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cBR-8 & CCAP

Leveraging Operational Best Practices

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BRKSPG-2515

Cisco live!

June 9-13, 2019 · San Diego, CA

Agenda

- CCAP Introduction
- Operational Best Practices for cBR-8 Features & Tools
- Troubleshooting Techniques for CCAP Services
- cBR-8 Optimizations and Automation
- Summary
- Q & A

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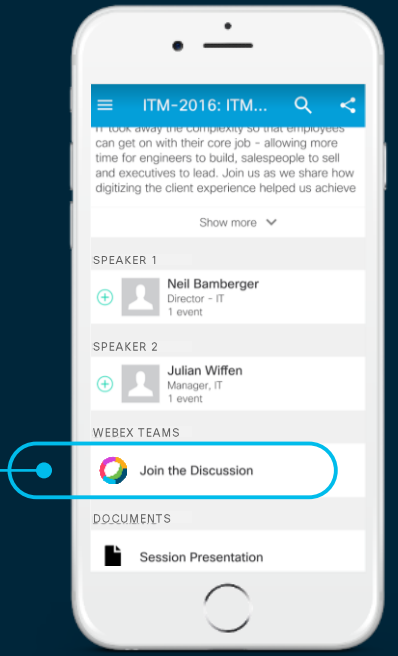

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CCAP Introduction

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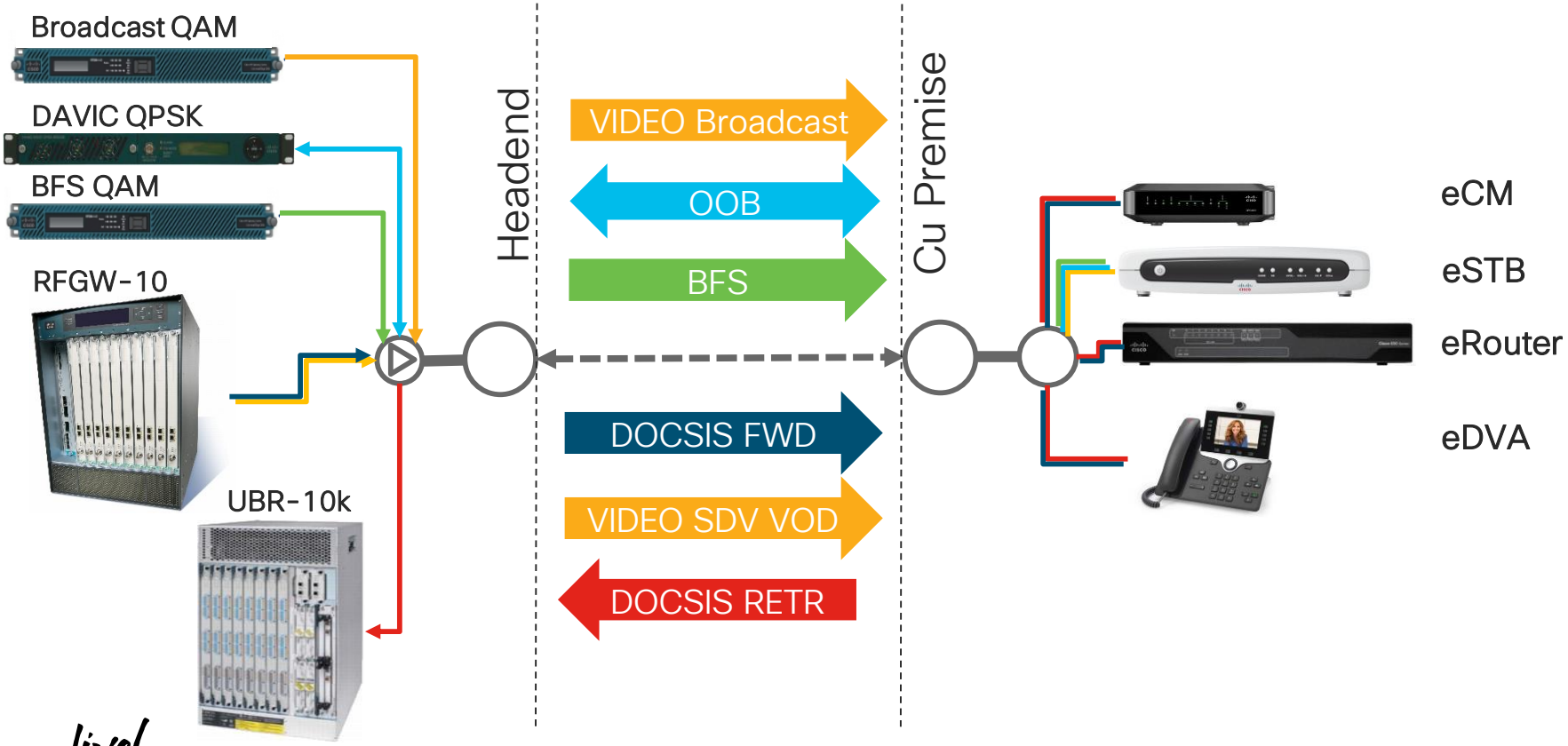
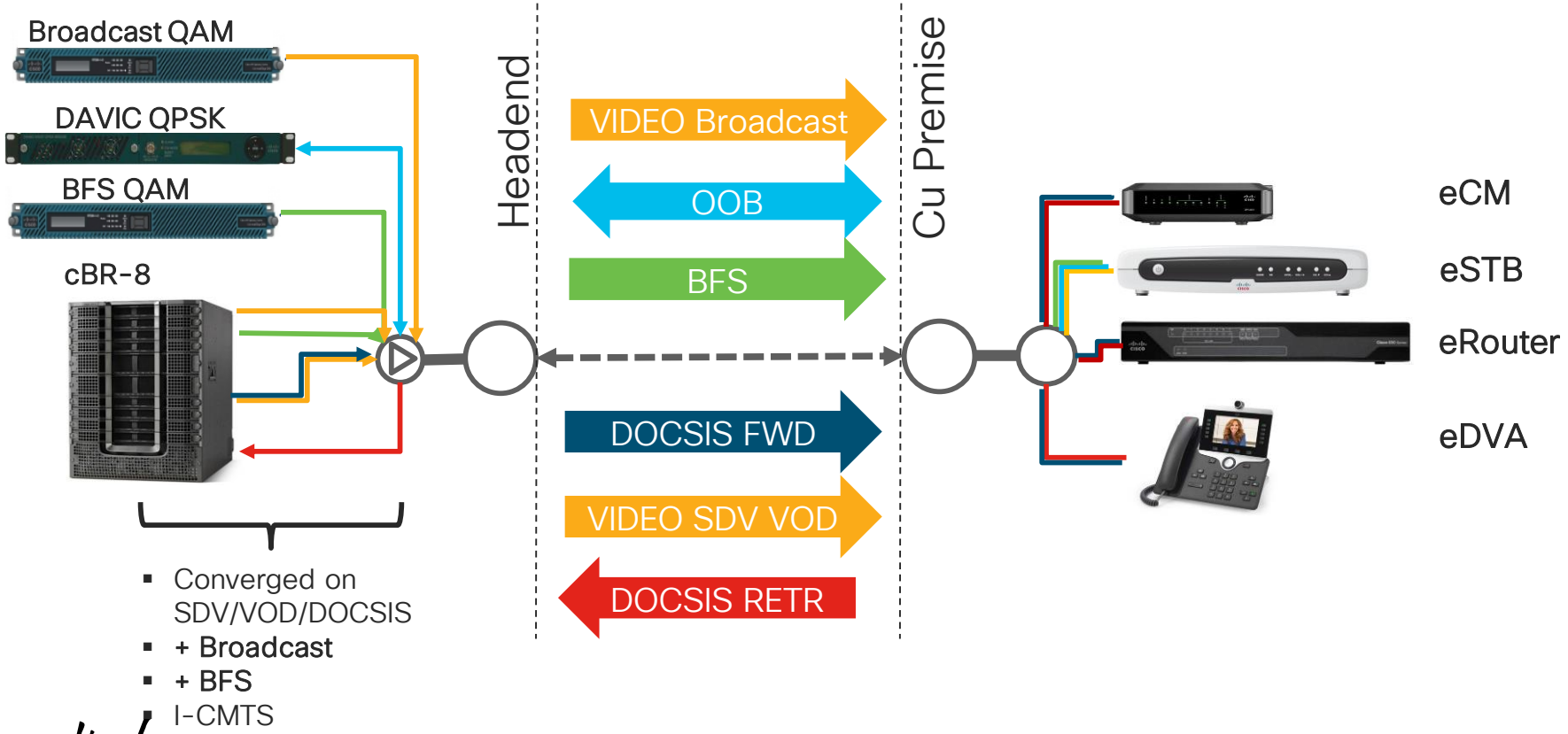
Early CCAP

- Legacy uBR10k and RFGW-10



CCAP Progression

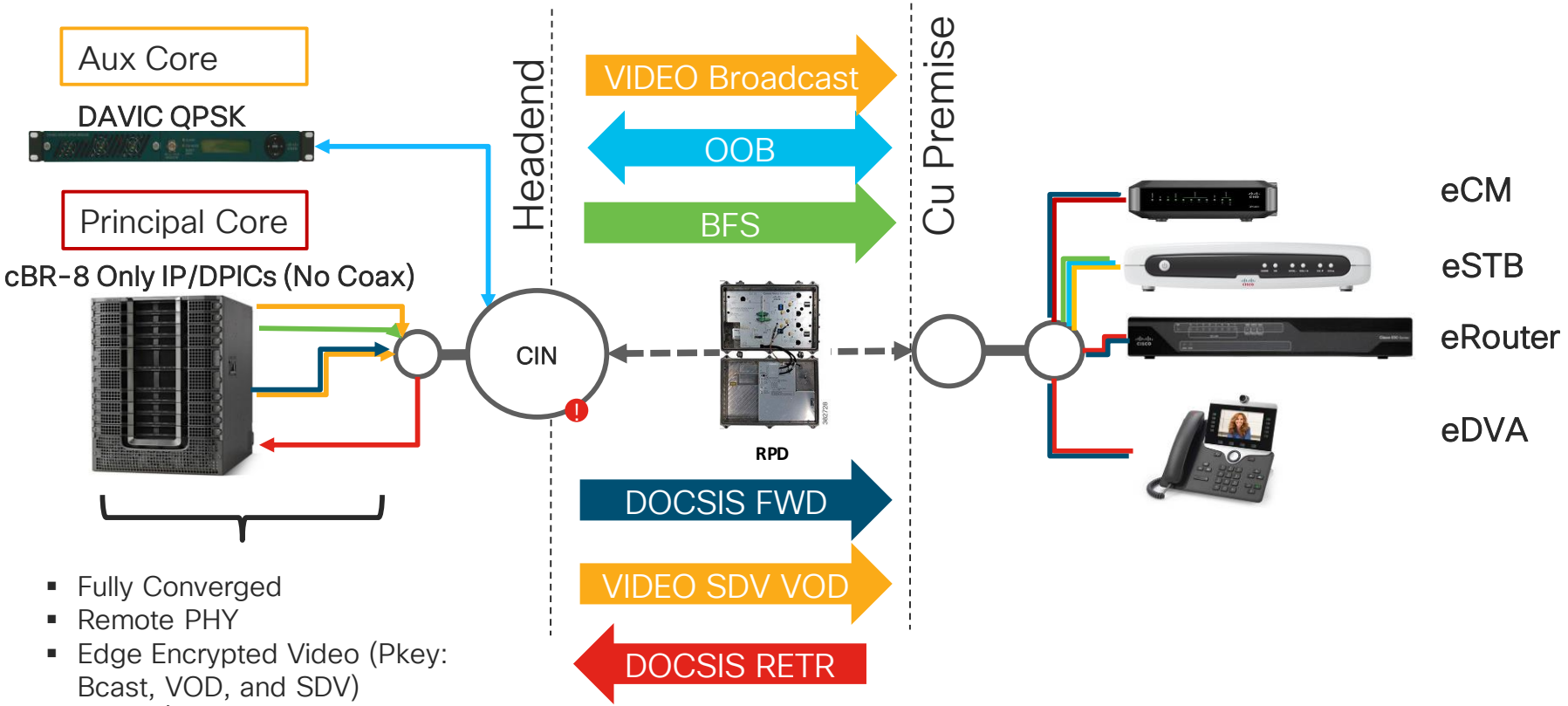
- Video OOB / BFS / Broadcast not yet converged



- Converged on SDV/VOD/DOCSIS
- + Broadcast
- + BFS
- I-CMTS

CCAP Progression and DAA (Distributed Access Architecture)

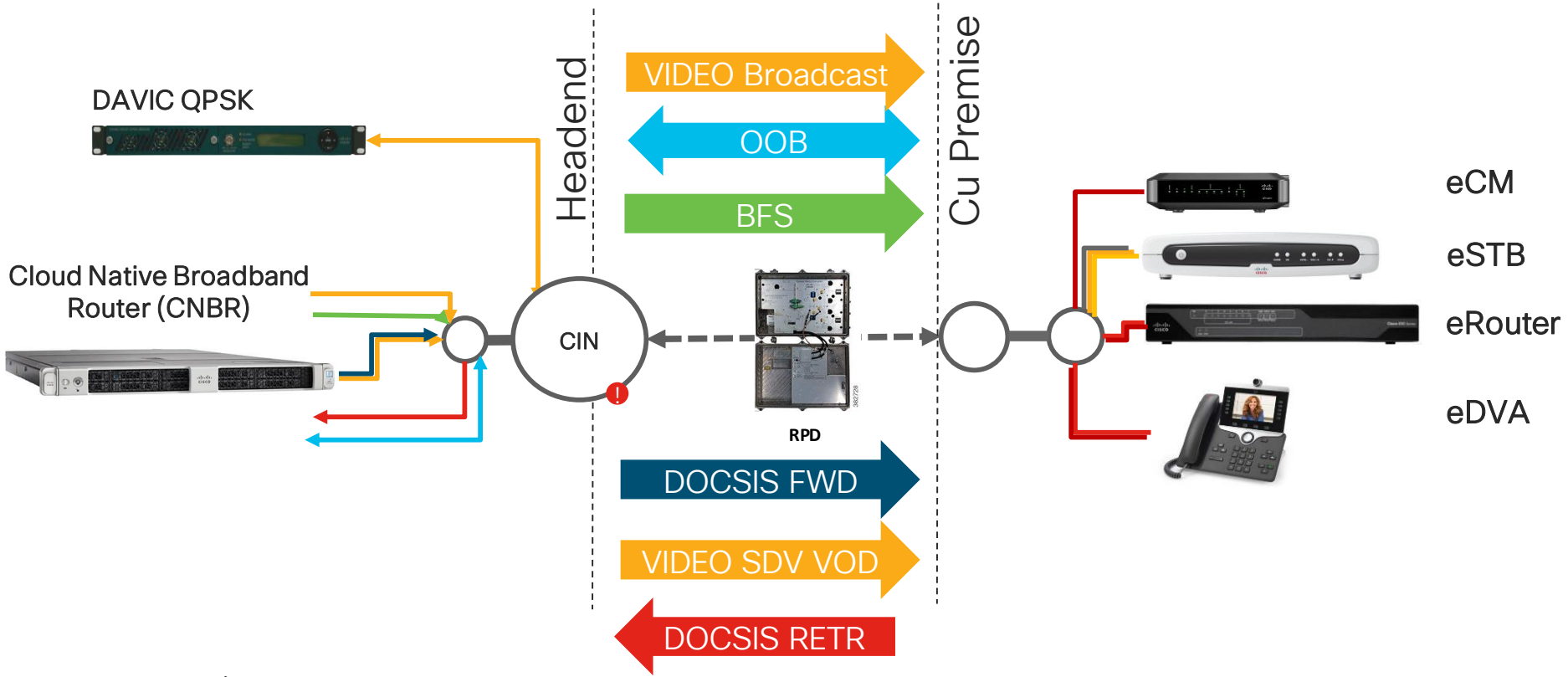
- Transition to DAA with support for Video OOB, BFS, and Encryption



- Fully Converged
- Remote PHY
- Edge Encrypted Video (Pkey: Bcast, VOD, and SDV)

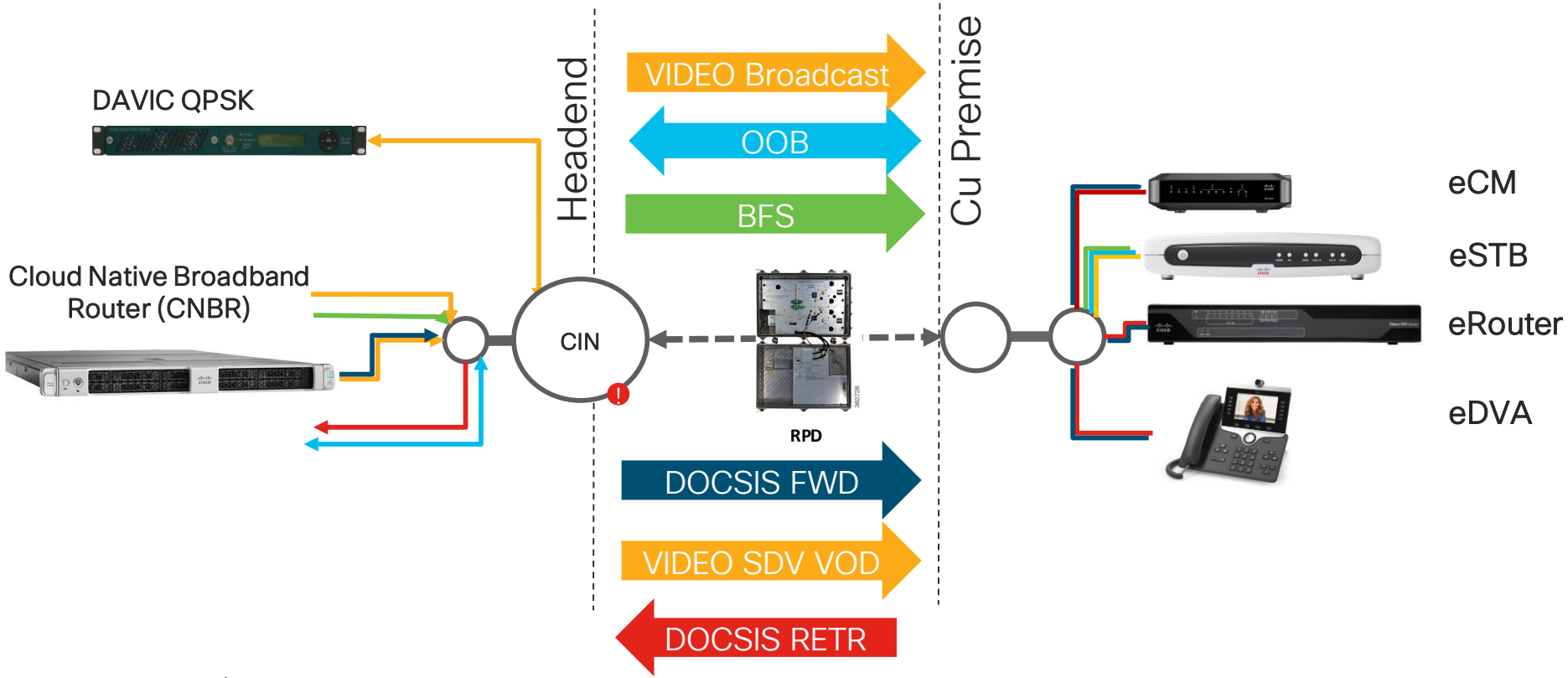
Cloud Native

- Virtualize the CMTS



Cloud Native

- Virtualize the CMTS



Challenges

- Staying productive with day-to-day management
- Achieving effective troubleshooting in the face of increasing complexity
- Deploying, Managing, and Monitoring with ever increasing density and scale

- Operational Best Practices for cBR-8 Features & Tools
- Troubleshooting Techniques for CCAP Services
- cBR-8 Optimizations and Automation

Operational Best Practices for cBR-8 Features & Tools

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Agenda

Features & Tools

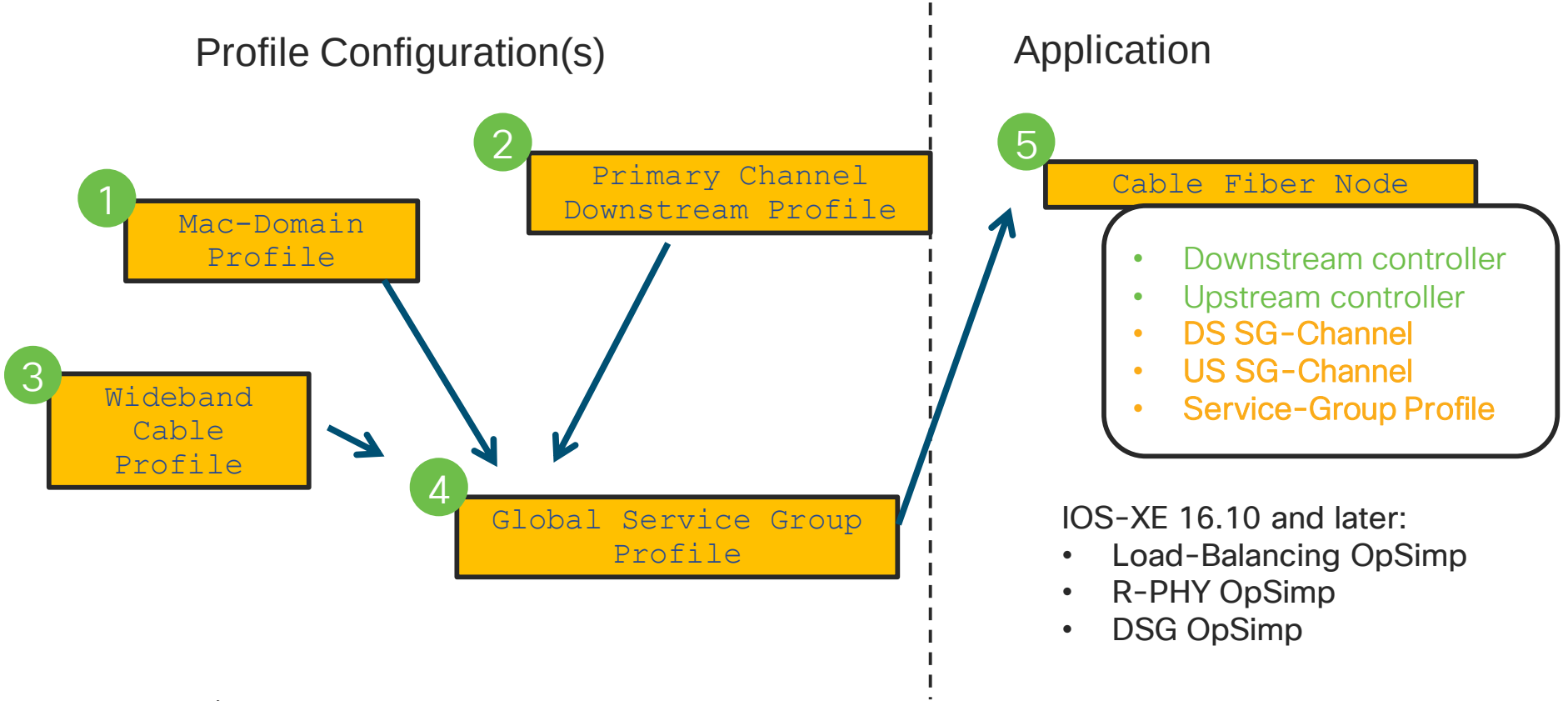
- Operational Simplification with Service Groups, Load-Balancing, and DSG
- Dynamic Bonding Group
- Load Balancing with Dynamic Bonding Groups
- Upstream Resiliency
- Linear Power Tilt
- D3.1 – Time and Frequency Division Multiplexing
- Timing Considerations for R-PHY and CIN
- DOCSIS Predictive Scheduler
- PTP Considerations
- IOS Guest Shell
- *Telemetry and MIB Updates*

Operational Simplification

- Service-Groups
- Load-Balancing
- DSG

- Simplified and Shortened configuration(s)
- Per-Fiber Node instantiation
- Model similar to future Cisco offerings (cloud native)
- Cannot adjust on-the-fly for individual SGs

