabler for testing the solution in a simple and efficient way

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