Operational Simplification



Operational Simplification

```
cable wideband auto-reset
#(rphy)# cable wideband rphy-auto-reset

cable profile mac-domain MD-1-PROFILE
 cable shared-secret 7 secret
 cable privacy mandatory

cable profile downstream DS-1-PROFILE
  cable rf-bandwidth-percent 1

cable profile wideband-interface WB-1-PROFILE
  cable downstream attribute-mask 0x80000000
```

```
cable profile service-group RPHY-1-PROFILE
 cable bundle 1
 mac-domain 0 profile MD-1-PROFILE
  downstream sg-channel 0-31 profile DS-1-PROFILE
  upstream 0 sg-channel 0
  upstream 1 sg-channel 1
  upstream 2 sg-channel 2
  upstream 3 sg-channel 3
  us-bonding-group 1
   upstream 0
   upstream 1
   #...
 wideband-interface 1 profile WB-1-PROFILE
  downstream sg-channel 0-3 rf-bandwidth-percent 1
 #...
  downstream sg-channel 0-31 rf-bandwidth-percent 1
 wideband-interface 33 profile WB-1-PROFILE
  downstream sg-channel 0-31 158 rf-bandwidth-percent 1
```

```
interface Cable1/0/0
 downstream Integrated-Cable 1/0/0 rf-channel 0-31 158
 upstream 0 Upstream-Cable 1/0/0 us-channel 0
 upstream 1 Upstream-Cable 1/0/0 us-channel 1
 upstream 2 Upstream-Cable 1/0/0 us-channel 2
 upstream 3 Upstream-Cable 1/0/0 us-channel 3
 cable upstream 0 power-adjust continue 6
 cable upstream 1 power-adjust continue 6
 cable upstream 2 power-adjust continue 6
 cable upstream 3 power-adjust continue 6
 cable upstream balance-scheduling
 cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
...
 cable bundle 1
```

```
interface Cable1/0/0
 cable mac-domain-profile MD-1-PROFILE
 ...
 cable bundle 1
 cable managed fiber-node 1
!
```

```
cable fiber-node 1
 downstream Downstream-Cable 1/0/0
 upstream Upstream-Cable 1/0/0
 downstream sg-channel 0 31 downstream-Cable 1/0/0 rf-channel 0 31
 downstream sg-channel 158 downstream-Cable 1/0/0 rf-channel 158
 upstream sg-channel 0 3 Upstream-Cable 1/0/0 us-channel 0 3
 service-group profile RPHY-1-PROFILE
```

Operational Simplification with Load-Balancing

- Create a Profile Load-Balance and apply it within the Profile Service-Group

```
cable profile load-balance LB_1_Profile
 method utilization primary-distributed us-method
utilization
 threshold load 2
 policy pcmm
 interval 1

cable profile service-group RPHY-1-PROFILE
 cable bundle 1
 load-balance docsis-group 0 profile LB_1_Profile
 mac-domain 0 profile MD-1-PROFILE
  downstream sg-channel 0-31 profile DS-1-PROFILE
  upstream 0 sg-channel 0
  upstream 1 sg-channel 1
  upstream 2 sg-channel 2
  upstream 3 sg-channel 3
  us-bonding-group 1
   upstream 0
   upstream 1
 #...
```

```
cable fiber-node 1
 downstream Downstream-Cable 1/0/0
 upstream Upstream-Cable 1/0/0
 downstream sg-channel 0 31 downstream-Cable 1/0/0 rf-channel 0 31
 downstream sg-channel 158 downstream-Cable 1/0/0 rf-channel 158
 upstream sg-channel 0 3 Upstream-Cable 1/0/0 us-channel 0 3
 service-group profile RPHY-1-PROFILE
```

```
cBR8-01#show cable load-balance docsis-group fn 1 md c1/0/0

DOCSIS LB Enabled: Yes
DOCSIS 2.0 LB Enabled: Yes
DOCSIS 3.0 LB Enabled: No
DOCSIS 3.0 Static LB Enabled: Yes
DOCSIS 3.0 Dynamic Downstream LB Enabled: No
DOCSIS 3.0 Dynamic Upstream LB Enabled: No


DOCSIS 3.0 General LB
MD       FN  Group ID    S Intv DCC mask  Policy     Mtd MD-CM-SG  Thre
                                /UCC                  D/U           …
Ca1/0/0  1   2147508224 E 30   0xF8(0)/N 0          m/m 0x300601  …
```

Operational Simplification with DSG

- In your Profile Service-Group add DSG Configurations

```
…

cable profile service-group RPHY-1-PROFILE
 cable bundle 1
 mac-domain 0 profile MD-1-PROFILE
  downstream sg-channel 0-31 profile  DS-1-PROFILE
  upstream 0 sg-channel 0
  upstream 1 sg-channel 1
  upstream 2 sg-channel 2
  upstream 3 sg-channel 3
  cable downstream dsg chan-list 111
  cable downstream dsg timer 1
  cable downstream dsg vendor-param 2
  cable downstream dsg tg 4500
  cable downstream dsg tg 4500 priority 2
  cable downstream dsg tg 4500 vendor-param 2
  cable downstream dsg tg 4500 ucid 1 2
…
```

What about *DSG TG Channel* ?
It is auto-generated upon instantiation

```
interface Cable1/0/0
 cable mac-domain-profile MD-1-PROFILE
 ...
 cable bundle 1
 cable managed fiber-node 1
!
```

```
cable fiber-node 1
 downstream Downstream-Cable 1/0/0
 upstream Upstream-Cable 1/0/0
 downstream sg-channel 0 31 downstream-Cable 1/0/0 rf-channel 0 31
 downstream sg-channel 158 downstream-Cable 1/0/0 rf-channel 158
 upstream sg-channel 0 3 Upstream-Cable 1/0/0 us-channel 0 3
 service-group profile RPHY-1-PROFILE
```

Use “show derived-configs” to see individual instantiations

```
cBR8-01# Show derived-config interface Cable1/0/0

interface Cable1/0/0
#…
 cable downstream dsg chan-list 111
 cable downstream dsg timer 2
 cable downstream dsg vendor-param 2
 cable downstream dsg tg 4500 channel 1
end
```

Dynamic Bonding Groups

- Optimization of utilization by creation of as-needed Bonding Group(s)
- Optimization against CM bonding capabilities
- Compatible with LB, RBG(s), and Static BG(s)
- Relatively new
- Hard to completely backout

Dynamic Bonding Groups

- To enable configure “cable dynamic-bonding-group”
- IOS-XE will attempt to create bonding groups to accommodate CM capabilities and distributions
- DBG feature complies with standard RCP profiles
- Interoperable with Resiliency Bonding Groups and Load-balancing
- Unused dynamic bonding groups can be reclaimed by system
- Only way to cleanly back out is to reload

Dynamic Bonding Groups

- Feature will attempt to match CM RCP and create new Bonding Group

```
cBR8-1# show cable mac-domain cable1/0/0 rcc

RCC-ID   RCP              RCs MD-DS-SG CMs   WB/RCC-TMPL       D3.0  D3.1
1        00 00 00 00 00   32  0        0     WB (Wi1/0/0:0)    Y     Y
2        00 00 00 00 00   8   0        1     WB (Wi1/0/0:1)    Y     Y
3        00 00 00 00 00   16  0        1     WB (Wi1/0/0:2)    Y     Y
4        00 00 00 00 00   24  0        1     WB (Wi1/0/0:3)    Y     Y

cBR8-1# show cable dynamic-bonding-group summary

Dynamic bonding group: Enable
BG ID BG Name      BG Size  CMs  ServFlows Create Time          Create Client   BG State     RFid list
8194  Wi1/0/0:3    24       8    16         Apr 7 09:12:47.190  MODEM_ONLINE    OPERATIONAL  8200-
8223
…
```

Create Client	Meaning
MODEM_ONLINE	Modem Need (RCP)
STATIC_LOAD_BALANCE	Static (Mdm Count) Based LB
DYNAMIC_LOAD_BALANCE	Dynamic (Utilization) Based LB

Load-balancing with Dynamic Bonding Groups

- Creates bonding groups for DOCSIS 3.1/3.0 modems to leverage based on utilization

```
cable acfe enable
cable dynamic-bonding-group
cable dynamic-bonding-group reclaim-threshold percent 5 modems 6
       …
cable load-balance docsis-enable
cable load-balance docsis30-enable
cable load-balance docsis30-enable dynamic downstream
cable load-balance method-utilization min-threshold 20
..
cable load-balance docsis-group FN 1 MD Cable1/0/0
method utilization
policy pure-ds-load
interval 60
…
```

Load-balancing with Dynamic Bonding Groups

- Utilization based load-balancing seeks to fill-in underutilized BW

```
cBR8-1# show cable load-balance docsis-group fn 1 md c1/0/0 rfch-util

Interface     Pstate    Pending-In Pending-Out Throughput(Kbps) Util    NBCM WBCM
In1/0/0:0     up        No         No          36784              98%     4    27
In1/0/0:1     NA        No         No          37935             100%     0    27
…
In1/0/0:22    NA        No         No          28415              75%     0    5
In1/0/0:23    NA        No         No          28415              75%     0    5
In1/0/0:24    initial   No         No          2146                5%     0    2
In1/0/0:25    NA        No         No          0                   0%     0    2
In1/0/0:26    NA        No         No          0                   0%     0    2
In1/0/0:27    NA        No         No          0                   0%     0    2
In1/0/0:28    initial   No         No          2146                5%     0    2
In1/0/0:29    NA        No         No          0                   0%     0    2
In1/0/0:30    NA        No         No          0                   0%     0    2
In1/0/0:31    NA        No         No          0                   0%     0    2
In1/0/0:158   up        No         No          18743              49%     0    3
Average: 68.30. Variance: 1583.544
```

Underutilized RF-Channels

Load-balancing with Dynamic Bonding Groups

- Utilization based load-balancing fills-in underutilized BW by creating BG to leverage RF-channel(s)

```
cBR8-1# show cable dynamic-bonding-group summary

Dynamic bonding group: Enable
BG ID BG Name      BG Size  CMs  ServFlows Create Time          Create Client        BG State            RFid
list
8194  Wi1/0/0:1    16       7    7         Apr 10 15:38:44.720  MODEM_ONLINE         OPERATIONAL    8208-8223
…
8200  Wi1/0/0:7    8        2    4         Apr 10 16:00:18.447  DYNAMIC_LOAD_BALANCE OPERATIONAL    8199-8205,8208
8201  Wi1/0/0:8    16       5    8         Apr 10 16:01:18.738  DYNAMIC_LOAD_BALANCE OPERATIONAL    8192-8207
```

Load-balancing with Dynamic Bonding Groups

- For example – after LB with DBG we see utilization across all RF-ch

```
cBR8-1# show cable load-balance docsis-group fn 1 md c1/0/0 rfch-util

Interface     Pstate    Pending-In Pending-Out Throughput(Kbps) Util    NBCM WBCM
In1/0/0:0     up        No         No          36787              98%     3    7
In1/0/0:1     NA        No         No          22567              60%     0    7
In1/0/0:2     NA        No         No          22568              60%     0    7
In1/0/0:3     NA        No         No          22567              60%     0    7
In1/0/0:4     up        No         No          21524              57%     0    7
In1/0/0:5     NA        No         No          22567              60%     0    7
In1/0/0:6     NA        No         No          22567              60%     0    7
In1/0/0:7     NA        No         No          22568              60%     0    8
…
In1/0/0:25    NA        No         No          37938             100%     0    18
In1/0/0:26    NA        No         No          37938             100%     0    18
In1/0/0:27    NA        No         No          37938             100%     0    18
In1/0/0:28    up        No         No          36788              98%     9    22
In1/0/0:29    NA        No         No          37938             100%     0    18
In1/0/0:30    NA        No         No          37938             100%     0    18
In1/0/0:31    NA        No         No          37938             100%     0    18
In1/0/0:158   up        No         No          18581              49%     0    3
Average: 85.757
Variance: 284.62
```

Upstream Resiliency

Data-Burst Resiliency for D3.0 MTC-Mode

- Improvement on classic US Partial Mode transitions

US Resiliency Mode	Detection Method	Pros & Cons
Traditional	Missed Station Maintenance (SM) results in partial state	• Disparities when SM/IM is QPSK vs QAM16 (“Break points”)
Data-Burst	Threshold based on user-configured CM MER and FEC	• Better real-world detection • No SM bursts or Fast Polling

```
cable upstream resiliency data-burst polling-interval 60

interface Cable1/0/0
 cable upstream resiliency sf-move UGS
 cable upstream resiliency sf-move RTPS
 cable upstream resiliency sf-move NRTPS
 cable upstream resiliency data-burst snr 24 ufec 3 cfec 0 hys 4
...
```

SNR Threshold: 24, Fec/Cfec 3/0%, hysteresis 4dB

Logic Test: Data SNR AND (corr FEC OR uncorr FEC)

Upstream Resiliency

US Resiliency Service-Flow

- Moves UGS (active voice) off impaired upstream of CM
- Service flows preserved

```
cable upstream resiliency data-burst polling-interval 60

interface Cable1/0/0
 cable upstream resiliency sf-move UGS
 cable upstream resiliency sf-move RTPS
 cable upstream resiliency sf-move NRTPS
 cable upstream resiliency data-burst snr 24 ufec 3 cfec 0 hys 4
…
```

Linear Power Tilt

- Automatically configure controller to tilt the output power (linearly)
- Set with "**power-tilt linear** *db* **max-frequency** *Hz*" under controller

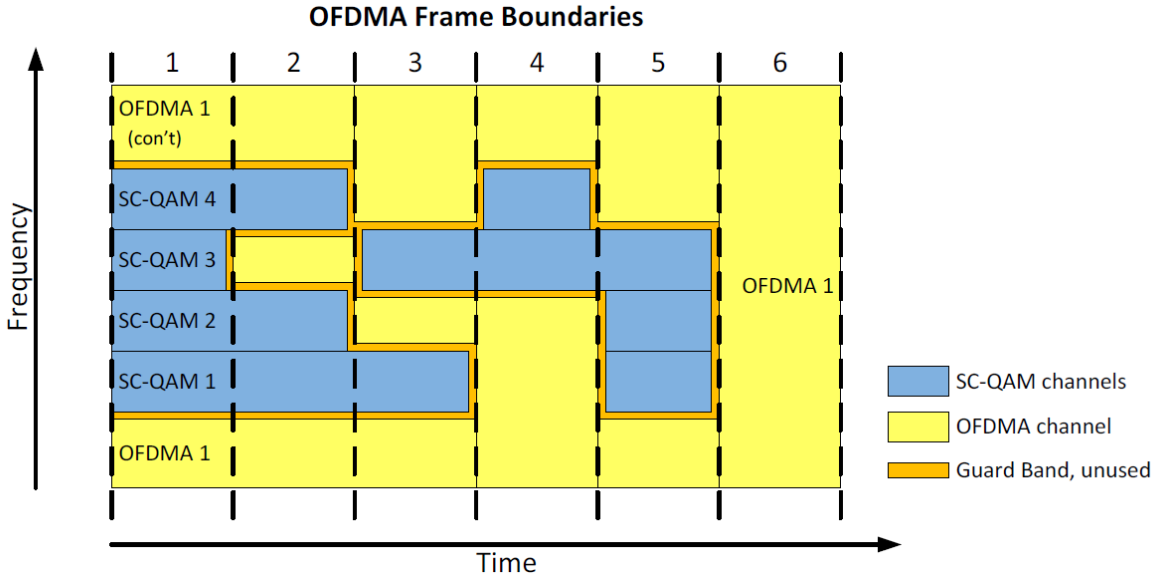
```
controller integrated-cable 1/0/0
max-carrier 96
base-channel-power 36
power-tilt linear 4.0 max-frequency 1218000000
rf-chan 0 31
 type DOCSIS
 frequency 60300
 rf-output NORMA
 power-adjust 0.
 qam-profile 1
 docsis-channel-
…
```

```
cBR8-01#show controller integrated-Cable 1/0/0 rf-ch 0-162

Chan State Admin Frequency  Type   Annex Mod  srate Interleaver  dcid  power  output
 0     UP    UP   603000000 DOCSIS  B    256   5361  I32-J4        1    35.1   NORMAL
 2     UP    UP   615000000 DOCSIS  B    256   5361  I32-J4        3    35.1   NORMAL
 3     UP    UP   621000000 DOCSIS  B    256   5361  I32-J4        4    35.2   NORMAL
 4     UP    UP   627000000 DOCSIS  B    256   5361  I32-J4        5    35.2   NORMAL
 5     UP    UP   633000000 DOCSIS  B    256   5361  I32-J4        6    35.2   NORMAL
 6     UP    UP   639000000 DOCSIS  B    256   5361  I32-J4        7    35.3   NORMAL
 7     UP    UP   645000000 DOCSIS  B    256   5361  I32-J4        8    35.3   NORMAL
 8     UP    UP   651000000 DOCSIS  B    256   5361  I32-J4        9    35.3   NORMAL
 9     UP    UP   657000000 DOCSIS  B    256   5361  I32-J4        10   35.4   NORMAL
 10    UP    UP   663000000 DOCSIS  B    256   5361  I32-J4        11   35.4   NORMAL
 11    UP    UP   669000000 DOCSIS  B    256   5361  I32-J4        12   35.4   NORMAL
  …
```

Time and Frequency Division Multiplexing

DOCSIS 3.1 OFDMA and D3.0 SCQAM Over the same spectrum

- Optimize upstream for D3.1 and D3.0 environment
- Division against time-axis
- Caveats: Bandwidth considerations from cross-bonding (D3.1 vs D3.0 devices)



TaFDM Configuration Sample

- Overlap the OFDMA Frequency Range with SC-QAM
- Configure the Initial Ranging Frequency
- **IOS-XE will automatically implement TaFDM**
- Ensure you are running 16.7 and later IOS-XE
- Caveats – Possible bandwidth limitations with D3.0 only modems

```
cable mod-profile-ofdma 470
 subcarrier-spacing 50KHz
 initial-rng-subcarrier 64
 fine-rng-subcarrier 192
 data-iuc 9 modulation 1024-QAM pilot-pattern 1
 data-iuc 10 modulation 512-QAM pilot-pattern 1
 data-iuc 11 modulation 256-QAM pilot-pattern 1
 data-iuc 12 modulation 128-QAM pilot-pattern 1
 data-iuc 13 modulation 64-QAM pilot-pattern 1
```

```
controller Upstream-Cable 7/0/0
 …
 us-channel 12 docsis-mode ofdma
 us-channel 12 subcarrier-spacing 50
 us-channel 12 modulation-profile 470
 us-channel 12 frequency-range 10000000 85000000
 us-channel 12 initial-rng-frequency-start 50000000
 us-channel 12 cyclic-prefix 96 rol
 us-channel 12 symbols-per-frame 8
 no us-channel 12 shutdown
```

Overlaps with SCQAM

Specify the IM Freq

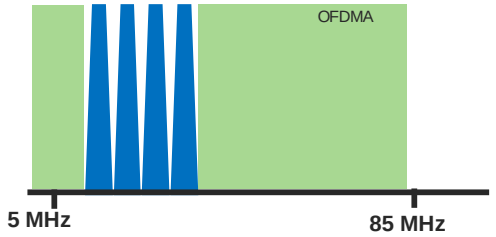
TaFDM Considerations

Should you implement TaFDM?

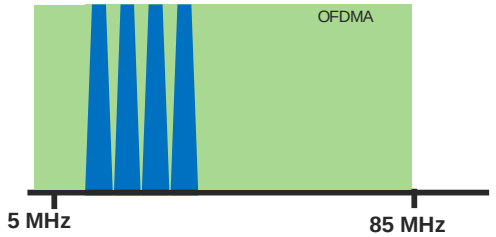
- Faster D3.1 Speeds Possible with TaFDM than with Cross-Bonded
- … Possibly at the cost of D3.0 Traffic rates!
- Current scheduler only reserves up to 20% for SC-QAM traffic
- TaFDM does provide higher D3.1 modem speeds but at the expense of limiting D3.0 traffic
- Cross bonding between OFDMA channel and SC-QAM provides almost the same D3.1 speeds without as much impact to D3.0 traffic

Parameters	Throughput
OFDMA < 16 MHz + Four ATDMA + OFDMA 42-85 MHz	~445 MBps
OFDMA: 5-16 MHz @64-QAM +16-85 MHz @256-QAM	~515 MBps

Cross Bonded



TaFDM

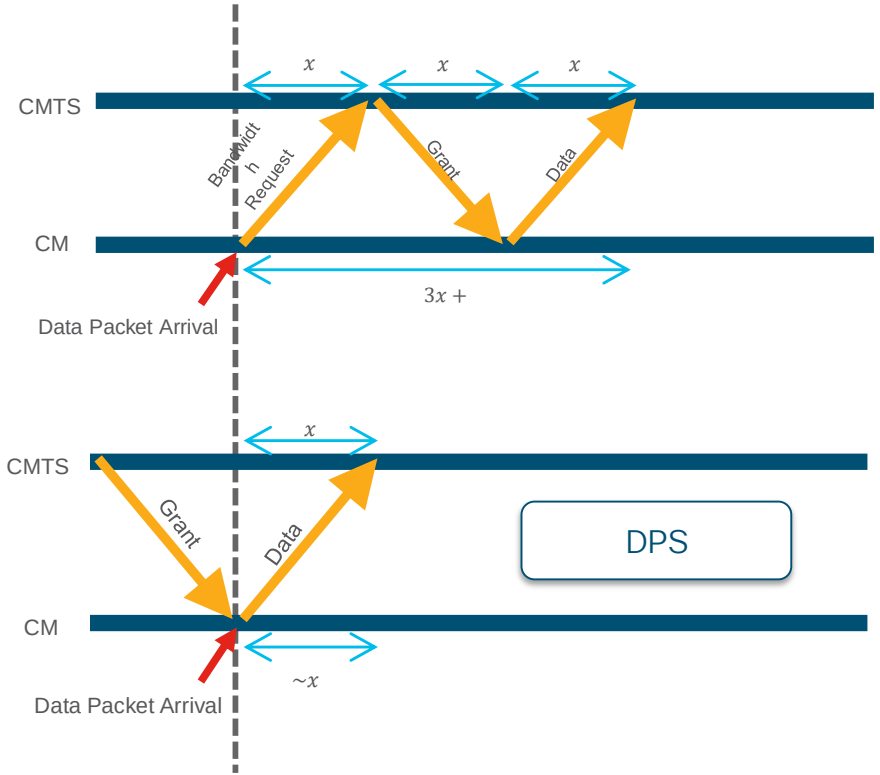


DOCSIS Timing Considerations for R-PHY & CIN

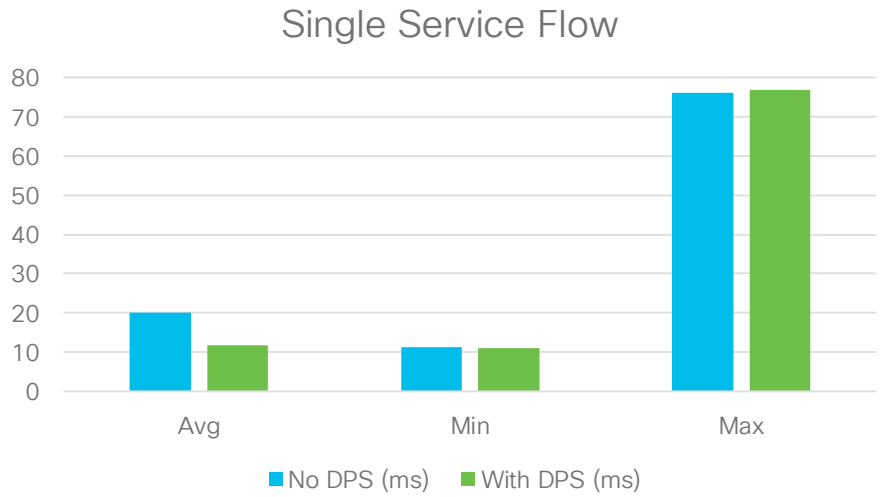
- DOCSIS requires timing elements to schedule upstream
- PTP is used to achieve common timing for CCAP core and RPD
- DLM can be use so MAP advance time adjust to changes in CIN
- DLM does not reduce request-grant delay in CIN with large delay times or address high CIN delay variance
- DOCSIS Predictive Scheduling (DPS) can reduce / eliminate request-grant delay by proactively giving upstream grants to modems based on historic traffic patterns

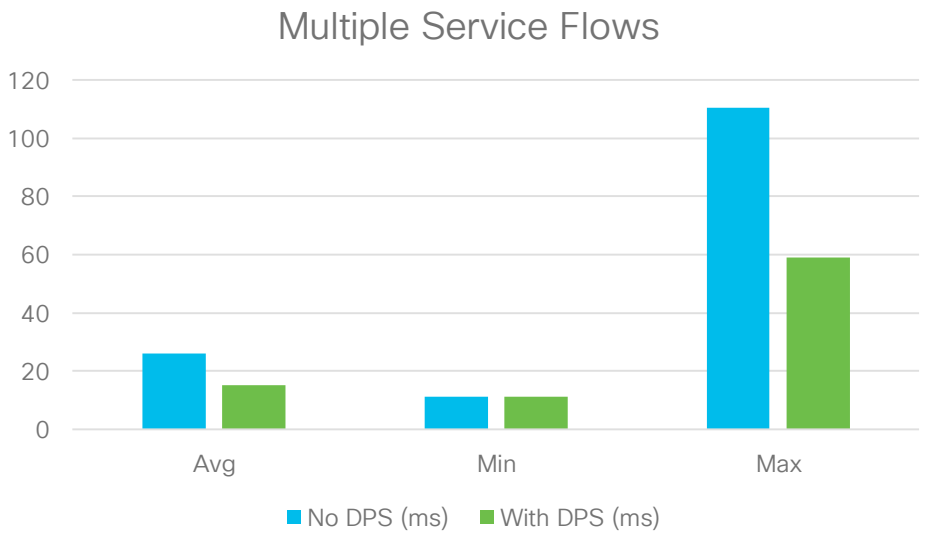
DOCSIS Predictive Scheduler

- Possible Increased delay with DAA
- Account for this with DOCSIS Predictive scheduler
- Result is generally higher throughput potential



DOCSIS Predictive Scheduler





- Tests use UDP, 40 Mbps with mixed packet size, BE SFs
- 10 ms of latency in the CIN
- Significant improvement in average latency in both cases, but outliers still exist

DOCSIS Predictive Scheduler

- Configure under the MAC-Domain with “cable upstream dps”

```
cBR8-01#show interface cable 1/0/0 mac-scheduler 0

     DOCSIS 1.1 MAC scheduler for Cable1/0/0/U0 : rate 15360000
     wfq:None
     us_balance:OFF
     dps:ON
     dpon_mode:OFF
     fairness:OFF
     Queue[Rng Polls] flows 0
     Queue[CIR Grants] flows 0
     ...
```

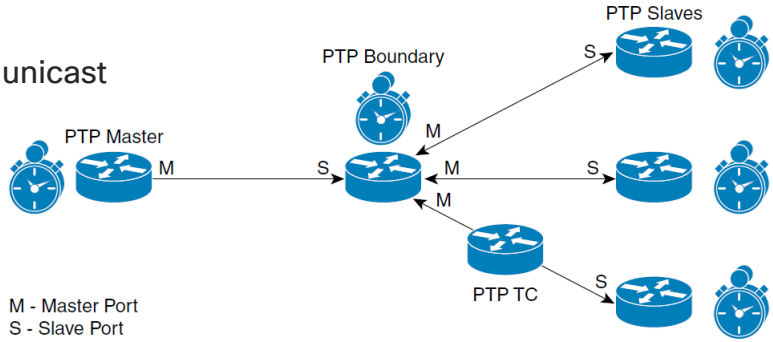
Timing Servers and Placement

- **PTP Boundary and Master Support for cBR-8 starting in 16.12**
- Master Clock have scale limitations
- Placement affects Latency and Jitter
- Path Delay Variance must be <=10ms
- Core and associated RPDs should have common master, be in common domain
- GM to client (RPD) latency independent from and can be much larger than Core to RPD latency

- Allows increased sessions by making cBR8 PTP Master or Boundary
- Consider placing ASR or NCS Master along CIN Spine
- Symmetric path between Master and Slave important

Further Timing Considerations

- Scaling supported by Grandmaster (GM) clock – Total number of unicast sessions
- Increase number of available sessions by:
  - Adding more GMs and limiting #of sessions per GM
  - Adding PTP Boundary Clocks
- Grand Master connected to CIN spine layer
  - Third party or using a Cisco devices like the ASR900 Series
  - ASR900 (IOS-XE) and NCS 5k supports timing from Loopback interface

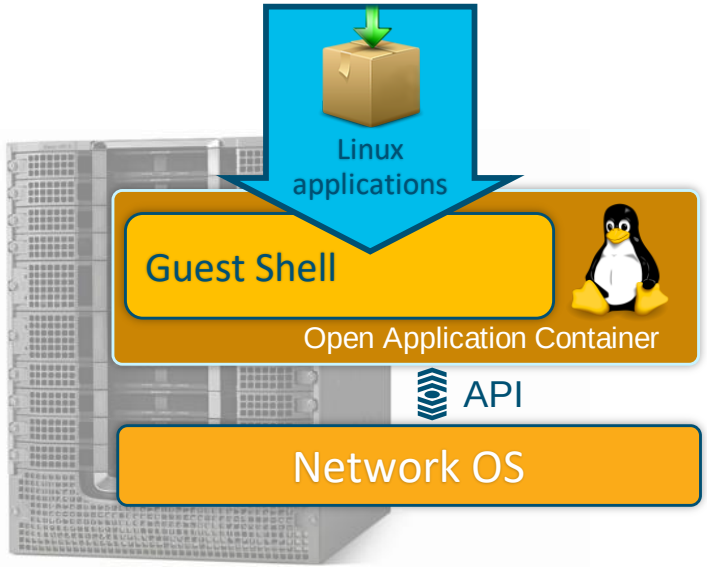


Keeping a symmetric path between master and slave is important

- Boundary clock on leaf node connected to RPD is ideal for scale and performance
- Use redundant GMs connected to different nodes, should maintain symmetry via normal IP routing if master is multi-hop

IOS Guest Shell

- Decoupled execution space within a Linux container
- IOS-XE 16.10.1d and later



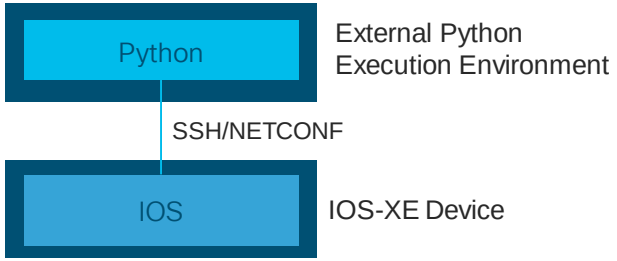
- Access to the network over Linux network interfaces
- Access to bootflash
- Access to IOS CLI
- Ability to install and run python scripts
- Ability to install and run Linux applications

Guestshell and Python

IOS-XE "On-Box" Python

- Scripts executed locally on cBR-8
- Ideal for:
  - Provisioning automation (ZTP)
  - Automating Embedded Event Manager responses
  - Application development
  - Internet of things (IOT)
  - Complex Troubleshooting Tooling

IOS-XE "Off-Box" Python



- Scripts executed externally
- Ideal for:
  - Configuration management automation
  - Telemetry & Operational data
  - Controller use cases including APIC-EM / Cisco Network PNP

IOS Guest Shell

- Configure "**iox**", Interface VirtualPortGroup, and app-hosting parameters

Command	Description
guestshell enable	Starts the guestshell microservice
guestshell disable	Stops the guestshell microservice
guestshell destroy	Destroys (clears) the microservice
show iox-services	Displays the IOX services running and resource utilization
show app-hosting list	Displays the containers running

```
cBR8-01#show iox-service

IOx Infrastructure Summary:
---------------------------
IOx service (CAF)     : Running
IOx service (HA)      : Not Running
IOx service (IOxman)  : Running
Libvirtd              : Running
```

```
interface VirtualPortGroup31
 description For-Guest-shell
 ip address 13.50.0.1 255.255.255.0
 no mop enabled
 no mop sysid

app-hosting appid guestshell
 app-vnic gateway0 virtualportgroup 31 guest-interface 0
  guest-ipaddress 13.50.0.2 netmask 255.255.255.0
 app-default-gateway 13.50.0.1 guest-interface 0
```

```
cBR8-01# guestshell enable
Interface will be selected if configured in app-hosting
Please wait for completion
guestshell installed successfully
Current state is: DEPLOYED
guestshell activated successfully
Current state is: ACTIVATED
guestshell started successfully
Current state is: RUNNING
Guestshell enabled successfully

cBR8-01#show app-hosting list

App id                                   State
---------------------------------------------------------
guestshell                               RUNNING
```

IOS Guest Shell

Command	Description
guestshell run bash	Runs bash process
guestshell run python	Runs python process (default v2.7.5)

```
cBR8-01# guestshell run bash
[guestshell@guestshell etc]$ cat /etc/os-release
NAME="CentOS Linux"
VERSION="7 (Core)"
ID="centos"
ID_LIKE="rhel fedora"
VERSION_ID="7"
PRETTY_NAME="CentOS Linux 7 (Core)"
ANSI_COLOR="0;31"
CPE_NAME="cpe:/o:centos:centos:7"
HOME_URL="https://www.centos.org/"
BUG_REPORT_URL="https://bugs.centos.org/"
…
```

For **dohost** or Python CLI APIs please ensure you have **ip http server** configured

* CSCvn43093 fixed in 17.1 and later means you have to toggle "**ip http server**" off and back on while your guestshell is enabled

```
F241-36-04-cBR8-01#guestshell run python
Python 2.7.5 (default, Apr 11 2018, 07:36:10)
[GCC 4.8.5 20150623 (Red Hat 4.8.5-28)] on linux2
Type "help", "copyright", "credits" or "license" for more
information.
>>> from cli import *
>>> executep("show ver")
Load for five secs: 5%/0%; one minute: 7%; five minutes:
7%
Time source is NTP, 11:22:59.010 edt Tue May 14 2019
Cisco IOS XE Software, Version 16.10.01d
Cisco IOS Software [Gibraltar], cBR  Software
(X86_64_LINUX_IOSD-UNIVERSALK9-M), Version 16.10.1d,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
…
```

IOS-XE Guestshell Demo

IOS Guest Shell Example

Resiliency Bonding Group Customization

- You can configure an arbitrary number of Resiliency BGs per Mac-Domain
- More RBGs means better resiliency but also higher CPU and less for DBGs and Static BGs
- Less means possibly suboptimal protections
- Chassis-wide static RBG configurations may be suboptimal

Idea: Why not customize/optimize to each MAC-Domain the number of Resiliency BGs?

Algorithm:

- Assume Dynamic BG with Dynamic LB

Max(Σs [(s * i) / t] , MAX_NUM_RBG)

- s is the size of this bonding group (4-ch is s=4)
- i is the reoccurrence of this bg size
- t is total SC-QAM channels in MD (for 32 SC-QAMs, t=32)
- MAX_NUM_RBG for 16.10 is 16

Example: Say you have Eight 4-ch, four 16-ch, three 24-ch, and one 32-ch:

(4*8)/32 + (4*16)/32 + (3*24)/32 + 32/32 = 1 + 2 + 2 + 1 = 6 RBGs

IOS Guest Shell Example

Play Demo

IOS Guest Resource Utilization

- By default allocates 256 MB of memory and 1% of CPU

Command	Description
show app-hosting utilization appid guestshell	Current utilization
show app-hosting detail appid guestshell	Allocated resources

```
cBR8-01#show app-hosting utilization appid guestshell

Application: guestshell
CPU Utilization:
  CPU Allocation: 800 units
  CPU Used:       0.02 %
Memory Utilization:
  Memory Allocation: 256 MB
  Memory Used:       52124 KB
Disk Utilization:
  Disk Allocation: 1 MB
  Disk Used:       0.00 MB
```

```
cBR8-01# show app-hosting detail appid guestshell

App id                 : guestshell
Owner                  : iox
State                  : RUNNING
…
Resource reservation
  Memory               : 256 MB
  Disk                 : 1 MB
  CPU                  : 800 units
…
Network interfaces
   ---------------------------------------
…
```

IOS Guest Resource Resizing

- To resize configure under app "**resource profile custom cpu** *value* **memory** *memory-size*"
- Destroy & re-enable guestshell to take effect

```
app-hosting appid guestshell
 app-vnic gateway0 virtualportgroup 31 guest-interface 0
  guest-ipaddress 13.50.0.2 netmask 255.255.255.0
 app-default-gateway 13.50.0.1 guest-interface 0
 app-resource profile custom
  cpu 1000
  memory 1028
```

```
cBR8-01#show app-hosting detail appid guestshell

App id                 : guestshell
Owner                  : iox
State                  : ACTIVATED
Application
  Type                 : lxc
  Name                 : GuestShell
  Version              : 2.5.1
  Description          : Cisco Systems Guest Shell XE for x86_64
  Path                 : /guestshell/:guestshell.tar
Activated profile name : custom
…
Resource reservation
  Memory               : 1028 MB
  Disk                 : 1 MB
  CPU                  : 1000 units
```

Telemetry Updates

- IPDR Support for IPv6 and CMTS-Initiated IPDR (16.12)
- IPDR Template (16.12.1c)

MIB Updates

- DSG Tunnel Statistics – dsgIfTunnelDsStats (16.10)
- New MIB Entity Description for CISCO-ENTITY-ALARM-MIB (16.10.1g)
- Support for OFDMA Partial service and Related MIBs (16.12.1b)
- MIB for Capacity (16.12.1c)
- PNM MIB support for i-CMTS (16.12.1c)
- docsRphyStatsRpdDsScQamPerfStatsTable and docsRphyStatsRpdUsScQamChanPerfStatsTable (16.10.1d)

Troubleshooting Techniques for CCAP Services

You make the power of data **possible**

Cisco live!

Agenda

Troubleshooting cBR-8 and R-Phy Features

- IOS Shell
- D3.1 CM Throughput And Bonding Validation
- CCAP Video Troubleshooting
- Advanced Voice Troubleshooting Techniques
- DTrack
- SmartPHY

IOS Shell

IOS Shell

Not the same as IOS Guest Shell

- Basic shell on IOS-XE CLI
- Configuration and Exec both possible
- Enable with configuration "**shell processing full**"
- Disable with configuration "**no shell processing**"
- Enable on exec with "**terminal shell**" (term shell trace)
- Terminating the VTY terminals the process
- Be aware of security considerations

- Speeds up simple and repetitive tasks
- Missing variable substitution

```
cBR8-01#terminal shell trace
cBR8-01#for i in 1 2 3 4 5 6 ; do
do..done>echo $i
do..done>done
1
…
6
cBR8-01#show log | tail
006067: May 15 08:38:28.909: %PARSER-6-LOG:
CLI_command: show cable rpd name
006068: May 15 08:38:28.931: %PARSER-6-LOG:
CLI_command: show license all
<snip>
…
```

IOS Shell Sample

Iterative LCHA Failover for every LC

```
term shell

for slot in 1 2 3 6 7 8 9; do

 echo "Targeting Slot $slot for LCHA Failover to Slot 0"
 echo "Check if LCHA available"

 # Warm loop
 for i in 1 2 3 4 5 6 ; do
  warm=0;
  for xx in `show redund line all`; do
   if [[  "Warm" == $xx ]]; then
    #echo 'Warm Found'
    warm=1;
   fi
  ; done
  if [[ $warm == 1 ]]; then
    echo " Warm Found - ready to failover from $slot"
    break
  else
    echo " Not warm - wait 3 minutes and try again"
    if [[ $i == 6 ]]; then
      echo " Timeout waiting warm, $slot, aborting..."
      exit $slot
    fi
    sleep 180
  fi
 ;done

 redundancy linecard switchover from slot $slot
 echo "Failover initiated - wait 5 minutes"
 sleep 300
```

```
 # Continued …

 # Find hot for revertive
 # Hot loop

 for j in 1 2 3 4 5 6 ; do
  hot=0;
  for xx in `show redund line all`; do
   if [[  "Hot" == $xx ]]; then
    hot=1;
   fi
  ; done
  if [[ $hot == 1 ]]; then
    echo " Hot Found - ready to failback"
    break
  else
    echo " No hot - wait 3 minutes and try
again"
    if [[ $i == 6 ]]; then
      echo "  Timeout waiting hot, $slot,
aborting..."
      exit $slot
    fi
    sleep 180
  fi
 ;done

 redund linecard switchover from slot 0
 echo "Failback initiated to $slot - wait 5
minutes"
 sleep 300

;done
```

D3.1 CM Throughput And Bonding Validation

D3.1 CM Throughput And Bonding Validations

- D3.1 OFDM and OFDMA Configuration Verification
- Bonded CM Operational Verification
- Overall Throughput Numbers On cBR-8
- Per CM DS and US Performance Verification

D3.1 DS Configuration

- OFDM Channel Profile(s)
- OFDM Modulation Profile(s)
- Controller Integrated-Cable
- Interface Wideband

Profile ID	1	100
Cyclic Prefix	1024	192
Roll Off	128	128
FFT Khz	50	50
Intl Depth	16	16
Pilot Scale	48	48
Modulation Control	D:256	D:256
NCP	D:16	D:16
Data Profile 1-2-3-4-5	2048	1024
	1024	2048
		4096

```
cable downstream ofdm-chan-profile 100
  cyclic-prefix 192
  interleaver-depth 16
  pilot-scaling 48
  roll-off 128
  subcarrier-spacing 50KHZ
  profile-control modulation-default 256-QAM
  profile-ncp modulation-default 16-QAM
  profile-data 1 modulation-default 1024-QAM
  profile-data 2 modulation-default 2048-QAM
  profile-data 3 modulation-default 4096-QAM
```

```
interface Wideband-Cable2/0/1:13
 cable bundle 1
 cable rf-channels channel-list 0-31 158
bandwidth-percent 1
```

OFDM ch 158 added

```
controller Integrated-Cable 2/0/1
 max-ofdm-spectrum 384000000
 max-carrier 64
 base-channel-power 35
 rf-chan 0 31
  type DOCSIS
  frequency 591000000
  rf-output NORMAL
  power-adjust 0
  qam-profile 1
  docsis-channel-id 1
 rf-chan 158
  power-adjust 0.0
  docsis-channel-id 159
  ofdm channel-profile 100 start-frequency
780000000 width 192000000 plc 873000000
```

OFDM Starts @ 158

Diff data mod profile for range of sub-carriers

```
cable downstream ofdm-modulation-profile 1
subcarrier-spacing 50KHZ
width 192000000
start-freq 642000000
assign modulation-default 1024-QAM
assign modulation 512-QAM range-subcarriers freq-abs 824000000 width
10000000
assign modulation 2048-QAM range-subcarriers freq-abs 644000000 width
16000000
assign modulation 2048-QAM range-subcarriers freq-abs 660000000 width
32000000
assign modulation 4096-QAM range-subcarriers freq-abs 692000000 width
30000000
```

D3.1 US Configuration

- OFDMA Channel Profile(s)
- OFDMA Modulation Profile(s)
- Controller Upstream-Cable
- Interface Cable

Expanded to 7 IUCs (9 to 13)

```
cable mod-profile-ofdma 424
  subcarrier-spacing 25KHz
  initial-rng-subcarrier 64
  fine-rng-subcarrier 128
  data-iuc 12 modulation 1024-QAM pilot-pattern 8
  data-iuc 13 modulation 256-QAM pilot-pattern 8
<snip>
```

```
interface Cable 2/0/1
 load-interval 30
 downstream Integrated-Cable 2/0/1 rf-channel 0
 downstream Integrated-Cable 2/0/1 rf-channel 4
 downstream Integrated-Cable 2/0/1 rf-channel 8
 downstream Integrated-Cable 2/0/1 rf-channel 12
 downstream Integrated-Cable 2/0/1 rf-channel 158
 upstream 0 Upstream-Cable 2/0/2 us-channel 0
 upstream 1 Upstream-Cable 2/0/2 us-channel 1
 upstream 2 Upstream-Cable 2/0/2 us-channel 2
 upstream 3 Upstream-Cable 2/0/2 us-channel 3
 upstream 4 Upstream-Cable 2/0/2 us-channel 12
 cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  upstream 4
  attributes 80000000
 cable bundle 1
```

US-CH 12-15 OFDMA

OFDMA channel with profile

```
controller Upstream-Cable 2/0/2
us-channel 0 frequency 17600000
us-channel 0 channel-width 1600000 1600
us-channel 0 docsis-mode atdma us-chann
minislot-size 4
us-channel 0 modulation-profile 221
us-channel 0 equalization-coefficient
<snip>
 us-channel 12 docsis-mode ofdma
 us-channel 12 subcarrier-spacing 25KHz
 us-channel 12 modulation-profile 424
 us-channel 12 frequency-range 42000000 85000000
 us-channel 12 cyclic-prefix 96 roll-off-period 0
 us-channel 12 symbols-per-frame 9
 no us-channel 12 shutdown
```

OFDMA channel as a part of USBG

DOCSIS 3.1 Operational Maintenance

Identifying D3.1 Modems

```
cBR8-01# show cable modem docsis version d31-capable
MAC Address    I/F           MAC          Reg  Oper DSxUS DS    RCC  US
                             State        Ver  Ver        OFDM  ID   OFDMA
14b7.f80e.3ee4 C3/0/1/UB     w-online(pt) 3.1  3.1  33x5  1     69   1
14b7.f80e.3ffc C3/0/1/UB     w-online(pt) 3.1  3.1  33x5  1     69   1
```

Operational Version 3.1

33 Channels – 32 SC-QAM + 1 OFDM

Number of OFDM Chans

Number of OFDMA Chans

Show Cable Modem Docsis Version Summary Total

```
CBR8-01# show cable modem docsis verion summary total

                  DOCSIS Registered             US QoS    US Phy Mode      DOCSIS Mode
             ----------------------------- --------- --------------- -------------------
             On-
Interface    line v3.1 v3.0 v2.0 v1.1 v1.0 v1.1 v1.0 ofdm atdm tdma UP  WB  WP  NB
C2/0/1/UB    32   7    25   0    0    0    32   0    7    25   0    0   32  0   0
C2/0/0/UB    4    1    3    0    0    0    4    0    0    4    0    0   4   0   0
C3/0/0/UB    38   8    30   0    0    0    38   0    0    38   0    0   38  0   0
C3/0/1/UB    5    3    2    0    0    0    5    0    0    5    0    0   5   0   0
-----------------------------------------------------------------------------------
Total:       118      v3.1: 21            v1.1: 118   UB  : 116    WB:  116
                      v3.0: 95                        UP  : 0      WP:  0
                      v2.0: 2             v1.0: 0     ofdm: 7      NB:  2
                      v1.1: 0                         atdm: 111
                      v1.0: 0                         tdma: 0
-----------------------------------------------------------------------------------
```

Total D3.1 modems per MD

Total D3.1 modems per chassis

D3.1 Bonding Validations CM

- **Show cable modem** {*mac-address* | *ipaddress* } **wideband rcs-status**
  - Make sure CM is not in “Partial Service”
    - MAC state will be “p-online(pt)” for DS partial service

Chan status for a CM

```
cBR8-01#show cable modem 14b7.f80e.3ee4 wideband
CM              DS-CTRL  RF   CH ID  STATUS        TYPE      PRIM-CHAN
--------------  -------  ---  -----  ------------  --------  ---------
14b7.f80e.3ee4  2/0/1    0    1      UP            SC-QAM    NO
                         1    2      UP            SC-QAM    NO
                         2    3      UP            SC-QAM    NO
                         7    8      UP            SC-QAM    NO
                         8    9      UP            SC-QAM    YES
                         30   31     UP            SC-QAM    NO
                         31   32     UP            SC-QAM    NO
                         158  159    UP            OFDM      NO
```

Overall Throughput Numbers On cBR-8

show controllers { downstream-cable | integrated-cable } *slot/sub/port* counter rf-channel 0-162

```
cBR8-01# show controllers integrated-Cable 2/0/1 counter ofdm-channel
Controller Chan# Profile/PLC              Packets                Bytes MaxRate     Rate       Utilization
                                                                        (Mbps)      (Mbps)     (%)
2/0/1      158   Total                 21215976761       20531535357096       -    1216.056926  100.0
2/0/1      158   0                       178625333         254776976190     496      0.004952   0.0
2/0/1      158   1                         5290363           214635993     616      0.001600   0.0
2/0/1      158   2                     21015238174       20274362725057    1216   1216.005271  100.0
2/0/1      158   PLC-MMM                  15771114           1161805398               0.008840
2/0/1      158   PLC-EM                          0                    0               0.000000
2/0/1      158   PLC-TR                          0                    0               0.000000
```

```
cBR8-01# show controllers downstream-cable 7/0/0 counter rf-channel

Controller  RF    MPEG       MPEG       MPEG    Sync      MAP/UCD   User    QAM
            Chan  Packets    bps        Mbps    Packets   Packets   Mbps    Util
                  Tx                             Tx        Tx                Percentage
7/0/0       0     0          0          00.00   0         0         00.00   000.00
7/0/0       1     0          0          00.00   0         0         00.00   000.00
7/0/0       2     8239954    2475952    02.47   0         0         02.39   006.60
7/0/0       3     85927382   25769779   25.76   0         0         24.94   068.71
7/0/0       4     85927608   25769027   25.76   0         0         24.94   068.71
7/0/0       5     8239088    2474599    02.47   0         0         02.39   006.59
7/0/0       6     8210840    2463770    02.46   0         0         02.38   006.57
7/0/0       7     50103      15040      00.01   0         0         00.01   000.04
…
```

Field	Meaning
MPEG BPS	Raw throughput (MPEG)
User BPS	Payload throughput
QAM Util Percentage	(New) Percentage utilized based on 37.5 MBP pipe

DS Performance Verification

- Show cable modem <mac/ip-add> service-flow

```
cBR8-01#show cable modem 14b7.f80e.3ee4 service-flow
MAC Address     IP Address       Host           MAC                 Prim  Num Primary     DS
                                 Interface      State               Sid   CPE Downstream  RfId
14b7.f80e.3ee4 13.41.0.34        C2/0/1/UB      w-online(pt)        7     8   In2/0/1:8   12296
Sfid  Dir Curr  Sid   Sched  Prio MaxSusRate  MaxBrst   MinRsvRate  Throughput
          State       Type
 11   US  act   7     BE     0    0           3044      0           19930223
 12   DS  act   N/A   N/A    0    0           3044      0           1899996040

DOWNSTREAM SERVICE FLOW DETAIL:
SFID  Flg Policer              Scheduler              FrwdIF
          Xmits      Drops      Xmits      Drops
12        0          0          1726       0          Wi2/0/1:13
UPSTREAM SERVICE FLOW DETAIL:
SFID  SID  Requests   Polls      Grants     Packets
11    7    15569323   0          15569045   1565745
```

No P-online(pt) or partial-service in Up mode

Current DS throughput

Wideband intf is for forwarding. Modular intf. Or Dynamic WC Intf For WB CM in partial service mode

US Requests for Grants US BW

Upstream Performance Verification

```
cBR8-01#show cable modem 14b7.f80e.3ee4
MAC Address    IP Address      I/F           MAC                Prim  RxPwr  Timing Num I
                                             State              Sid   (dBmv) Offset CPE P
14b7.f80e.3ee4 13.41.0.34      C2/0/1/UB     w-online(pt)       7     0.00   2095   0   N
```

US Not in Partial-Service

Partial-Mode Information	Failed TCS Bitmap LSB is highest US
Ranging Status	**cnt** = continue **dr** = down recovery **sta** = station maint (good)
Codewords	Good CW incrementing Corrected and Uncorr not
Tjming offset	Not changing much

For throughput >= 40M

2 sid clusters with 2 max request per sid

For fairly balanced utilization on US channels under one USBG per MD

Configure "***cable upstream balance-scheduling"*** globally

Only see this info if modem in Partial Service on US side

Good Codewords received..

All US in "sta" Station Maint. Mode with good SNR

```
cBR8-01#show cable modem 14b7.f80e.3ee4 verbose
Partial-Mode Information          : reason 0x1  failed-tcs 0x2
MAC Address                       : 14b7.f80e.3ee4
IP Address                        : 13.41.0.34
IPv6 Address                      : ---
Dual IP                           : N
Prim Sid                          : 7
Host Interface                    : C2/0/1/UB
Upstream Channel                  : US0        US1        US2        US3
Ranging Status                    : sta        sta        sta        sta
Upstream SNR (dB)                 : 42.4       42.4       39.8       38.12
Upstream Data SNR (dB)            : 40.0       39.8       39.8       35.56
Received Power (dBmV)             : 0.00       0.00       0.00       0.00
Data Burst resiliency suspended   : N          N          N          N
Reported Transmit Power (dBmV)    : 30.00      30.00      30.00      30.50
Commanded Transmit Power (dBmV)   : 30.00      30.00      30.00      30.50
Good Codewords rx                 : 888920     852219     882345     855338
Corrected Codewords rx            : 0          0          0          0
Uncorrectable Codewords rx        : 7          0          0          0
Phy Operating Mode                : atdma*     atdma*     atdma*     atdma*
```

Upstream Performance Verification

```
cBR8-01#sho cable modem 14b7.f80e.3ee4 service-flow 11
Sfid                : 11
Hfid                : 285
Mac Address         : 14b7.f80e.3ee4
Type                : Primary
Direction           : Upstream
Current State            : Active
Rate Limit Delayed Grants     : 0
Rate Limit Dropped Grants     : 0
Current Throughput       : 16017517 bits/sec,2010 packets/sec
US Bonded           : YES
Upstream Bonding Group  : UBG-1
Sid Cluster         : SC-0, Sid [ 7 7 7 7 ]
Sid Cluster         : SC-1, Sid [ 11 11 11 11 ]
Upstream PCH             : 12  13    14    15
Segments Valid           : 10926917
Segments Discarded       : 0
Segments Lost            : 0
<snip>
Sid                              : 7
Request polls issued             : 0
BWReqs {Cont,Pigg,RPoll,Other}   : 189704, 10753203, 0, 0
Grants issued                    : 301850
Packets received                 : 137439110
Bytes received                   : 67873270485
Queue-indicator bit statistics   : 0 set, 0 granted
Good Codewords rx                : 30964862
```

```
cBR8-01#sh cable admission-control int c2/0/     all
Interface  Cable2/0/1
Upstream # 0

Upstream Bit Rate (bits per second) = 30720000
    Sched Table Rsv-state: Grants 0, Reqpolls 0
    Sched Table Adm-state: Grants 0, Reqpolls 19, U   il
0%
    UGS    : 11 SIDs, Reservation-level in bps 959365
    UGS-AD : 0 SIDs, Reservation-level in bps 0
    RTPS   : 0 SIDs, Reservation-level in bps 0
    NRTPS  : 19 SIDs, Reservation-level in bps 318155
    BE     : 72 SIDs, Reservation-level in bps 0
Maximum AC reservable bandwidth is not configu   ed
```

UGS flow numbers

Two US SID Clusters

Per US sid numbers

NRTPS flow (Voice Signaling)numbers

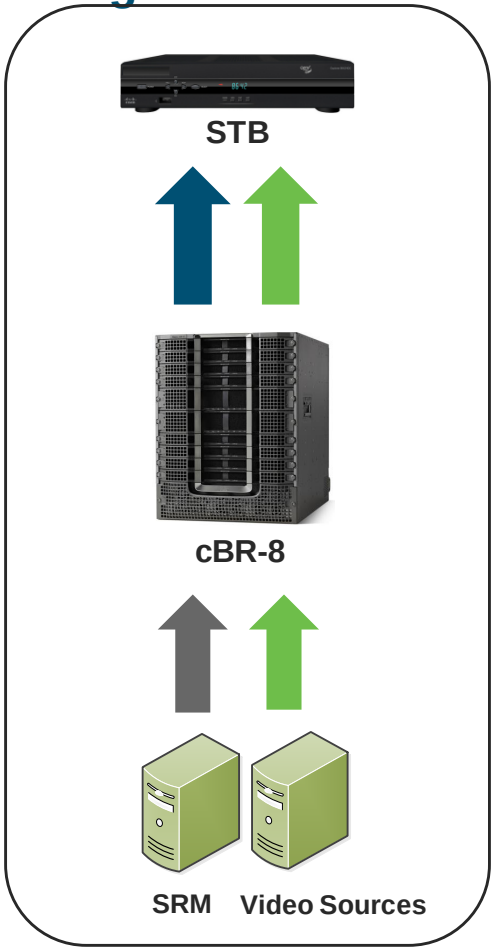
CCAP Video Troubleshooting

Video Services Troubleshooting

Common Problems

- 1. No Video
  - Video Configurations
  - Session Validations
  - ADSG Validations
- 2. Macro-blocking or Impaired Video
  - Throughput Rates
  - Dropped Packets
  - Reserved Session Rates

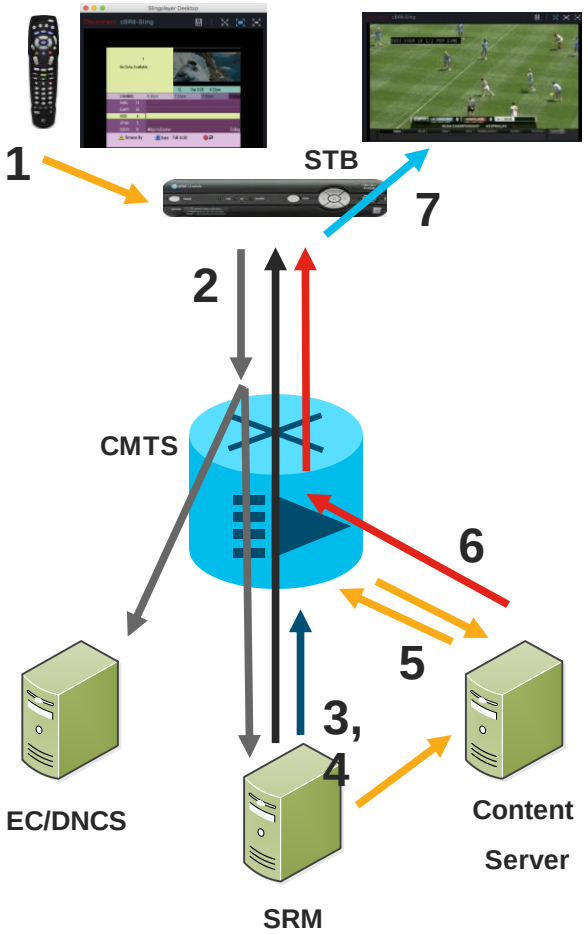
High Level Video Flow



Video Services

Video Session Setup

- 1 Customer STB selects programming
- 2 STB communicates to EC/SRM to request content
- 3 SRM requests session creation to cBR-8
  - Source Specific Multicast or Unicast (VOD)
- 4 SRM transmits to STB the session information
- 5 cBR-8 obtains content from Content Server
  - Add Encryption if cBR-8 doing edge Encryption
  - cBR-8 initiates the SSM / SRM instructs source to start
- 6 cBR-8 forwards content on the appropriate SG
- 7 Set Top tunes to appropriate QAM Carrier
  - Decodes program with the provided encryption keys and program information



Video Services Configuration

cBR-8 Configuration Overview

- Logical Edge Device LED
- Virtual Carrier Group VCG
- Service Distribution Group SDG
- Binding VCG and SDG
- Interface Virtual Port Group VPG
- Subnet for Virtual Edge Input VEI
- Controller for Video QAMs
- IP Subnets for VPG and VEI(s)
- Chassis MAC Address
- Access-list(s) and Route-Map(s)

Checklist

Best Practices
- One LED Per Cable Line Card
- Unique Output Port Numbers for each LEDs and VCGs
- Uniform binding of VCGs and SDGs
- Uniform naming conventions
- Loopback for Management Interface(s)
- Separate Subnets of Virtual-Port Group and VEI

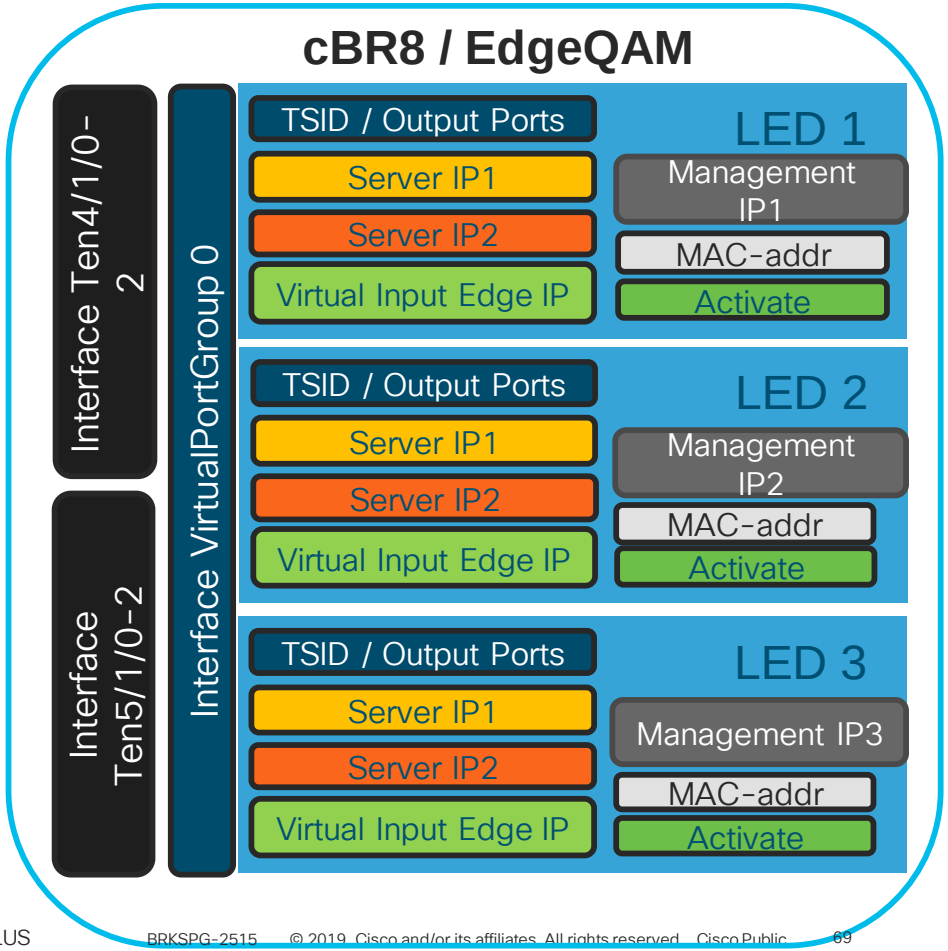
IP Subnets Required
- Bundle – CPE / STB subnets
- Virtual Port Group 0 – Management Subnet
- Virtual Edge Interface - /32 Static Subnet

IGP Routing Required
- Redistribute Connected Virtual Port Group
- Redistribute Static Virtual Edge Device IP(s)

Access Lists Required
- Multicast Uplink ACL allowed

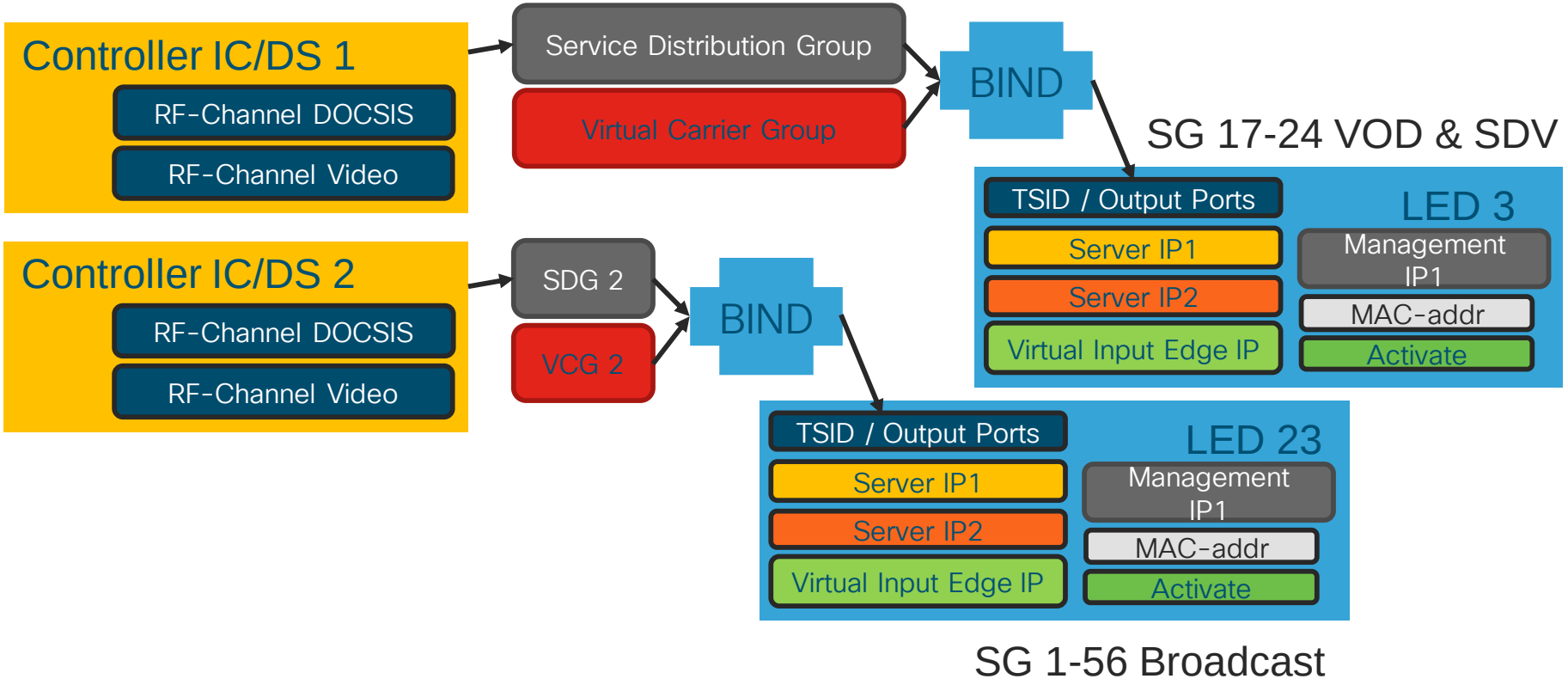
Cable Video Components

- LED – Logical Edge Device
  - "QP" QAM Partition in RFGW-10
  - LED can be though of as "Virtual RFGW-1"
- Management IP
  - IP of the LED
- Server IP 1 and IP 2
  - IP Address of VSRM Primary and Standby
- Virtual Edge Input
  - Destination IP for VOD
- Interface Virtual Port Group 0
  - Loopback/Virtual
  - Subnet where Mgmt Ips are
  - Redistribute Connected in IGP
- Encryption
- Multicast Uplink and ACL



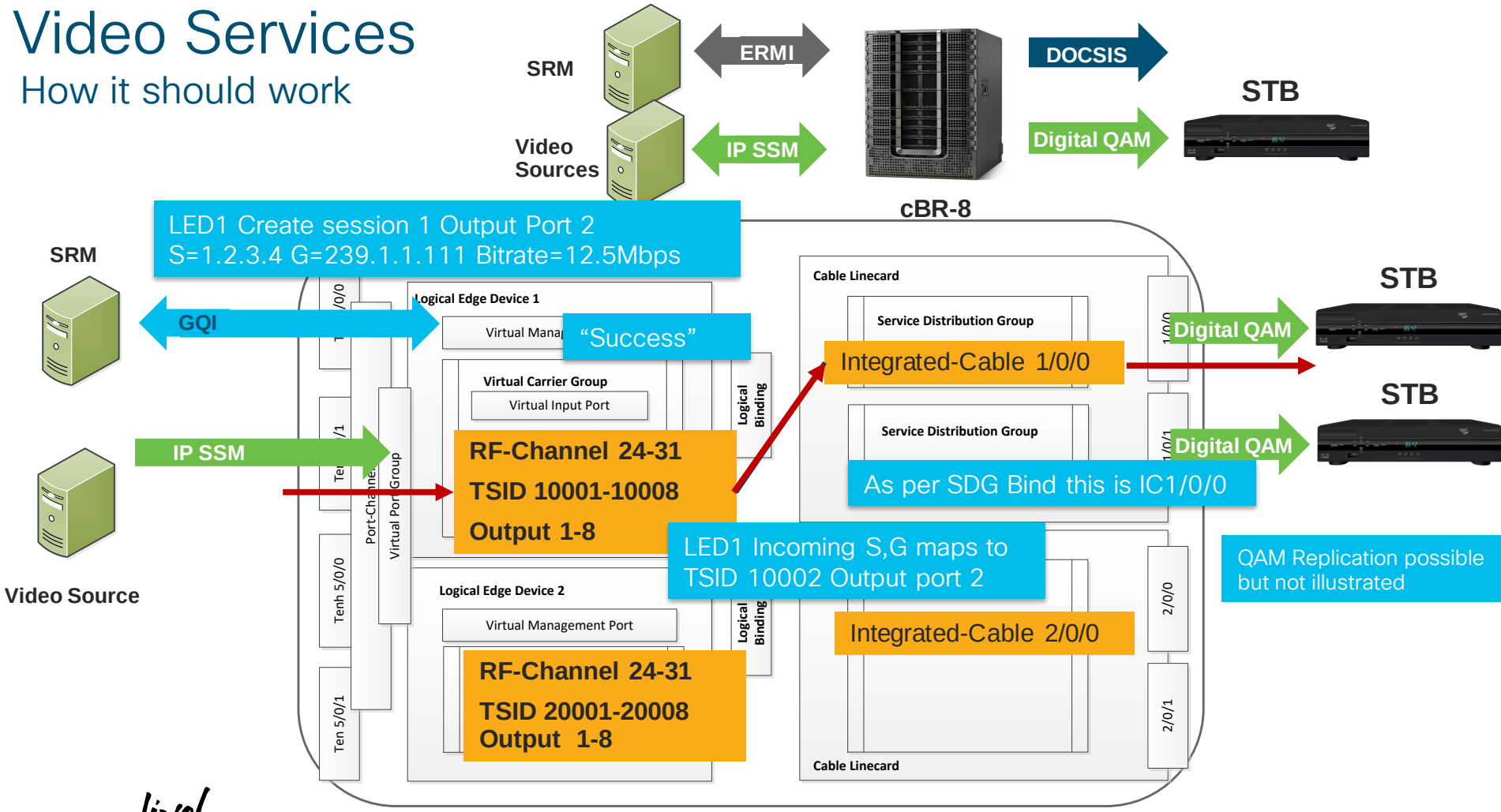
Configuration Example

Various services for each LED to SG



Video Services

How it should work



CCAP Video Troubleshooting

Video Sessions Deep-Dive

Command	Insight
show cable video sessions logical id *id*	Per-LED Sessions : Look for statistics, trends, general health
show cable video sessions all [summary]	Per-Chassis Sessions : Statics, trends, session states
show cable video session logical id *id* **session-id** *sess-id*	Per-Session Details: Input/Output, Packet counts, and MPEG Stats

```
CBR8-01# show cable video sessions logical id 1

LED Session    Output Streaming   Sess Session Source              UDP   Output  Input     OutputInput    Output   Encrypt       Encrypt   Low PMV  Session
Id  Id         Port   Type        Type Ucast Dest IP/Mcast IP (S,G) Port  Program State     State Bitrate  Bitrate  Type          Status    Lat NUM  Name
-------------------------------------------------------------------------------------------------------------------------------------------------------
1   1107156    26     Passthru    SSM  10.225.139.11,239.203.49.50  0     -       ACTIVE-PSI ON    21961    16573    CLEAR         -         N   -    0x545200F04…
1   1191769    26     Remap       SSM  10.225.139.11,239.202.2.253  0     1050    ACTIVE-PSI ON    8955242  8927587  Pre-encrypted Encrypted N   -    …9B066E9C6C
1   1197288    26     Remap       SSM  10.225.139.11,239.202.11.9   0     1104    ACTIVE-PSI ON    8565688  8597610  Pre-encrypted Encrypted N   -    …9B067041B5
1   1197362    104    Remap       UDP  13.136.70.223                23902 2001    ACTIVE-PSI ON    14846535 14833575 PowerKey      Encrypted N   -    …5A00000F09
```

```
cBR8-01#show cable video session all summary

Video Session Summary For Chassis:

Active     : 2105            Init       : 0             Idle        : 0
Off        : 0               Blocked    : 0             PSI-Ready   : 2105
UDP        : 36              ASM        : 0             SSM         : 2069
Remap      : 730             Data       : 0             Passthru    : 1375
Pending    : 0               Encrypted  : 36            Low Latency: 0

Total Sessions       : 2105
Total Input Bitrate  : 6237924818 BPS
Total Output Bitrate : 6190313200 BPS
Total LEDs           : 7
```

State	Meaning
Pre-Encrypted	Bulk Encrypted
Active-PSI	Active and PSI Info
Init	Session pinned up
Idle	Waiting for incoming traffic
Off	Timed out waiting

CCAP Video Troubleshooting

Video Sessions Deep-Dive

```
cBR8-01# show cable video sess logical id 1 session-id 1197362

Session Name          : 0x4C83DE17F1A500000F09
Session Id            : 1197362
Creation Time         : Wed May 15 10:53:52 2019

Output Port           : 104
TSID                  : 7599
ONID                  : 0
Number of Sources     : 1
  Destination IP      : 13.136.70.223
  UDP Port            : 23902
Config Bitrate        : 14957724
…
Off Timeout           : 300 sec
Encryption Type       : PowerKey
Encryption Status     : Encrypted

Input Session Stats:
====================
  State: ACTIVE-PSI, Uptime: 0 days 00:19:32
  IP Packets: In 1613285, RTP 0, Drop 0
  TP Packets: In 11166215, PCR 50656, PSI 19111, Null 126780
              Unreference 0, Discontinuity 17
  Errors: Sync loss 0, CC error 65, PCR Jump 0,
          Underflow 1, Overflow 1, Block 0
  Bitrate: Measured 14863277 bps, PCR 14891916 bps

Output Session Stats:
=====================
  State: ON, Uptime: 0 days 00:19:32
  TP Packets: In 11174905, PCR 50652, PSI 19110,
              Drop 9554, Forward 11146241, Insert 11723
  Errors: Info Overrun 0, Info Error 0, Block 0, Overdue 0,
          Invalid Rate 0, Underflow 0, Overflow 0
  Bitrate: Measured 14853156 bps
```

MPEG Counters	Meaning
CC Error	Continuity Check error – Incoming stream inconsistent
PCR Jump	Clock/Timing Inconsistency
Under/Overflow	Jitter and latency buffers

```
PAT Info:
=========
  Version 0, TSID 1, len 16, section 0/0
  Program 1: PMT 480

Input PMT Info:
===============
  Program 1, Version 0, PCR 481, Info len 0
  PID 481: Type 2, Info len 0
  PID 482: Type 129, Info len 24, (desc 5 len 4), (lang eng), (desc 129 len
10)

Output PMT Info:
================
  Program 2001, Version 7, PCR 2129, Info len 0
  PID 2129: Type 2, Info len 9, (CA SYS-ID 3584, PID 2159, Private data:
01010b)
  PID 2130: Type 129, Info len 33, (desc 5 len 4), (lang eng), (desc 129 len
10), (CA SYS-ID 3584, PID 2159, Private data: 01010c)

Output PID Map:
===============
  PID 480 -> 2128
  PID 481 -> 2129
  PID 482 -> 2130
```

CCAP Video Troubleshooting

Debugs and Tracing

Command	Insight
debug cable video gqi	Enables GQI Debugs
set platform software trace {led-01} **RP active** { **vgqi-mgmt** | **vgqi-msg** } **noise**	Sets additional tracing for Debugs to be meaningful
show platform software trace message {led-01} **RP active**	Displays the resulting debug/trace logs

```
[vgqi-mgmt]:vgqi_msg_encode_query_sessions_response_v2 - Session ID Count on requested QAM: 1
[vgqi-mgmt]:vgqi_msg_encode_query_sessions_response_v2 - GQI Output Port 1 maps to physical QAM -> slot 1 port 0
channel 24
[vgqi-mgmt]:vgqi_allocate_response, Allocating GQI Response: GQI Server IP 10.225.198.88, LED Mgmt IP 13.135.69.2
[vgqi-msg]:vgqi_rpc_print_session_list_query_params -> Received GQI Query Sessions Request:
  Transaction Header:
    Transaction ID: 00D30000
    Response Program Number: 30000082
  Output Port Number: 1
[vgqi-mgmt]:get_gqi_rpc_message_remote_local_ip, Received GQI Query Sessions V2 Request from 10.225.198.88 to
13.135.69.2
```

RPHY - RPD Video Troubleshooting Deep-Dive

show downstream channel counter { dps | tpmi | dpmi }

	What is it	What does it tell us
DPS	Transmitted Packets	What packets are tx on the carrier
TPMI	Rx Match Destination MAC, IP, and L2TPv3 Session ID	If incrementing : valid tuple received for channel
DPMI	Rx Match L2TPv3 Session ID and Sequence Number Checking	If incrementing : valid sequencing received If SeqErr-Pkt : Out of sequence packets received

```
R-PHY# show downstream channel counter tpmi
Level      Rx-pkts     Rx-sum-pkts
Node Rcv   182177630   182177630
Depi Pkt   2382390178  2382390178

Port Chan  Rx-pkts     Rx-sum-pkts
DS_0 39    778328859   778328859
...
DS_0 44    460223051   460223051
DS_0 45    460211632   460211632
DS_0 46    460221125   460221125
DS_0 47    460344092   460344092

Port       Rx-pkts     Rx-sum-pkts  Drop-pkts   Drop-sum-pkts
DS_0       3863639261  3863639261   0           0
US_0       485970657   485970657    0           0
US_1       2244        2244         0           0
```

```
R-PHY# show downstream channel counter dps
Chan Tx-packets Tx-octets   Drop-pkts   Tx-sum-pkts Tx-sum-octs Drop-sum-pkts

46   1412715444 3597499732 0           1412715444  3597499732  0
47   1412733756 3600941072 0           1412733756  3600941072  0
158  719767     47391972   0           719767      47391972    0
...
```

```
R-PHY# show downstream channel count dpmi
Field         Pkts        Sum-pkts
Dpmi Ingress  2203906685  2203906685
Pkt Delete    0           0
Data Len Err  0           0
Chan Flow_id  Octs        Sum-octs    SeqErr-pkts  SeqErr-sum-
pkts
47   0        3887236816  3887236816  5            5
47   1        0           0           0            0
47   2        0           0           0            0
47   3        0           0           0            0
```

Advanced Voice Troubleshooting Techniques

Advanced Voice Troubleshooting

- Vacancy Tables and the MAC-Scheduler
- Voice Show and Debug
- Service Flow Troubleshooting
- SID Tracker

Vacancy Tables and MAC-Scheduler

Command	Purpose & Validation
show interface cable *slot/sub/port* **mac-scheduler** *upstream*	Utilization % and Number of Service Flows
show interface cable *slot/sub/port* **mac-scheduler** *upstream* **map-stats**	Mini-Slot Vacancy Tables are correct

```
cBR8-01#show interface cable 1/0/0 mac-sch 0 map-stat

UBR MAP Proxy U0 for Cable1/0/0/U0:
UBR MAP Proxy U0 for Cable1/0/0/U0:
     mslots_per_frame: 1 frame_in_nsecs: 12500
     Bktwidth:(2000 usecs, 20480 tstamps, 160 mslots) numbkts:150
     Tblwidth:(300000 usecs, 3072000 tstamps, 24000 mslots)
     Vacant bkt interval: 4800 mslots
     Bucket vacancy table (slot_count, used_ms, vacancy_ms)
     (  1,160,  0) (  0,  3,157) (  0,  3,157) (  0,  3,157) (  0,
     (  0,  3,157) (  0,  3,157) (  0,  3,157) (  0,  3,157) (  0,
     (  0,  3,157) (  0,  3,157) (  0,  3,157) (  0,  3,157) (  0,
…
```

```
cBR8-01#show interface cable 1/0/0 mac-sch 0

 DOCSIS 1.1 MAC scheduler for Cable1/0/0/U0 : rate 15360000
     wfq:None
     us_balance:OFF
     dps:ON
     dpon_mode:OFF
     fairness:OFF
     Queue[Rng Polls] flows 0
     Queue[CIR Grants] flows 0
…
     Avg upstream channel utilization(%data grants) : 65%
     Avg upstream channel utilization in 30 sec : 66%
     Avg percent contention slots : 30%
     Avg percent initial ranging slots : 2%
     Avg percent minislots lost on late MAPs : 0%
     Avg percent guardband slots : 0%
```

Voice Services

Commands

- show cable upstream service-flow summary
- show cable modem voice
- show cable modem *mac-address* service-flow [verbose]
- show interface cable *slot/subslot/port* service-flow qos us | include UGS
- show interface cable *slot/subslot/port* service-flow *sflow-id* verbose
- show interface cable *slot/subslot/port* dynamic-service statistics
- show cable admission-control interface *slot/subslot/port* {bonding-group all | upstream *us-number*}
- debug cable dynsrv
- debug cable qos

Voice Services Flow Debugs

Dynamic Service Flow

Debug cable dynsrv & Debug cable tlvs

```
Mar 9 19:28:49.792: DSA-REQ-RECD: OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:49.792: DSA-STATE-CREATED: OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:49.796: Found Upstream Service Flow TLV
Mar 9 19:28:49.796:    Service Flow Reference : 1
Mar 9 19:28:49.796:    QoS Parameter Set Type : 0x2
Mar 9 19:28:49.796:    Scheduling Type : 6
Mar 9 19:28:49.796:    Request/Transmission Policy : 0x17F
Mar 9 19:28:49.796:    Unsolicited Grant Size : 232
Mar 9 19:28:49.796:    Nominal Grant Interval : 20000
Mar 9 19:28:49.796:    Tolerated Grant Jitter : 800
Mar 9 19:28:49.796:    Grants Per Interval : 1
Mar 9 19:28:49.796: Found Upstream Packet Classifier TLV
Mar 9 19:28:49.796:    Classifier Reference : 1
Mar 9 19:28:49.796:    Service-Flow Reference : 1
Mar 9 19:28:49.796:    Rule Priority : 128
Mar 9 19:28:49.796:    Activation State : 0
Mar 9 19:28:49.796:    Found IP Packet Classifier Sub-TLV
Mar 9 19:28:49.796:            Protocol : 17
Mar 9 19:28:49.796:            Source Address : 24.34.240.235
Mar 9 19:28:49.796:            Destination Address : 24.34.240.247
Mar 9 19:28:49.796:            Source Port Start : 53456
Mar 9 19:28:49.796:            Source Port End : 53456
Mar 9 19:28:49.796:            Destination Port Start : 53456
Mar 9 19:28:49.796:            Destination Port End : 53456
```

Mac-add of CM

DSA REQ Received

Admit Service Flow only

US Scheduling type UGS

Std. UGS size for G.711/20ms

20 ms grant interval

Classifier not active yet

RTP port numbers

Voice Service Flow Debugs

Debug cable dynsrv & Debug cable tlvs

```
Mar 9 19:28:49.796: Found Downstream Service Flow TLV
Mar 9 19:28:49.796:    Service Flow Reference : 2
Mar 9 19:28:49.796:    QoS Parameter Set Type : 0x2
Mar 9 19:28:49.796:    Traffic Priority : 5
Mar 9 19:28:49.796:    Maximum Sustained Traffic Rate : 87200
Mar 9 19:28:49.796:    Maximum Traffic Burst : 1522
Mar 9 19:28:49.796:    Minimum Reserved Traffic Rate : 87200
Mar 9 19:28:49.796:    Minimum Reserved Rate Packet Size : 218
Mar 9 19:28:49.796: Found Downstream Packet Classifier TLV
Mar 9 19:28:49.796:    Classifier Reference : 2
Mar 9 19:28:49.796:    Service-Flow Reference : 2
Mar 9 19:28:49.796:    Rule Priority : 128
Mar 9 19:28:49.796:    Activation State : 0
Mar 9 19:28:49.796:    Found IP Packet Classifier Sub-TLV
Mar 9 19:28:49.796:            Protocol : 17
Mar 9 19:28:49.796:            Source Address : 24.34.240.247
Mar 9 19:28:49.796:            Destination Address : 24.34.240.235
Mar 9 19:28:49.796: Auth Block:
Mar 9 19:28:49.796: 0x0000: 01 06 01 04 00 00 14 3E
Mar 9 19:28:49.796: Sfref = 1, SFID = 103 <- Service Flow IDs assigned by CMTS
Mar 9 19:28:49.796: Sfref = 2, SFID = 104
Mar 9 19:28:49.796: Cfr-ref = 1, CFID = 33, SF-ref 1, SFID 103
Mar 9 19:28:49.796: Cfr-ref = 2, CFID = 34, SF-ref 2, SFID 104
Mar 9 19:28:49.796: DSA-RSP-SENT: CM->0013.1050.3801 TranscId->89 ConfCode->0
Mar 9 19:28:49.896: DSA-ACK-RECD: OrgMac->0013.1050.3801 OrgId->89 ConfCode->0
Mar 9 19:28:50.196: DSA-REQ End : Transaction over-T8 timer expired. OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:50.196: DYN-SRV-STATE-DESTROYED : OrgMac->0013.1050.3801 OrgId->89
```

Admit Service Flow only

DS service flow with high priority

DQOS Gate ID contained here

SFID assigned for US and DS

DSA Response sent and ACK received

Voice Service Flow

Service Flow Verification

Dynamic Service Flow

Alternative: Show interface cable *slot/subslot/port* service-flow sfid verbose

```
CBR8-01# show cable modem 0000.cad6.eeb6 service-flow verbose
Sfid                                    : 143
Mac Address                             : 0000.cad6.eeb6
Type                                    : Secondary(Dynamic)
Direction                               : Downstream
Current State                           : Active
Current QoS Indexes [Prov, Adm, Act]    : [0, 11, 11]
Active Time                             : 24:02
Sid                                     : N/A
Traffic Priority                        : 5
Minimum Reserved Rate                   : 87200 bits/sec
Admitted QoS Timeout                    : 200 seconds
Current Throughput                      : 87254 bits/sec, 50 packets/sec
Application Priority       : 3
Classifiers:
Classifier Id                       : 79
Service Flow Id                     : 143
CM Mac Address                      : 0000.cad6.eeb6
Direction                           : downstream
Activation State                    : active
Classifier Matching Priority        : 128
PHSI                                : 0
Number of matches                   : 72112
IP Classification Parameters:
       IP Source Address            : 14.80.82.7
       Source IP Address Mask       : 255.255.255.255
       Destination IP Address       : 14.80.82.141
       Destination IP Address Mask  : 255.255.255.255
```

DS dynamic service flow

DS Service Flow

High Priority for DS flow

Min Reserve rate

Current throughput

Source IP of DS flow

Destination IP of DS flow

SID Tracker

- **From the LC console:**
- Enable SID Tracker:
  - **debug cable interface c***x/y/z* **serv** *<sfid>* **track**
  - **test cable mod-sched show-sf-track** *<md> <sfid> <start-idx> <num_entries>*
- Clear SFID tracker:
  - **test cable mod-sched clear-sf-track** *<us-channel> <sfid>*

DTrack

Dtrack

Alternate Method

- To track control plane packets—packets transitioning RP-both ways
- For Example..DDoS attacks, IF debugs showing DHCP Discover and Request only (e.g. ingress only), CM config file, Routing updates

Where	Debug	What it does
SUP	**show platform hardware qfp active feature docsis dtrack statistics clear**	Clear Dtrack stats so you have clean start
SUP	**test platform hardware qfp active feature docsis dtrack mac** *mac*	Enable dtrack against a mac-address
SUP	**test platform hardware qfp active feature docsis dtrack packet-copy**	Enable dtrack packet-copy
SUP	**clear cable modem** *mac* **reset**	Reset CM
SUP	**show platform hardware qfp active feature docsis dtrack statistic**	Display Dtrack Stats
SUP	**show platform hardware qfp active feature docsis dtrack statistic verbose**	(Optional) Deep dive stats, packet header etc..
SUP	**test platform hardware qfp active feature docsis dtrack disable**	Turn off Dtrack

Dtrack Example

```
F241-36-04-cBR8-01#show platform hardware qfp active feature docsis dtrack statistics clear
dtrack not enabled

F241-36-04-cBR8-01#test plat hard qfp act feat doc dtrack mac 848d.c7eb.

F241-36-04-cBR8-01#test plat hard qfp act feat doc dtrack packet-copy

F241-36-04-cBR8-01#clear cable modem 848d.c7eb.16cc reset

F241-36-04-cBR8-01#show plat hard qfp act feat doc dtrack stat

DTRACK # mac-addr 848d.c7eb.16cc # flags 0x0000001F
CABLE:upstream
 8           match
 0           transmit
 Punt
 count       ID  punt-cause
 2           007 ARP request or response
 4           103 cable modem pre reg
 2           107 Cable DHCP
 Drop
  no drops

CABLE:downstream
 3           match
 3           transmit
```

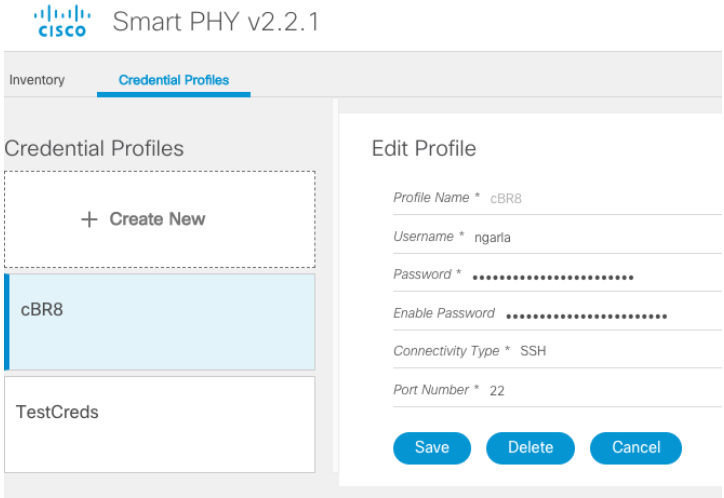
```
CABLE:inject-ds
 count       ID  inj-cause
 3           040 Cable L2 unicast inject
 all transmitted

CABLE:bundle-flood
 not enabled

WAN:dhcp6-to-server
 no matches

WAN:dhcp6-from-server
 no matches

WAN:dhcp4-to-server
 4           match
 4           transmit

WAN:dhcp4-from-server
 2           match
 Punt
 count       ID  punt-cause
 2           107 Cable DHCP
 Drop
  no drops
```

SmartPHY

Checking configuration from cBR-8

- Used to track RPD related config changes via any tool on cBR-8
- Ensure you have archive logging enabled
- show archive log config user *username* 0
- Monitoring logging changes for “any” automation tool (SmartPhy/BPA/NSO)

```
cBR8-01#sh run | sec archive
archive
 log config
  logging enable
  logging size 1000
  notify syslog contenttype plaintext
  hidekeys
```

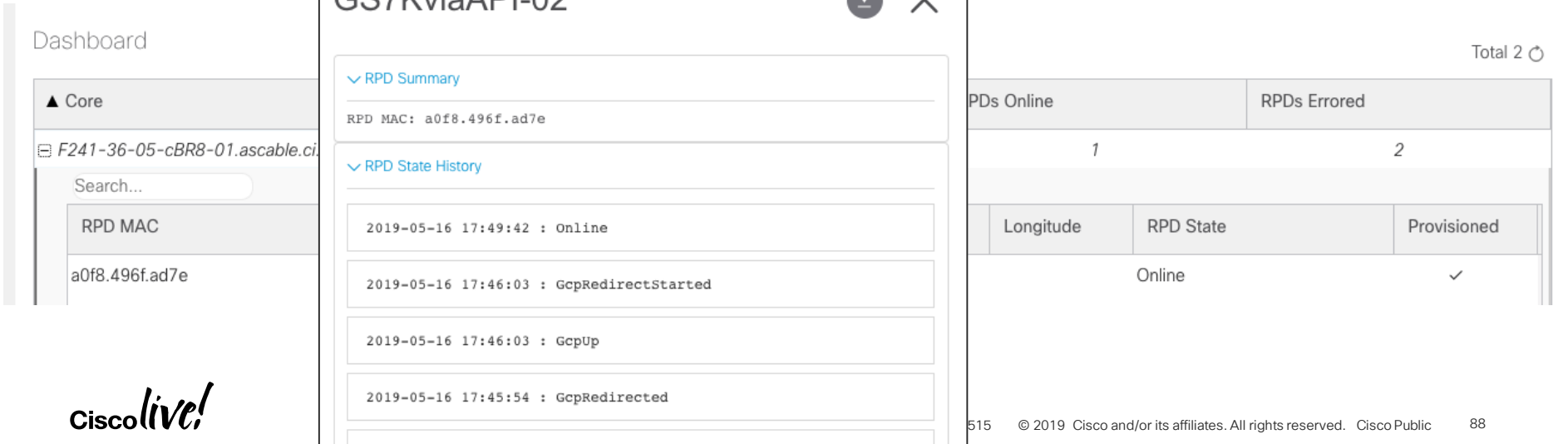


SmartPHY

Validating RPD Transition States

- From Dashboard -> Overview
- Or Dashboard -> RPD Assignment -> Select RPD -> Details -> Under “RPD State History”

State	Meaning
Online	Online
NotProvisioned	SmartPhy not provisioned for this RPD and GCP messages discarded
GcpRedirectStarted	RPD provisioned on cBR-8
GcpRedirectError	RPD unable to redirect
GcpRedirected	RPD ACK redirect
Offline	Not online on the cBR-8



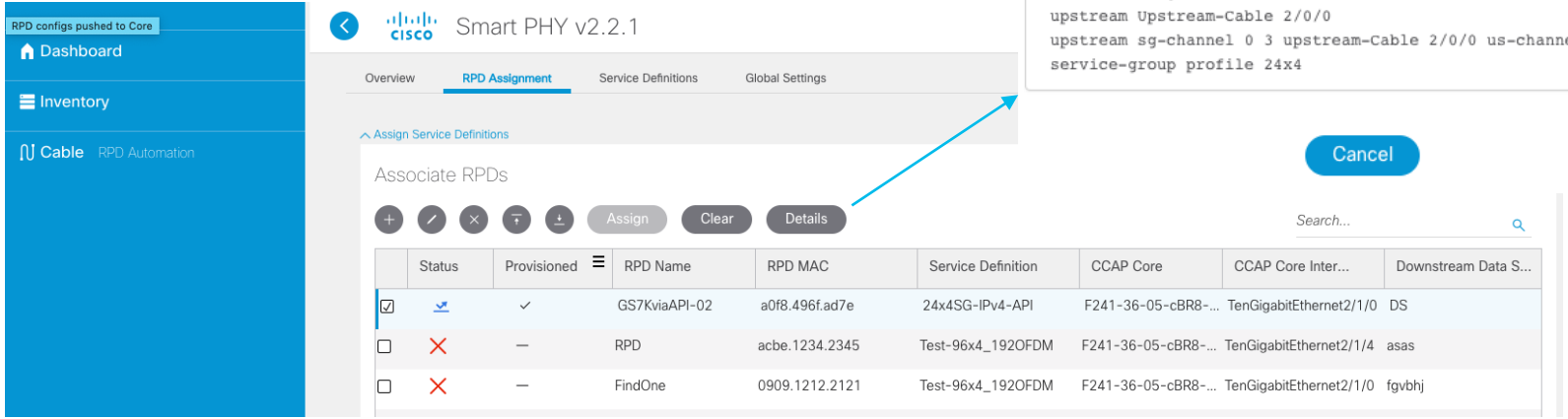
SmartPHY

Checking configuration for RPD or cBR-8

- RPD: Go to RPD Assignment Page -> Select RPD -> Details

RPD CLI

```
cable rpd GS7KviaAPI-02
 description Test
 identifier a0f8.496f.ad7e
 core-interface Te2/1/0
  principal
  rpd-ds 0 downstream-cable 2/0/0 profile 50
  rpd-us 0 upstream-cable 2/0/0 profile 60
 r-dti 1
 rpd-event profile 5
cable fiber-node 1
 downstream Downstream-Cable 2/0/0
 downstream sg-channel 0 23 downstream-Cable 2/0/0 rf-channel 0 23
 upstream Upstream-Cable 2/0/0
 upstream sg-channel 0 3 upstream-Cable 2/0/0 us-channel 0 3
 service-group profile 24x4
```



cBR-8 Optimizations and Automation

You make multi-cloud **possible**

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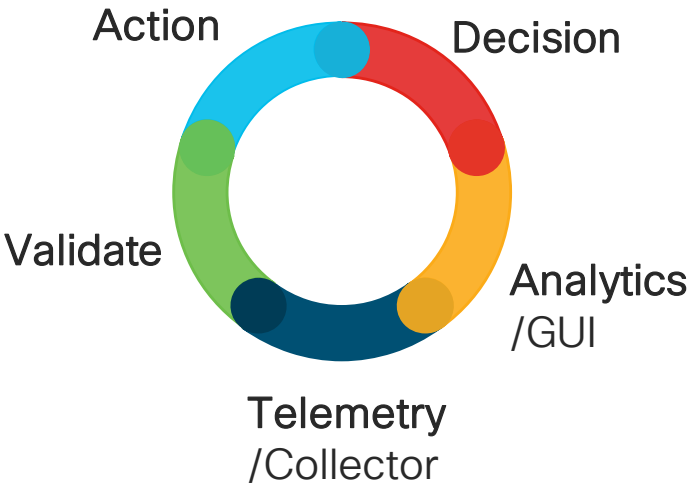
Agenda

Optimization and Automation

- SmartPHY
- Evolved Programmable Network Manager
- Business Process Automation (+Demo cBR-8 IOS-XE Upgrade)
- Automated Fault Manager

The Automation Cycle

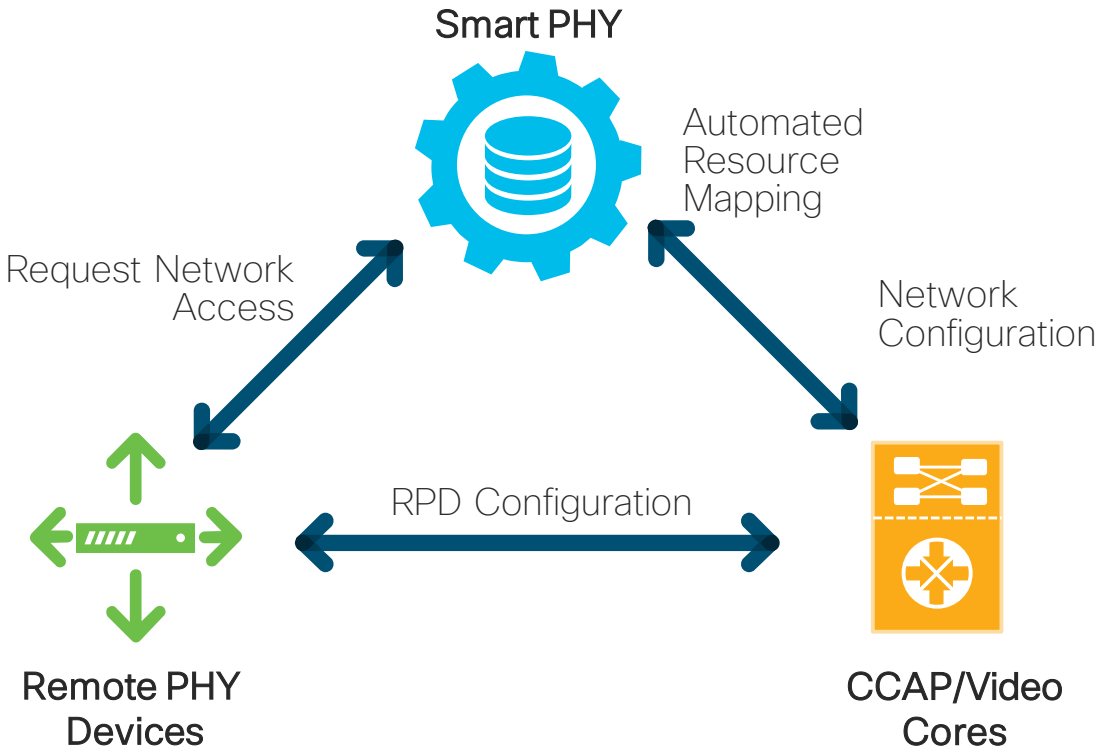


The Automation Cycle	
Telemetry	Get the Data
Analytics	Find the relevance
Decision	Act on insight
Action	Make the change
Validation	Did we improve?

True automation requires all steps

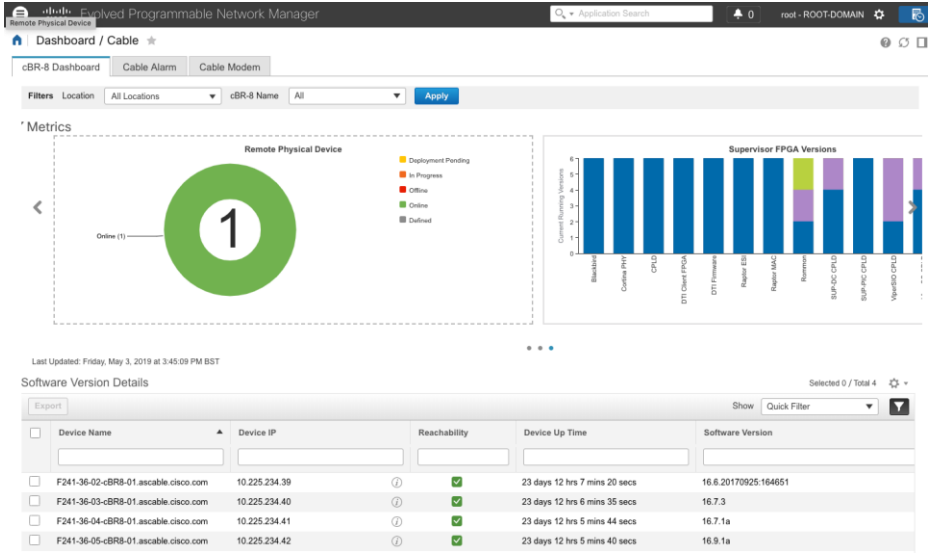
SmartPHY

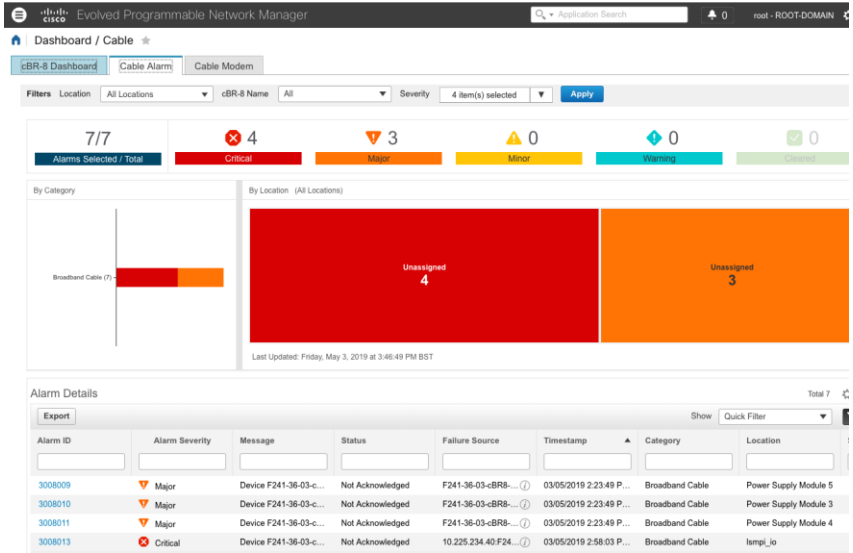
- **Deployment Simplified**
  - Resource Selection
  - DOCSIS & Video
  - cBR-8 and RPD orchestration
- **Unified Provisioning**
  - Common DHCP Policy
  - Flexible RPD to SG mapping without managing one-offs
- **Cisco Crosswork Platform**
  - Common Infrastructure
  - API-Centric Design
- **Advanced Monitoring & Troubleshooting**



Evolved Programmable Network Manager

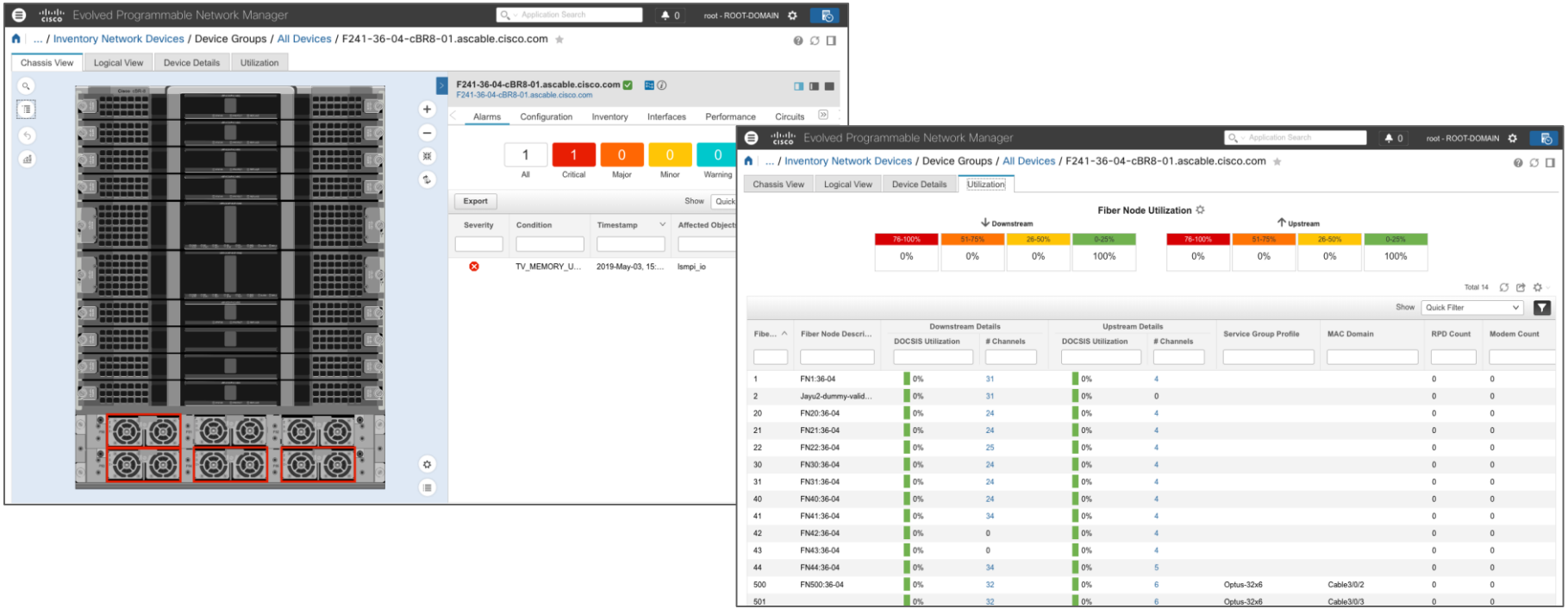
- Version 3.0 supports cBR-8 Specific Features and Dashboard





Evolved Programmable Network Manager

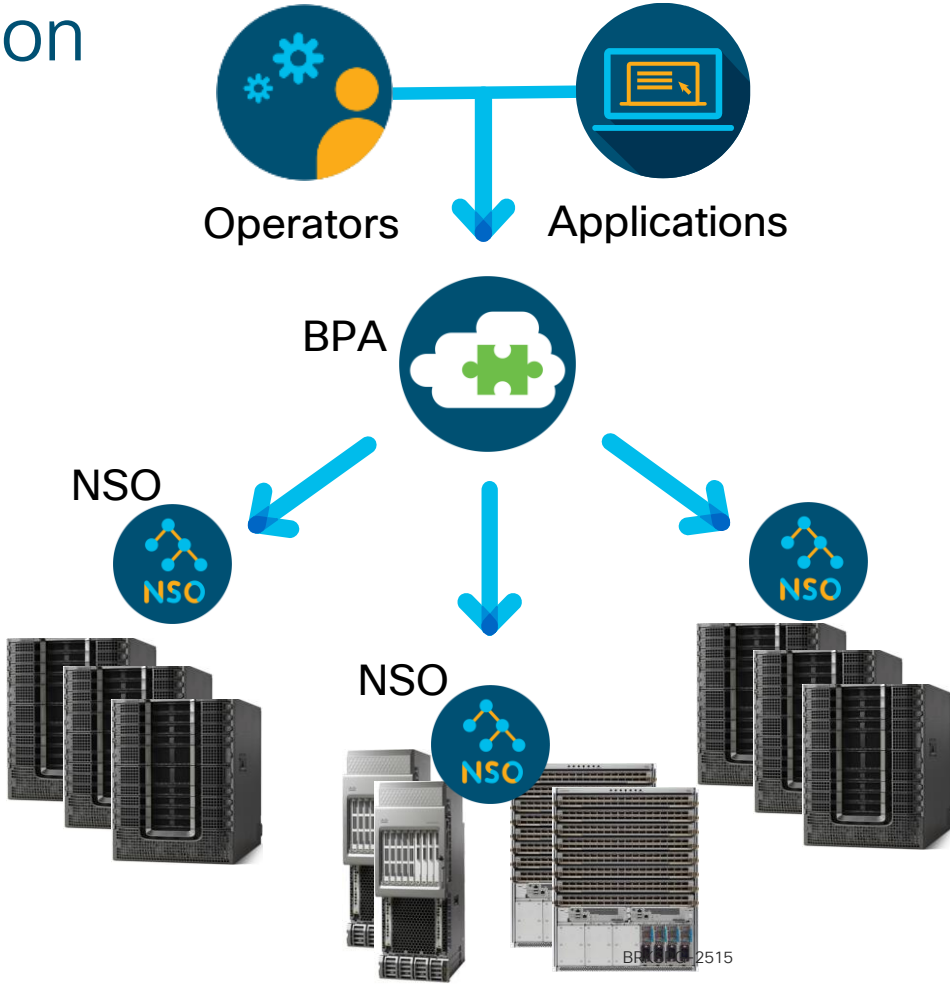
- Device Specific View



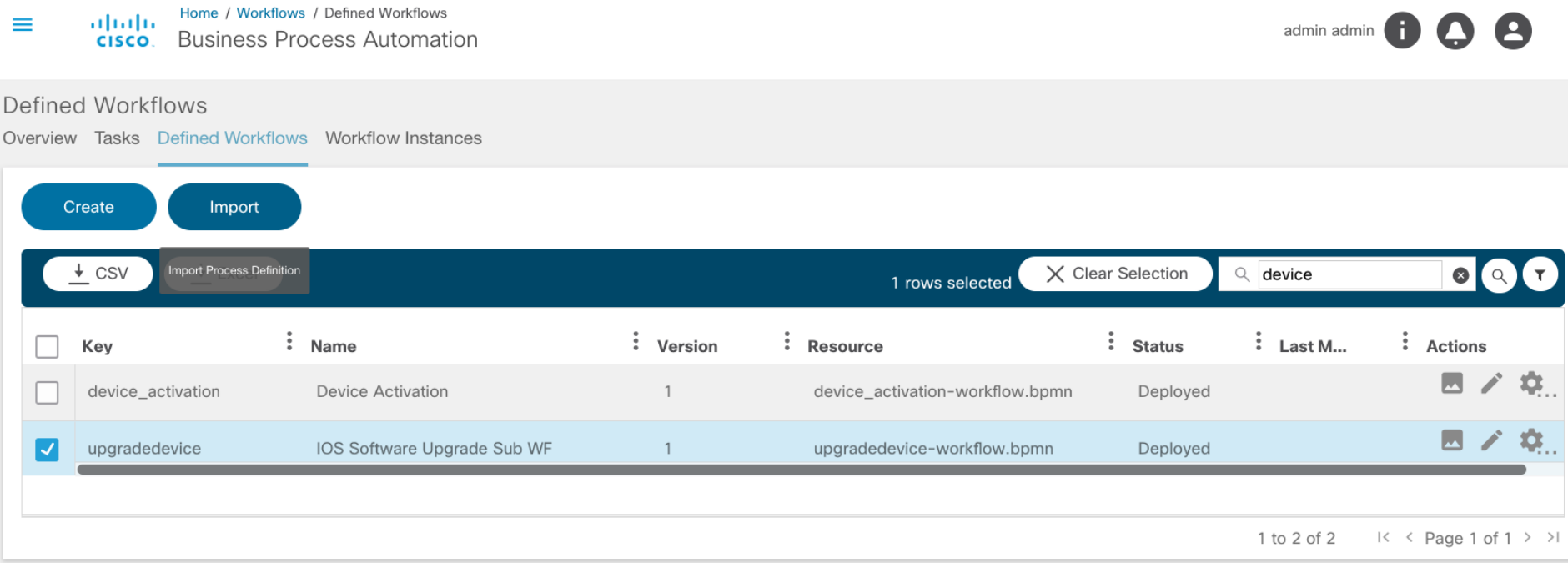
Business Process Automation

- A software workflow engine
  - Leverages Cisco Network Services Orchestrator (NSO)
  - Leverages BP workflows

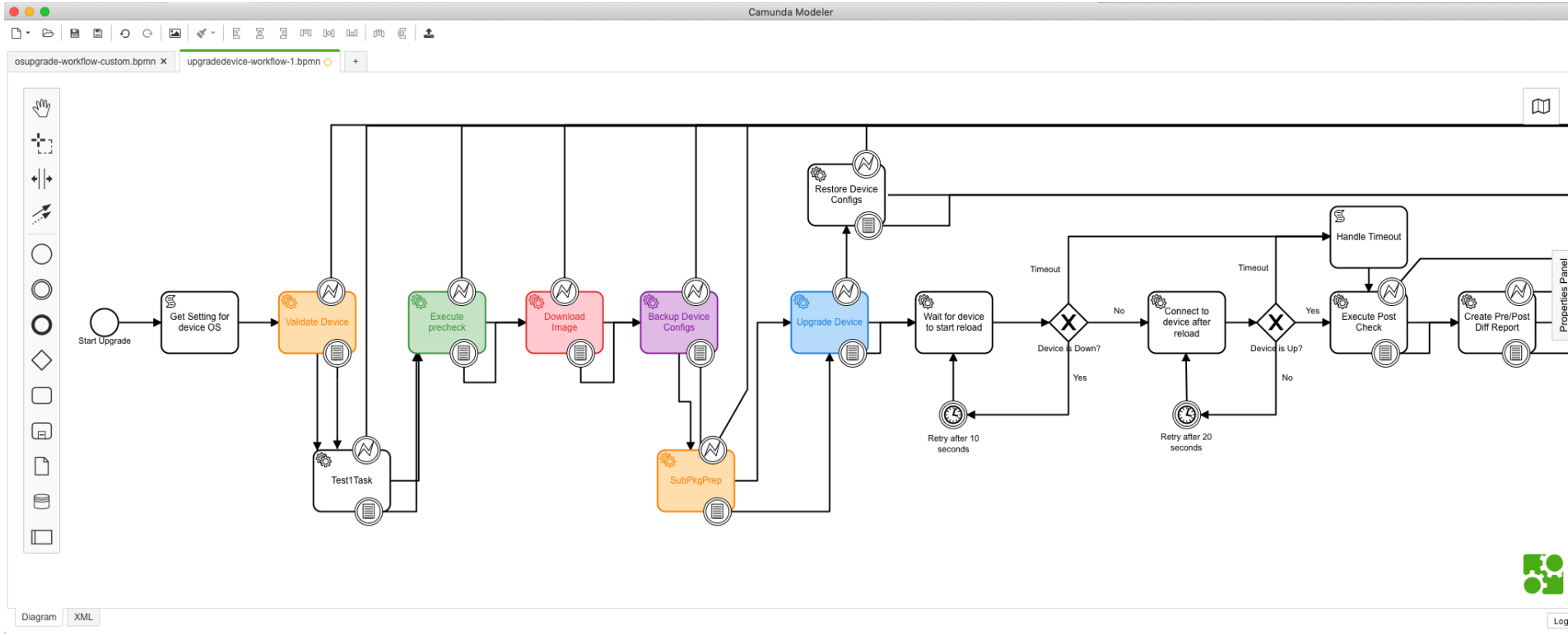
Real-World Use Cases
ASR9k to NCS Migration
cBR-8 IOS-XE Upgrade
RPD and CIN Onboarding



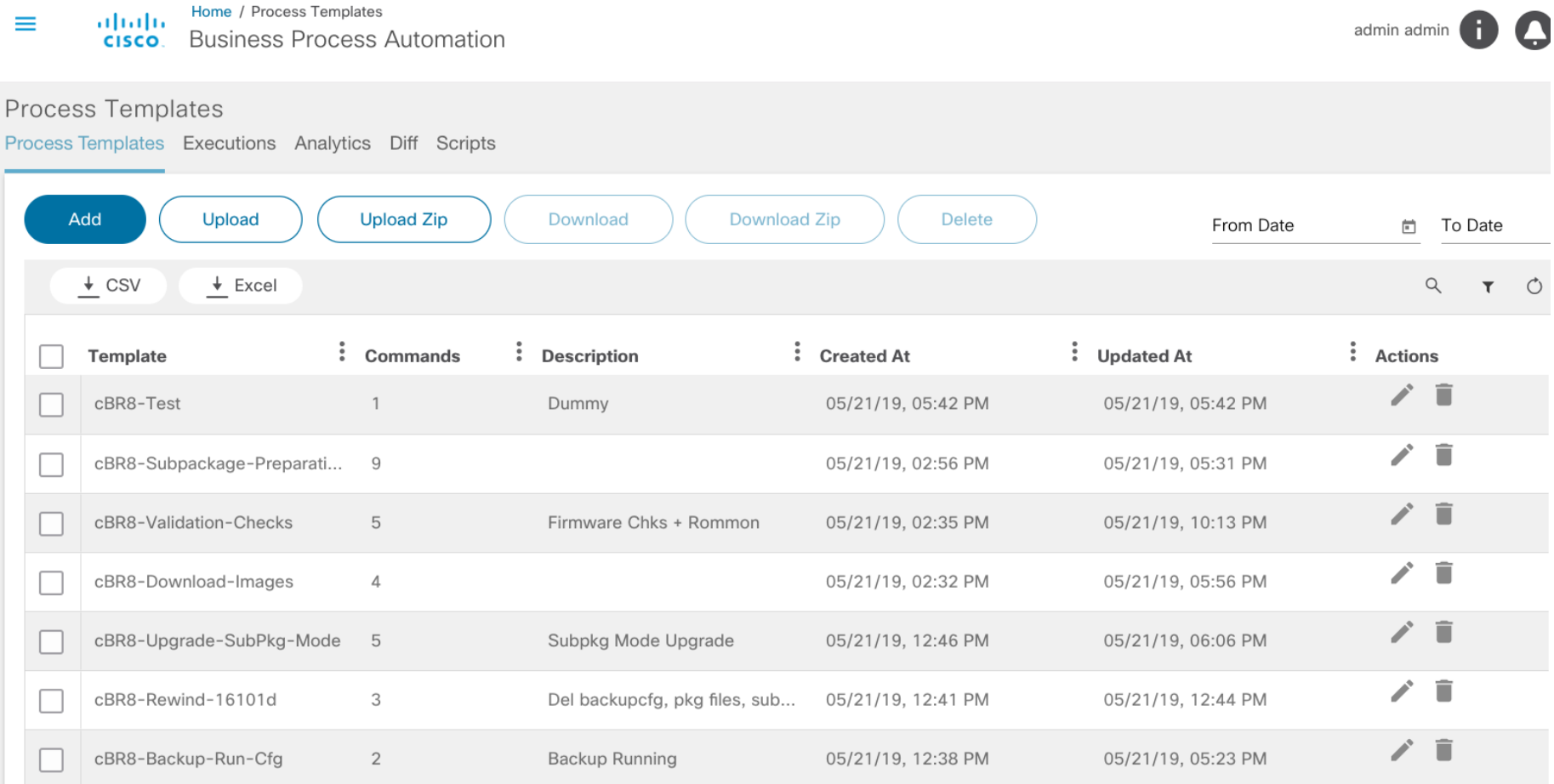
BPA Workflow Example – cBR-8 IOS-XE Upgrade



BPA Workflow Example – cBR-8 IOS-XE Upgrade



BPA Process Template Sample



Process Templates

Process Templates | Executions | Analytics | Diff | Scripts

Name: cBR8-Subpackage-Preparatior
Description:
Pass Criteria: 1&&3&&8

Select NED

Test

1	verify /sha512 bootflash:cbrsup-universalk9.16.10.01d.SPA.bin
2	verify /sha512 stby-bootflash:cbrsup-universalk9.16.10.01d.SPA.bin
3	verify /sha512 bootflash:/cbrsup-programmable_firmware.16.10.01d.SPA.pkg
4	copy bootflash:cbrsup-programmable_firmware.16.10.01d.SPA.pkg stby-bootflash: | prompts ENTER
5	copy bootflash:cbrsup-universalk9.16.10.01d.SPA.bin stby-bootflash: | prompts ENTER
6	dir stby-bootflash: | prompts ENTER
7	verify /sha512 stby-bootflash:/cbrsup-programmable_firmware.16.10.01d.SPA.pkg
8	request platform software package expand file bootflash:cbrsup-universalk9.16.10.01d.SPA.bin to bootflash:/IOSXE/ wipe
9	request platform software package expand file stby-bootflash:cbrsup-universalk9.16.10.01d.SPA.bin to stby-bootflash:/IOSXE/ wipe

Demo – Business Process Automation cBR-8 IOS-XE Upgrade

Automated Fault Management

What

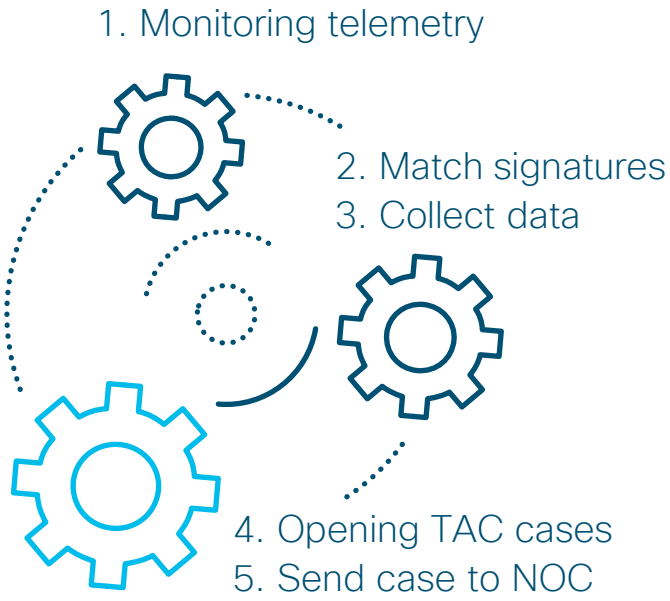
Near-real time, accurate fault detection.

How

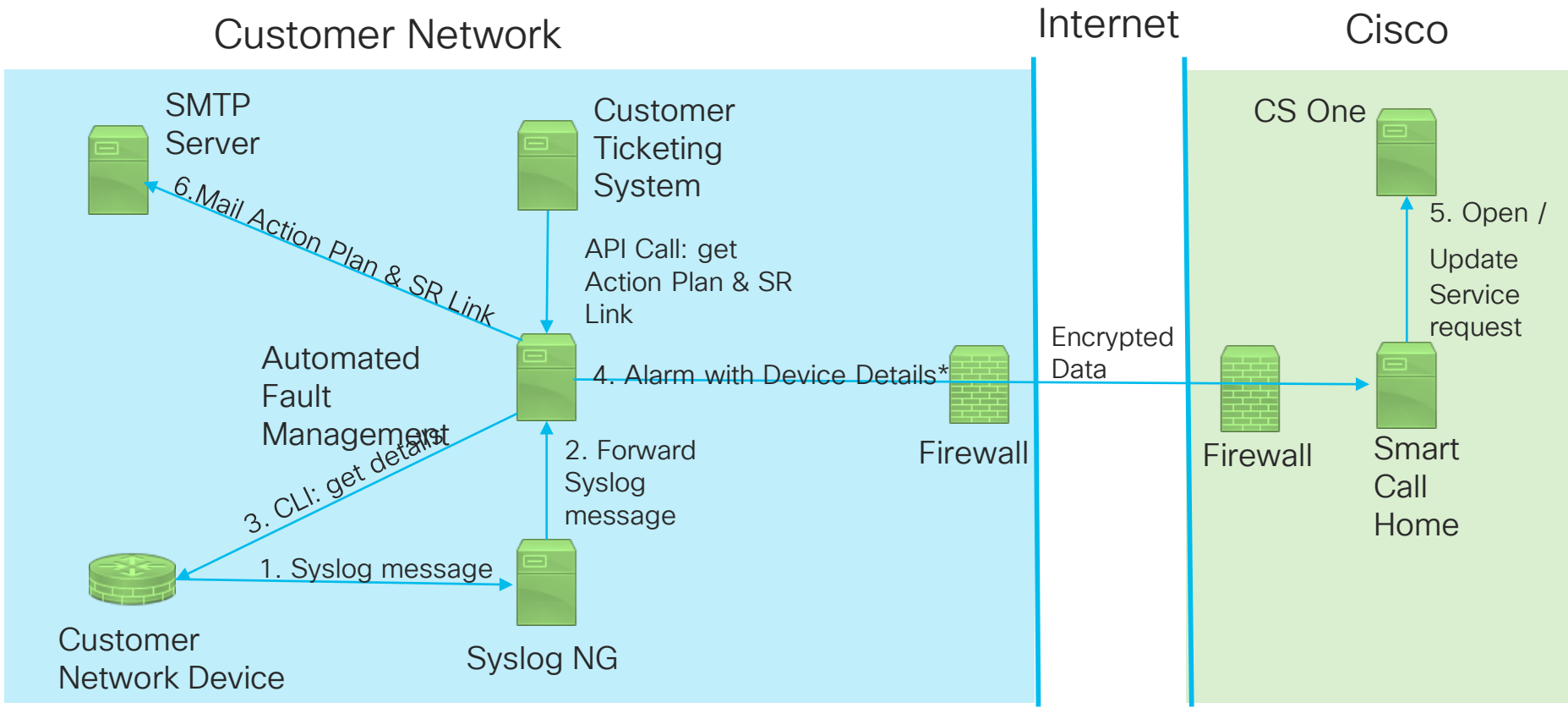
World-class event collection, identification and correlation functionality combined with Cisco proprietary intellectual capital.

Why

Speed issue resolution and increase staff utilization.

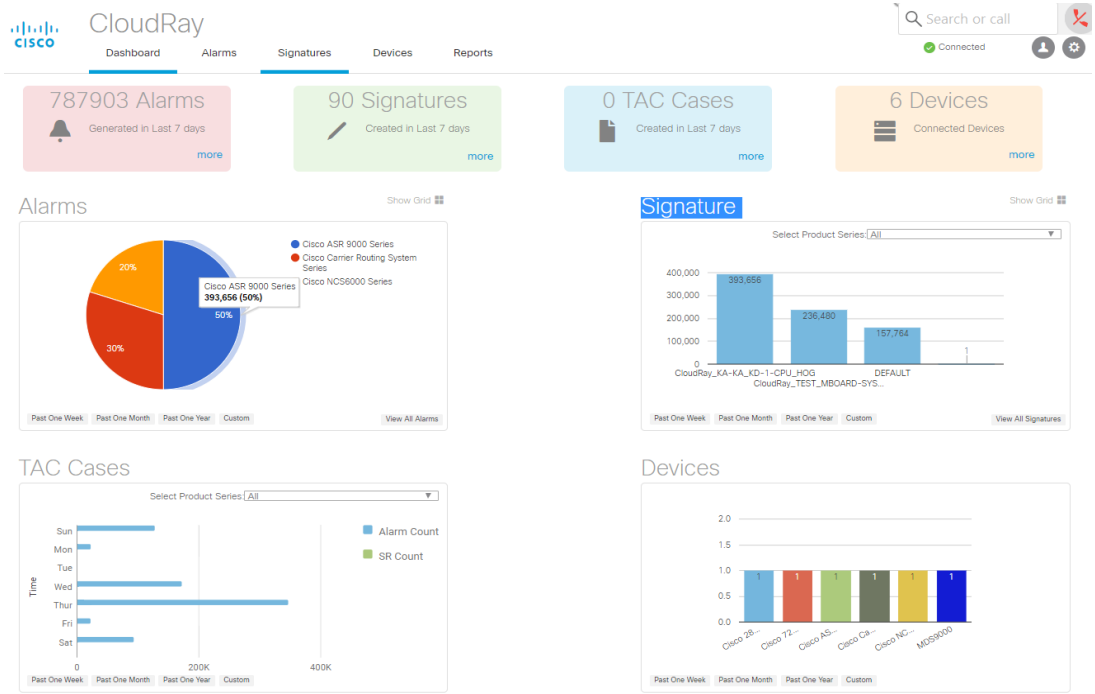


Automated Fault Management Architecture



*Some alarms are notification only and don't need to generate a Cisco Service Request, but this is modifiable.

Summary Tab



Summary

You make customer experience **possible**

Summary

- CCAP Journey
- Deployment And Operational Best Practices for cBR-8 Features
- Troubleshooting Techniques for CCAP Services
- Tools Review For cBR-8 Optimizations and Automation
- Detailed Troubleshooting cBR-8 Voice services (In appendix)
- Downstream Bonding Resiliency (in appendix)

Q & A

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Complete your online session evaluation

- Please complete your session survey after each session. Your feedback is very important.
- Complete a minimum of 4 session surveys and the Overall Conference survey (starting on Thursday) to receive your Cisco Live water bottle.
- All surveys can be taken in the Cisco Live Mobile App or by logging in to the Session Catalog on ciscolive.cisco.com/us.

Cisco Live sessions will be available for viewing on demand after the event at ciscolive.cisco.com.

Continue your education

Demos in the Cisco campus

Walk-in labs

Meet the engineer 1:1 meetings

Related sessions

SPG Walk-In Labs – Hosted in World of Solutions

- No reservation required, just show up and get hands-on experience
- A great way to get hands-on experience on a lot of topics covered here

Session ID	Title
LABSPG-1020	MPLS Segment Routing Introduction
LABSPG-1327	Introduction to Segment Routing v6 (SRv6) with IOS-XR
LABSPG-2000	Network Slicing with Segment Routing Flex-Algorithm for 5G and other Applications
LABSPG-2001	Intent Based Networking using Segment Routing Traffic Engineering
LABSPG-2068	Configure and Implement BGP-EVPN with Segment Routing using IOS-XR
LABSPG-2109	Ethernet VPN (EVPN) Implementation and Troubleshooting
LABRST-1015	Introduction - Segment Routing for Policy Aware Network

Thank you

You make **possible**

Appendix

You make networking **possible**

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cBR-8 Quick Reference Sheet

Ciscolive!
BRKSPG-2515 v1 2019
Jack Yu & Tejal Patel

Sheet is in color – careful about b&w copy
Impacting(!) **debug (orange)**
italicized- name, note/instruction
[] – optional, special-LC con/trace
() – required,
| - "or"
(cd) – conditional debug
(tr) – trace debug
(clc) – cable linec ard console
(rpd) – on RPD command

Key

PART IDs

Chassis	CBR-8-CCAP-CHASS
Cable LC	CBR-CCAP-LC-40G
Prot PIC	CBR-RF-PROT-PIC
Supervisor	CBR-CCAP-SUP-160G
Optics	SFP+ 10GBASE-SR/-LR
Fan	CBR-FAN-ASSEMBLY
Pwr Shelf	CBR-DC-PS, -AC-PS
Pwr Modul	CBR-PEM-DC-6M
Rphy CLC	CBR-CCAP-LC-40G-R
Rphy PIC	CBR-DPIC-8X10G

Administration

Unix/Linux
(create) tar –cvf *name.tar src-path*
(extract) tar –xvf *name.tar*
gzip filename.zip source-files

Core, Console, & Shell
request plat software con attach *lc-num*
request plat software system shell [rp|r0|r1|0-3,4-9]
dir harddisk:/core/
dir stby-harddisk:/core/
archive tar /create *name.tar path-src*
request platform software trace slot rp active archive target harddisk:all-traces
Send msg to all TTY: send *, *msg* , ctrl+z

Images and Copying
Pushing from server: scp *local-filename username@cbr8-hostname:path*
copy scp: *target-path*
copy ftp:user:passwd@loc/dir/filename
verify *path* /md5 *md5-hash*
request platform software package expand file *path* to *path* [force | wipe]

IOS Upgrades ISSU and Consolidate
conf t + no boot sys + boot sys *path* + exit + write mem + show bootvar
request platform software package install node file bootflash:/318SP/*image-name*
reload cancel
reload [at *hh:mm* reason *text-reason*]
reload in *m-minute*

Firmware
upgrade rom-monitor filename *path* (R0|R1)
upgrade hw-programmable cable *slot*
rommon pkg_name *pkg-path*
upgrade hw-programmable cable *slot*
dsphy auto pkg_name *pkg-path*

Operational

Hardware & Facility
show platform [diag]
show env power
show facility-alarm status
show cable card *slot/subslot* ds-phy disp
hw-module {slot|subslot} *slot* {reload|start|stop}
hw-module slot r[0|1} {reload|start|stop}

Versions & Firmware
show platform software patch info
show platform & show platform diag
show version
show redundancy
show bootvar
show cable card *slot*/0 ds-phy display

Redundancy & Failover
show redundancy
show redundancy linecard all
show redundancy switchover history
redundancy force-switchover
redundancy linecard switchover from *origin-slot to target-slot*
test lcha toggle config_protect_mode
Linecard Health
show platform diag
show logging onboard slot *slot* message reverse
show logging onboard slot *slot* uptime
show logging onboard slot *slot* temp
test lcha toggle config_protect_mode

Licensing
show license all
license smart dereg
license smart reg idtoken *token*

SNMP
show snmp mib ifmib ifindex
snmp set v2c *ip community* oid {integer|ip-add|string}

Plant Health
show cable flap-list
show cable flap-list [wb-rf|sort-time|sort-interface|sort-flap]
show cable resiliency
show cable resil-rf-status
show cable modem resiliency

Service Flows
show interface cable *x/y/z* service-flow qos [ds|us]
show interface cable *x/y/z* service-flow *flow-id* [counters | qos | verbose]
show cable modem *mac* service-flow [verbose]
(cd) debug cable dyns / debug cable tlvs
MAC-Domain RCC/UCC/MDD/CGD
show cable mac-domain cable *x/y/z* rcc [timeline]
show cable mac-domain cable *x/y/z* mdd
show controller cable *x/y/x* downstream
show controller cable *x/y/x* upstream [*upstream-id*]
show controller integrated-cable *x/y/z* rf-channel 0-63 158-162
show controller integrated-cable *x/y/z* counter rf-channel

show controller integrated-cable *x/y/z* counter wb-channel

ADSG / PIM / IGMP / Video Mcast
show ip mroute & show ip mroute count
show ip mfib & show ip mfib count
show ip mroute *group* [count]
show cable video routing multicast
show cable dsg cfr
show cable dsg static-group bundle *bundleID*
show interface cable *x/y/z* dsg downstream dcd
show cable modem docsis-device | inc STB

ARP & IP Routing
show ip interface brief
show ip pim neighbor
show ip ospf neighbor
show arp & sh int cx/y/z modem
show ip bgp neighbor
show ipv6 interface brief
show ipv6 ospf neighbor
show isis neighbors

Bandwidth
show interface tengig *x/y/z*
show controller integrated-cable *x/y/z* counter rf-channel
show controller integrated-cable *x/y/z* counter wb-channel
show cable modem *mac* {qos|service-flow}
show interface cable *x/y/z*
show interface cable x/y/z upstream bonding-group

Modem States
show cable modem [*mac* [timeline | verb]]

	Init-State
R1,2	1: init Rng recv, 2: Rng adjust
RC	Ranging Complete
D,	DHCP Discover Recv
IO	DHCP Offer Recv
O	First TFTP Packet OR Bad Config File
S A R I	IPv6 S-Solicit, A-Advert, R-Request, I-Reply
O	First TFTP Packet OR Bad Config File
	Symbol
*	Pre - Bpi-policy not satisfied
#	Online - CM /out TFTP dwnld
!	State – Dyn Secret violation Time – Exceeded Max Delay Rx Power – Max transmit
(PT)	BPI - TEK assigned
(PK)	BPI - KEK (Key exch) assigned
(d)	Network access CPE disallowd
(na)	Reject – CM no REG-ACK
(c)	Reject – Class of service issue
w-online/p	Upstream Partial
p-online/UB	Downstream Partial
w-online/UB	DS/US Bonded

Cable Modem

	Scm verbose Ranging
IM/SM	Waiting Intial/Station, Maint
CNT	Continuous Rng: Miss Rng or Rng Adjustment occurring
DR	Down Recovery: Down, CMTS send IM rng oppor
DT	Down Timeout: No recovery
DI	Down Interface: intf shutdwn
STA	Station Maint: Good State

Modem Timeout Codes

T4	Rcv Rsp to Bcast Mnt Req, but no Ucast Mnt Opp recv
T3	Rng Req retries exhausted
T2	No mnt Bcast for Rng
T1	No UCDs

Partial & Impaired States
show cable mac-domain cable *x/y/z* us-impairment

Reset & Delete
clear cable modem *mac-address* delete
clear cable modem *mac-address* reset
clear cable modem interface cable *x/y/z* {all|offline|wideband}
clear cable modem device-class {STB|MTA|PS|RTR}
clear cable modem offline delete

Status
show cable modem [*mac|IP*]
show cable modem *mac* verbose
show cable modem *mac* cpe
show cable modem *mac* sysDescr

PHY, RF, Ranging
show cable modem *mac* flap
show cable modem *mac* phy
show cable modem *mac* rng-cdman
show cable modem *mac* partial-service
show cable modem *mac* verbose | inc Code
(cd) debug cable range [protocol]
set platform software trace cdman *slot*/0 cdman_docsis_rng debug
(clc) test cable rng unsolict-rng-rsp *mdm-mac us-ch timingoffset poweradj*

IP & IPv6
show cable modem *mac* ipv6
show cable modem *mac* dhcp-status
show cable modem *mac* dhcpv6-status

Privacy & Encryption
Show cable modem *mac* privacy [verbose]
(cd) debug cable privacy

DOCSIS 3.0 General
show cable modem wideband
show cable modem *mac* wideband
show cable modem *mac* wideband channel
show cable modem *mac* wideband rcs-status
show cable modem *mac* wideband primary-ch

DOCSIS 3.1 Downstream

show cable modem docsis version d31-capable
show cable modem select * where macver like "DOC3.1%"

Batch
show cable modem sql *sql-query*
show cable modem summary total
show cable modem primary summary total
show cable modem docsis device-class
show cable modem docsis device-class summary [total]
show cable modem docsis device-class withip

SQL Show Cable Modem
show cable modem sql *sql-query*

SQL Generic format:
select * where * [opt]
select *set* where *condition*
condition: is, like, "", %

Traditional	SQL
scm doc ver d31	select ip,mac where macver like "DOC3.1"
scm cable xyz summary	select intf as hostinterface, count(mac) as number group by intf

Trace & Debug

Debug – Modem Registration
Term mon
show logging
debug cable mac-address *mac* verbose
debug cable range
debug cable reg
debug cable dhcp
debug cable tlvs
debug cable priv
debug cable dyns
debug cable video gqi
debug cable video sessions
debug cable video qam
debug cable video led

Debug – Tracing Setup & Remove
set platform software trace *led-name* RP active *trace-name* debug
show platform software trace level cdman *linecard*
show platform software trace level *led-name* RP active
show platform software trace message cdman *linecard*
show platform software trace message *led-name* RP active
(reset) set platform software trace level *trace-id* RP active all-modules notice
show debugging
(reset) undebug all

Converged Video
show cable video session logical-edge-device id *led-id*

Input State	Meaning
Init	Pinned up, waiting traffic
Idle	No incoming traffic
Active(PSI)	Traffic started
Off	If traffic doesn't resume

Blocked	Error parsing PAT/PMT
Output State	
Off	QAM shut/non-Oper
On	QAM oper and fwding
Conflict	PgmPID cflt PMT/PAT
Pending	PMT missing CA

show cable video gqi connections
show cable video logical-edge-device id *led-id* [statistics]
show cable video session logical-edge id *led-id* [session-id]
clear cable video session logical-edge-device id *id-number* session-id *session-id*
set platform software trace led-*id* rp active {vgqi-mgmt|vgqi-err} noise
(cd) debug cable video gqi
(cd) debug cable video led

QFP Tracking:
Use QFP when tracing CM packet flow
test platform hardware qfp active feature docsis dtrack mac-address *mac-address*
test platform hardware qfp active feature docsis dtrack packet-copy
**reload the modem to reproduce the issue*
show platform hardware qfp active feature docsis dtrack statistics clear
test platform hardware qfp active feature docsis dtrack disable

QFP Rate-Limiting:
show platform hardware qfp active infrastructure punt sbrl
show platform hardware qfp active infrastructure punt policer

SID Tracker:
Use SID Tracker for Mac mgmt. grants and MAPs per modem
show cable modem *mac* service-flow
(clc) debug cable interface cable *xyz* sid *nnn* track
(clc) show int cable *xyz* up debug sid-tracking *nnn* clear
(clc) show int cable *xyz* up debug sid-tracking *nnn* 0 40000

DOCSIS 3.1

	Registration Process
1	Scan for OFDM DS
2	CM find PLC via Pilot & Preamble
3	PLC contains OCD & DPD
4	CM uses learned profile
5	O-INIT-RNG-REQ sent by CM RNG-RSP v5 sent by CMTS B-INIT-RNG-REQ v5 Fine Rng
6	CM declares sync complete
7	CM promoted to working profile
	If no OFDM: Scan SC-QAM

Downstream OFDM

Configuration Checklist DS OFDM	
	check diplexer ranges check modem capabilities & fw
1	Define Fiber Node
2	Controller Integrated-Cable *xyz*

cBR-8 Quick Reference Sheet

a	Max-ofdm-spectrum *mhz* + max carrier + base-power
b	rf-channel 158 (to 162)
c	ofdm channel-profile *num* start-frequency *freq* width *width* plc *plc-freq*

3	cable downstream ofdm-chan-profile *num*
A	Subcarrier-spacing {25|50}
B	Profile-ncp, Profile-data 1,2,3
4	Interface Wideband-cable xyz:*n*
A	Cable bundle + rf-bandwidth-percent
5	Interface cable *xyz*
A	(primary DS) downstream integrated-cable *xyz* rf-channel {158-162}
6	Interface wideband-cable *xyz:nnn*
	cable rf-channels channel-list *list+ofdm_ch* bandwidth-percent 1

show cable mac-domain cable *xyz* ocd
show cable mac-domain cable *xyz* dpd
show cable ofdm-chan-profile *prof-num*
show cable ofdm-modulation-profile *prof-num*
show cable ofdm-modulation-profile configuration
show interface cable *xz* controller | i \[OCD
show controllers Integrated-Cable *xyz* rf-channel {158-162} [verbose]
show controllers Integrated-Cable *xyz* rf-channel 158 prof-order
show controllers integrated-Cable *xyz* counter ofdm-channel

Upstream OFDMA

show controllers upstream-cable x/y/z us-channel {12-15 } [cdm-ump]
show cable card x/0 us-phy ofdma-channel cw-error
show cable card x/0 us-phy ofdma-channel {iuc-stat | map-stats } *phy-dev-instance ofdma-ch-num*
show cable modulation-profile ofdma *profile-number*

Configuration Checklist US OFDMA	
	check diplexer ranges check modem capabilities & fw
1	Configure OFDM Downstream
2	Define Fiber Node
3	US OFDMA Profile (or default)
4	Controller Upstream-Cable *xyz*
a	Us-channel {12-15} docsis-mode ofdma
b	Us-channel {12-15} docsis-mode frequency-start *start-freq end-freq*
c	no us-channel {12-15} shutdown
5	Interface cable *xyz*
a	Upstream 4 us-channel {12-15}
b	Upstream bonding-group *number*
c	Upstream 4 + desired

CM Profile Management
show cable modem *mac* phy ofdm-profile { downstream | upstream }
show cable modem *mac* prof-mgmt

Remote PHY

RPD

show cable rpd	
Int State	**Meaning**
Auth	Dot1x Auth
DHCP	Obtain IP for vbh0
ToD	Obtain Time of Day
cBR8 State	**Meaning**
offline	RPD offline, no comm
Init(auth)	CORE and RPD Auth
Init(gcp)	Control Protocol exch
Init(clksync)	Timing sync, Skip if Aux Cor
Init(l2tp)	DEPI/UEPI
Online	RPD fwding / recv

show cable rpd
show cable rpd *rpd-id*
show cable rpd slot *slot*
show cable rpd tengig *x/y/0*
show cable rpd { *ip* | *mac* } [teng *x/y/0*]
show cable rpd id *id*
show cable rpd name *name*
show cable rpd *mac-add* [principal | aux]
show cable rpd *mac-add* lcha-cores [active | standby]
show cable rpd [slot *slot* | ten *x/y/0*] summary

show cable downstream controller-profile
show cable upstream controller-profile

(rpd) show dot1x detail
(rpd) show dhcp
(rpd) show tod

clear cable rpd { all |*id* | *ip-add* | slot *slot* | ten *ssp*} [reset | delete]
clear cable rpd { same-above } modem { reset | delete }
clear cable rpd { same-above } powercycle

Logging & Event
show cable rpd *mac* tengig *x/y/0* log
show cable rpd *mac* event
(rpd) logging provision-archive scp *server-ip user-id dst_loc*
(rpd) show env sensor [*sensor-id*]
(rpd) show env table *sensor-id*

Generic Control Protocol
Purpose: CCAP-Core to control RPD configuration, event report, & query
show cable rpd *mac* ten *xyz* gcp-transaction [verbose]

show cable rpd *mac* ten *xyz* { gcp-session | gcp-state }	
State	**Meaning**
init	Recv RPD Notify Sent req RPD Capab
nego	Recv RPD Capability Sent CCAPCore Ident
Bulksync	DS/US Ch cfg & rsp
Ready	Configs done

(rpd) show provision { all | history }
(rpd) show gcp session
debug cable rpd
(tr) set platform trace rphyman rp rphy_gcp_infra noise
(tr) set platform trace rphyman rp rphy_gcp_tlv noise

PTP Timing
Purpose: Timing sync for MAC Mgmt

cBR8 State	RPD State
Free Run	**Ref Failed**
Acquiring	Acquiring
Freq Lock	Freq lock
Phase Aligned	**Phase Lock**
Holdover	**Holdover**

show ptp clock running
show platform software ptp stat stream {0|1}
(rpd) show ptp clock 0 config
(rpd) show ptp clock 0 state

DEPI & UEPI
Purpose: Encap DOCSIS or Video DS and US traffic to RPD

show controllers downstream-cable *xyz* counter rf-channel [verbose]	
Field	**Meaning**
High	UCDs, MAPs
Medium	MMM, High QoS Data
Low	Low QoS Data
MPEG DEPI	MPEG increment for video DEPI Incr: MMM, Data, Overhd
MAP UCD	Increment for DEPI Primary DS
SYNC	0 – RPD handles SYNC

show cable rpd *mac* depi [tunnel | session]			
M: MAP	D: Data	R: RngRq	S:SpcM
MPT	MPT: MPEG Transport		
PSP	Pkt Stream Proto : DOCSIS		
C R	**Message**	**Meaning**	
→	SCCRQ	Start Ctrl Ch Request	
←	SCCRP	Start Ctrl Ch Response	
→	SCCCN	Start Ctrl Ch Connected	
	StopCCN	Initiate teardown	
→	ICRQ	Incoming Call Request	
←	ICRP	Incoming Call Reply	
→	ICCN	Incoming Call Connected	
	CDN	Initiate session teardown	

show cable depi multicast pool
show cable depi multicast ip all
(rpd) show downstream depi config
(rpd) show upstream uepi config
(rpd) show downstream channel config
(rpd) show upstream channel config
(rpd) show l2tp { tunnel | session }
debug cable rpd r-depi
debug l2tp all

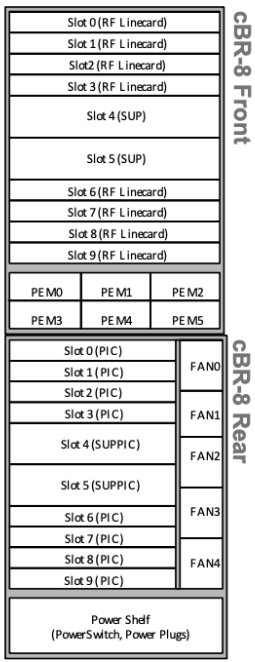
Access & Security
Default is SSH admin/admin
Remove Admin conf: ssh password off
Add SSH Pubkey: conf: ssh pubkey add
Disable auto reboot - set reboot hold

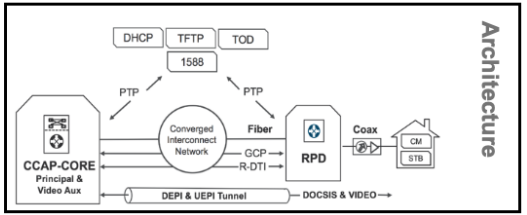
Enable auto reboot - clear reboot hold
(rpd) show ssh session
(rpd) show ssh nms-pubkey

Video RPD

(rpd) show downstream channel counter [tpmi | dpmi | dps]	
Type	**Meaning**
DPS	Transmitted Packets
DPMI	Rx Matching L2TPv3 Session ID and Sequence Number Checking
TPMI	Rx Match Destination MAC, IP, and L2TPv3 Session ID

(rpd) show fpga video statistics *start-rf-ch end-r-chf*
(rpd) show fpga video interrupt





cable rpd *RPD_NAME*
description *sample_RPD_1*
identifier 0000.aaaa.bbbb
core-interface Te *x/1/z*
principal
rpd-ds 0 downstream-cable *xyz* profile 30
rpd-us 0 upstream-cable *abc* profile 1
network-delay dlm 10
core-interface Te *x/1/z*
rpd-ds 0 downstream-cable *x1y1z1* profile 40
r-dti 1
rpd-event profile 5

interface Cable *xyz*
downstream Downstream-Cable *xyz* rf-channel *n*
upstream *m* Upstream-Cable *abc* us-channel *p*
cable bundle *bundle_id*

ptp clock ordinary domain 0
servo tracking-type R-DTI
clock-port *name-of-server* slave
delay-req interval -4
sync interval -5
sync one-step
transport ipv4 unicast interface Lo0 negotiation
clock source *master-ptp-server-IP*

ptp r-dti 1
ptp-domain 0
clock-port 1
clock source ip *master-ptp-serverIP*

cable downstream controller-profile 30
multicast-pool *pool_id*
rf-chan 0 31
type DOCSIS
frequency *rf-frequency_start_1*
rf-output NORMAL
qam-profile 1
docsis-channel-id 1
rf-chan 33 39
type VIDEO SYNC
frequency *rf_frequency_start_2*
rf-output NORMAL
qam-profile 5

cable upstream controller-profile 1
…
us-channel *n* channel-width 6400000 6400000
us-channel *n* docsis-mode atdma
us-channel *n* equalization-coefficient
us-channel *n* frequency *freq_center*
us-channel *n* minislot-size 2
us-channel *n* modulation-profile 224
no us-channel *n* shutdown

cable depi multicast pool *pool_id*
ip address 225.225.225.0 255.255.255.0

cable fiber-node *node_number*
downstream Downstream-Cable *xyz*
upstream Upstream-Cable *xvz*

Sample RPHY Configuration

Notes

Bonus Slides

You make networking **possible**

Cisco live!

Remote PHY

Configuration Overview

1. Hardware & Software Requirements
2. Configuration Reference
3. Configuration Validation
   a. Downstream and Upstream Controller(s)
   b. RPD
   c. Interface Cable & Fiber Node(s)
   d. Controller Profile(s)

1 Hardware & Software Requirements

- Remote PHY Support

Part ID	Component
CBR-CCAP-LC-40G-R	CCAP-CORE, Cable LC
CBR-DPIC-8X10G	CCAP-CORE, DPIC
RPD-1x2	RPD
IOS-XE Software	**Feature**
16.5 Polaris & Later	R-PHY Support
16.5(1r)S	SUP ROMMON
2011.03.18	Cable Linecard ROMMON

```
cBR-8# show run | include card
card 0/0 cBR-CCAP-LC-40G r-phy
card 2/0 cBR-CCAP-LC-40G r-phy
```

```
cBR8-01# show inventory
NAME: "clc 0", DESCR: "Cisco cBR CCAP Line Card"
PID: CBR-CCAP-LC-40G   , VID: V01  , SN: CAT1919E1RR
NAME: "CLC Downstream PHY Module 0/0", DESCR: "Cable PHY Module"
NAME: "ATO clc 2", DESCR: "Cisco cBR CCAP Line Card"
PID: CBR-CCAP-LC-40G-R , VID: V01  , SN: CAT2040E03T
NAME: "clc 2", DESCR: "Cisco cBR CCAP Line Card"
PID: CBR-CCAP-LC-40G-R , VID: V01  , SN: CAT2040E03T
NAME: "digi-pic 2/1", DESCR: "Cisco cBR CCAP Line Card Digital PIC"
PID: CBR-DPIC-8X10G    , VID: V01  , SN: CAT2113E003
```

```
cBR8-01# show platform
Chassis type: CBR-8-CCAP-CHASS
Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         CBR-CCAP-LC-40G     ok                    2w4d
0/1       CBR-DPIC-8X10G      ok                    2w4d
2         CBR-CCAP-LC-40G-R   ok                    2w4d
2/1       CBR-DPIC-8X10G      ok                    1w0d
SUP0      CBR-CCAP-SUP-160G   inserted              2w4d

Slot      CPLD Version        Rommon Version
--------- ------------------- ------------------------------------
0         00000025            2011.03.18
2         00000025            2011.03.18
SUP0      16052011            16.5(1r)S
```

3a DS and US Controllers

- cable downstream controller-profile *number*
- cable upstream controller-profile *number*

Downstream Profile
Multicast Pool (Optional)
RF Channel Range
Type
Frequency
RF-Output
QAM Profile
Shutdown
Cable DEPI Multicast pool *id*
Power Profile

```
cable downstream controller-profile 30
 multicast-pool 1
 rf-chan 0 31
  type DOCSIS
  frequency 405000000
  rf-output NORMAL
  qam-profile 1
  docsis-channel-id 1
 rf-chan 33 39
  type VIDEO SYNC
  frequency 603000000
  rf-output NORMAL
  qam-profile 5
```

```
cable depi multicast pool 1
ip address 225.225.225.0 255.255.255.0
```

*Base channel power and adjust moved to cable rpd configuration

Upstream Profile
US-channel(s) / US Channel Width
DOCSIS Mode
Pre-Equalization
Frequency
Modulation Profile
Minislot Size
Shutdown

```
cable upstream controller-profile 1
 us-channel 0 channel-width 6400000 6400000
 us-channel 0 docsis-mode atdma
 us-channel 0 equalization-coefficient
 us-channel 0 frequency 17500000
 us-channel 0 minislot-size 2
 us-channel 0 modulation-profile 224
 no us-channel 0 shutdown
…
 us-channel 3 channel-width 6400000 6400000
 us-channel 3 docsis-mode atdma
 us-channel 3 equalization-coefficient
 us-channel 3 frequency 37500000
 us-channel 3 minislot-size 2
 us-channel 3 modulation-profile 224
 no us-channel 3 shutdown
```

3b Remote PHY Device

- **cable rpd** *name*

Parameter	Purpose
Identifier	Mac-address of the RPD
Core interface	Interface of the DPIC TenGig
Principal & Auxiliary	Each RPD must have exactly one Principal
RPD-DS	Downstream-Cable Controller + Profile
RPD-US	Upstream-Cable Controller + Profile
RPD Base Power	Set the base power
DLM	DEPI Latency Management
R-DTI	Timing
RPD Event Profile	GCP Event Reporting

```
cable rpd P2Shelf_RTP
 description P2 1RU in AS Lab RTP
 identifier 0004.9f33.0449
 core-interface Te1/1/0
  principal
  rpd-ds 0 downstream-cable 1/0/0 profile 30
  rpd-us 0 upstream-cable 1/0/0 profile 1
  network-delay dlm 10
 core-interface Te1/1/6
  rpd-ds 0 downstream-cable 1/0/31 profile 40
 r-dti 1
 rpd-event profile 5
```

Pitfalls	
controller profile(s)	Cannot change an specific instantiation of the profile without entire editing profile
	Removing last downstream-cable controller from RPD requires removing all in-use channel(s) – .e.g Video Binding

3c Interface Cable & downstream-Cable, Fiber Node

- **interface cable** *slot/subslot/port*
- **interface downstream-cable** *slot/subslot/port:channel*
- **cable fiber node** *number*

Parameter	Purpose
Primary interface DS Cable	For each Primary RF -> Interface DC
	Downstream-Cable for RPHY
Downstream-Cable Controller	Forwarding controller
Upstream-Cable Controller	Return controller
Upstream Bonding Group(s)	Define USBG(s)

Parameter	Purpose
Bundle	(Inherited) Associates Primary RF to L3
RF-Bandwidth Percent	ACFE – Default 1%

```
interface Cable1/0/0
 downstream Downstream-Cable 1/0/0 rf-channel 0
 downstream Downstream-Cable 1/0/0 rf-channel 4
 downstream Downstream-Cable 1/0/0 rf-channel 8
 downstream Downstream-Cable 1/0/0 rf-channel 12
 downstream Downstream-Cable 1/0/0 rf-channel 16
 downstream Downstream-Cable 1/0/0 rf-channel 24
 upstream 0 Upstream-Cable 1/0/0 us-channel 0
 upstream 1 Upstream-Cable 1/0/0 us-channel 1
 upstream 2 Upstream-Cable 1/0/0 us-channel 2
 upstream 3 Upstream-Cable 1/0/0 us-channel 3
 cable bundle 1
```

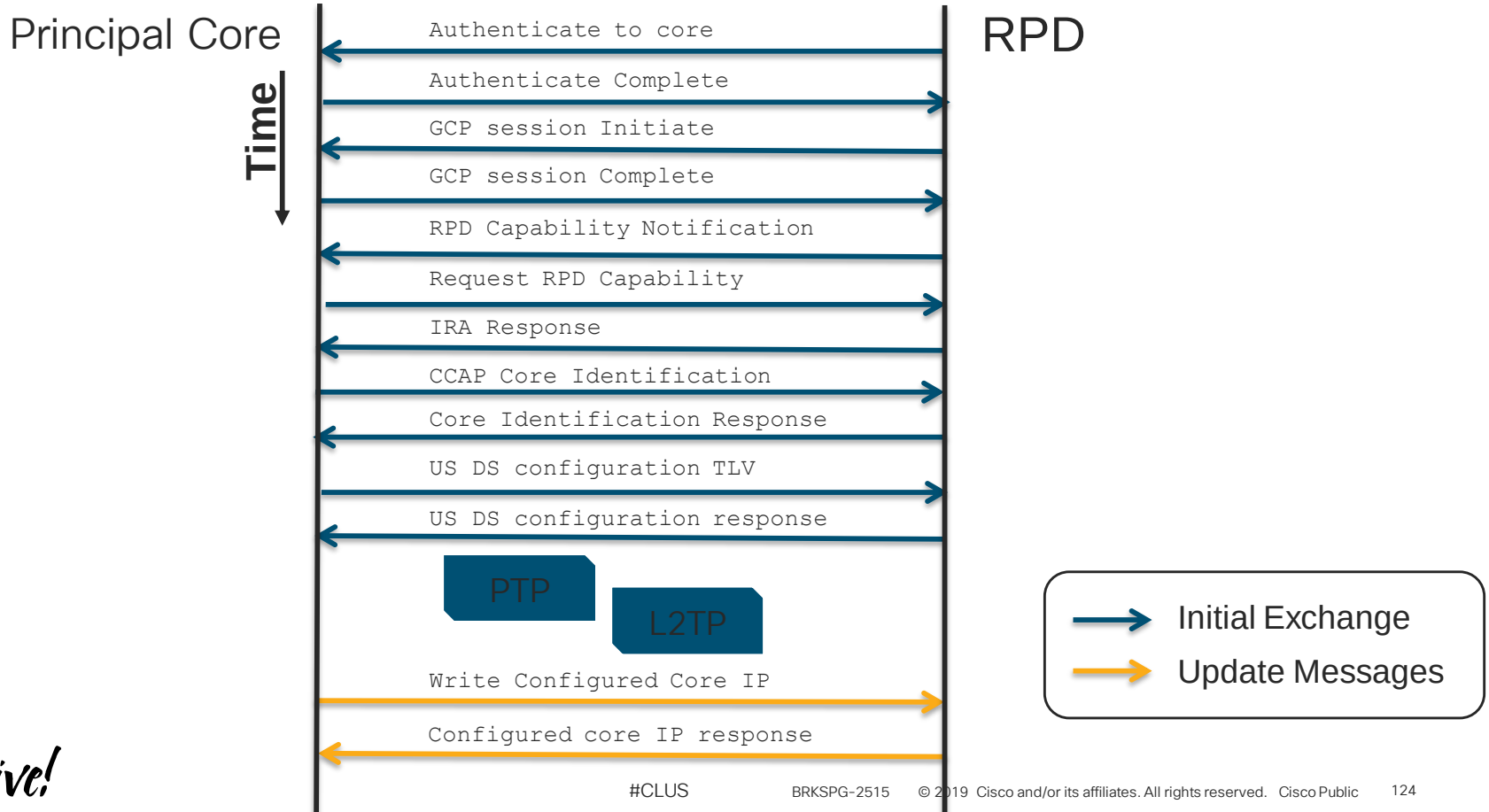
```
interface Downstream-Cable1/0/0:0
 cable bundle 1
 rf-bandwidth-percent 1

interface Downstream-Cable1/0/0:3
 cable bundle 1
 rf-bandwidth-percent 1
```

```
cable fiber-node 100
 downstream Downstream-Cable 1/0/0
 upstream Upstream-Cable 1/0/0

cable fiber-node 101
 downstream Downstream-Cable 1/0/0
 upstream Upstream-Cable 1/0/1
```

2 RPD and CCAP-CORE Exchange



2 Validate Configuration

- Precision Timing Protocol

Parameter	Purpose
IP reachability	cBR8 must be able to reach clock source IP
PTP Clock Domain	Define your PTP parameters use by R-DTI
Clock-Port	Slave clock, transport, source
Transport	Specify IPv4 / Unicast / Source Intf
Clock source	Match to master 1588 interface
PTP R-DTI {0-64}	Defines the R-DTI for RPD
PTP Domain {0-127}	Associates R-DTI to domain parameters

Pitfalls	
Transport	IPv4 only , no Port-Channel(s), support coming
R-DTI Config	Requires reboot of RPD to take effect
PTP Source	Can only use SUP-PIC TE 4/1/x and 5/1/x

```
interface Loopback0
 ip address 13.10.0.207 255.255.255.255
```

```
ip route 10.225.197.254 255.255.255.255
TenGigabitEthernet4/1/7 13.13.0.210
```

```
ptp clock ordinary domain 0
 servo tracking-type R-DTI
 clock-port slave-from-903 slave
  delay-req interval -4
  sync interval -5
  sync one-step
  transport ipv4 unicast interface Lo0 negotiation
  clock source 10.225.197.254
```

```
ptp r-dti 1
 ptp-domain 0
 clock-port 1
   clock source ip 10.225.197.254
```

5a RPD Access

- SSH to RPD
- admin/admin default
- No external console exists

Considerations	Best Practice …
Security - Access	Disable admin/admin Disable password login
	Install SSH Public Key for non-password access
Security - L2	Use 802.1x authentication
DHCP	Provision DHCP Server to assign unique IP
Reachability	IP Layer through the CIN

```
cBR8-01# show cable rpd
MAC Address      IP Address       I/F       State        Role HA  Name
badb.ad13.1452   13.52.0.19       Te1/1/0   online       Pri  Act GS7K_RTP
```

```
cBR8-01# ssh -l admin 13.52.0.19
Password:
BusyBox v1.23.2 (2017-04-16 02:15:01 CST) built-in shell (ash)
# Copyright (c) 2016 Cisco and/or its affiliates, and
#                    Cable Television Laboratories, Inc. ("CableLabs")

Already started.waiting
Starting OpenRPD CLI
rpd dependencies software is up
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
SECURITY WARNING: ssh password login is accessible!
Please use pubkey login and set password login off!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
        Welcome to Cisco R-PHY
R-PHY>enable
R-PHY#
```

5b RPD DHCP, TOD, and Dot1x

- show dhcp
- show tod
- show dot1x detail

Parameter	What to look for…
Interface	vbh0
IP Address	As expected
Mask	As expected
Time Servers	As expected
CCAPCores	cBR8 DPIC IP
Time Servers	As expected

```
R-PHY# show dhcp
Interface            IP-Address          Subnet-Mask
vbh0                 13.52.0.19          255.255.255.240

Details:
------------------------------------------------------------------------
Interface:                    vbh0
TimeServers:                  172.18.98.116, 172.18.98.117
TimeOffset:                   -18000
LogServers:                   172.18.98.57, 172.18.98.59
CCAPCores:                    13.13.0.226, 13.13.0.198
```

```
R-PHY# show tod
Server                                TimeOffset  Time                    Status
172.18.98.116, 172.18.98.117          -18000      2017 May 18 06:57:01    OK
```

```
R-PHY# show dot1x detail
Interface        Core-id                 EAP_Received        Status
vbh0             CORE-586853802          False               UP
bssid=01:80:c2:00:00:03
freq=0
ssid=
id=0
mode=station
pairwise_cipher=NONE
group_cipher=NONE
key_mgmt=IEEE 802.1X (no WPA)
wpa_state=ASSOCIATED
ip_address=13.52.0.19
address=ba:db:ad:13:14:52
Supplicant PAE state=HELD
suppPortStatus=Unauthorized
EAP state=FAILURE
uuid=e9432baa-15c6-5a12-8976-d505ba50cd25
```

4 Validate Clock on RPD

- show ptp clock 0 config
- show ptp clock 0 state

Parameter	What to look for …
APR State	PHASE_LOCK
Domain/Mode	Slave
Master IP	Server IP
Stream State	PHASE_LOCK

Clock States	
1	Ref Failed
2	Acquiring
3	Frequency Lock
4	Phase Lock

Network Issues → Holdover

```
R-PHY# show ptp clock 0 state
apr state        : PHASE_LOCK
clock state      : SUB_SYNC
current tod      : 3595870       Wed Feb 11 14:51:10 1970
active stream    : 0
==stream    0    :
  port id        :                  0
  master ip      :    10.225.197.254
  stream state   :        PHASE_LOCK
  Master offset  :                659
  Path    delay  :              -4022
  Forward delay  :              -3919
  Reverse delay  :              -4125
  Freq offset    :             -82699
  1Hz  offset    :                389

R-PHY# show ptp clock 0 config
Domain/Mode          :    0/OC_SLAVE
Priority 1/2/local   : 128/255/128
Profile              : 001b19000100-000000  E2E
Total Ports/Streams  : 1   /1
--PTP Port    1, Enet Port    1 ----
  Port local Address :13.52.0.19
  Unicast    Duration :300 Sync Interval  : -4
  Announce   Interval :  0 Timeout        : 11
  Delay-Req Intreval : -4 Pdelay-req     : -4
  Priority   local    :128 COS:   6    DSCP: 47
  ==Stream 0 : Port 1  Master IP: 10.225.197.254
```

1b Validating video throughput on RPD

- show downstream channel counter { dps | tpmi | dpmi }

	What is it	What does it tell us
DPS	Transmitted Packets	What packets are tx on the carrier
TPMI	Rx Match Destination MAC, IP, and L2TPv3 Session ID	If incrementing : valid tuple received for channel
DPMI	Rx Match L2TPv3 Session ID and Sequence Number Checking	If incrementing : valid sequencing received If SeqErr-Pkt : Out of sequence packets received

```
R-PHY# show downstream channel counter dps
Chan Tx-packets Tx-octets   Drop-pkts   Tx-sum-pkts Tx-sum-octs Drop-sum-pkts

46   1412715444 3597499732 0           1412715444   3597499732   0
47   1412733756 3600941072 0           1412733756   3600941072   0
158  719767     47391972   0           719767       47391972     0
```

```
R-PHY# show downstream channel counter dps
Chan Tx-packets Tx-octets   Drop-pkts   Tx-sum-pkts Tx-sum-octs Drop-sum-pkts

46   55300      10396400   0           1412770744   3607896132   0
47   55293      10396400   0           1412789049   3611337472   0
158  31         1979       0           719798       47393951     0
```

```
R-PHY# show downstream channel counter tpmi
Level      Rx-pkts     Rx-sum-pkts
Node Rcv   182177630   182177630
Depi Pkt   2382390178  2382390178

Port Chan  Rx-pkts     Rx-sum-pkts
DS_0 39    778328859   778328859
...
DS_0 44    460223051   460223051
DS_0 45    460211632   460211632
DS_0 46    460221125   460221125
DS_0 47    460344092   460344092

Port       Rx-pkts     Rx-sum-pkts Drop-pkts   Drop-sum-pkts
DS_0       3863639261  3863639261  0           0
US_0       485970657   485970657   0           0
US_1       2244        2244        0           0
```

```
R-PHY# show downstream channel count dpmi
Field          Pkts        Sum-pkts
Dpmi Ingress   2203906685  2203906685
Pkt Delete     0           0
Data Len Err   0           0
Chan Flow_id Octs          Sum-octs    SeqErr-pkts SeqErr-sum-
pkts
47   0       3887236816  3887236816  5           5
47   1       0           0           0           0
47   2       0           0           0           0
47   3       0           0           0           0
```

Tx Rx clears on multiple show

RxMER to Bit Loading Mapping

DOCSIS 3.1 PHY Spec – Table 7-41

RxMER (in ¼ dB)	RxMER (in dB)	QAM	Bit Loading
60	15	16	4
84	21	64	6
96	24	128	7
108	27	256	8
122	30.5	512	9
136	34	1024	10
148	37	2048	11
164	41	4096	12
184	46	8192	13
208	51	16384	14

Note: On cBR-8 use the CLI: **`show cable ofdm-rxmer-qam-bl-table`**

1 OFDM Mixed Modulation Profiles

```
cable downstream ofdm-chan-profile 100
  <snip>
  profile-data 1 modulation-profile 96
```

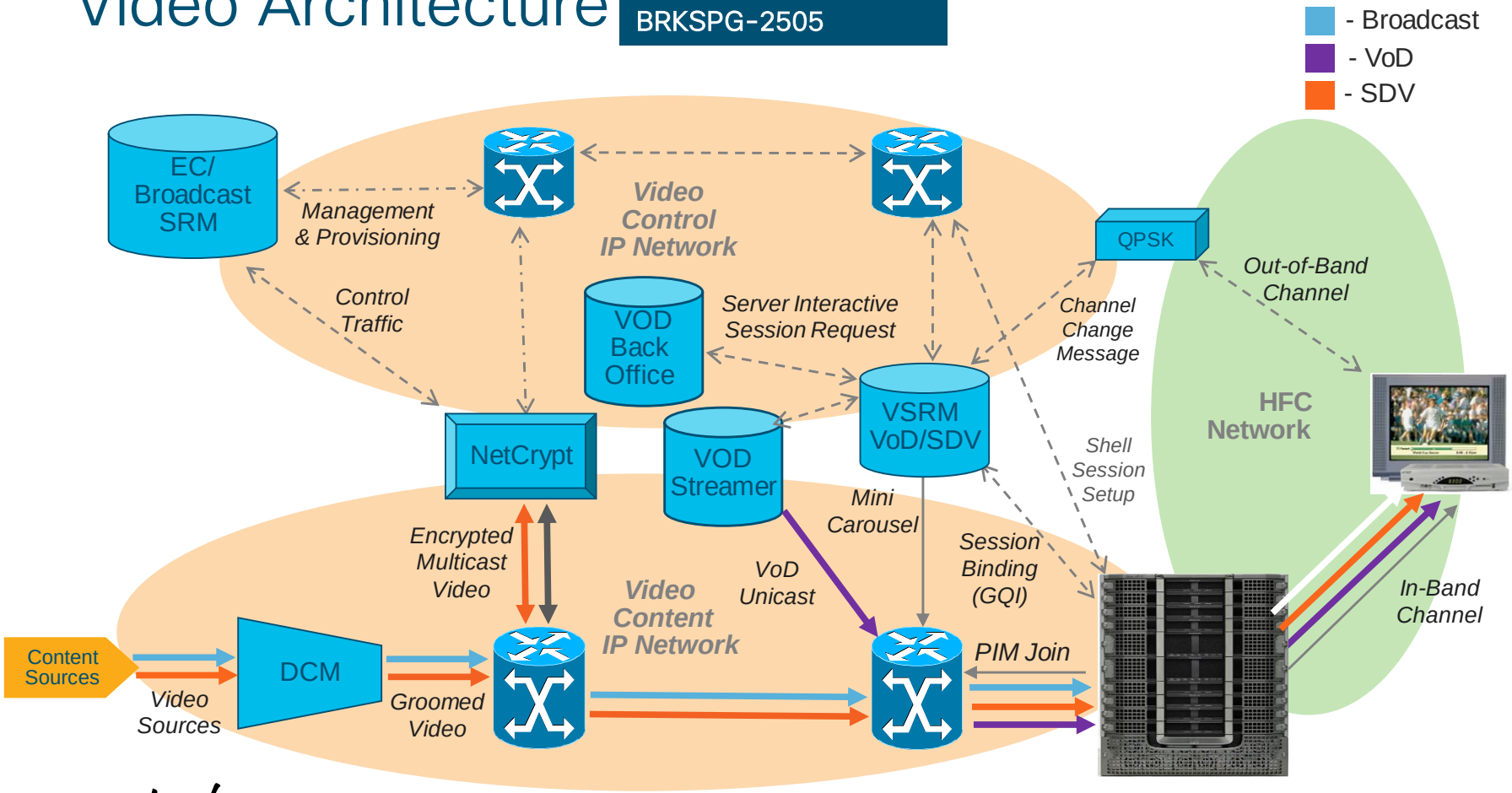
- Can be used for control or data profiles
- Each supports up to 5 ranges
- Define absolute or relative frequencies

```
cable downstream ofdm-modulation-profile 96
  subcarrier-spacing 50KHZ
  width 96000000
  start-freq 642000000
  assign modulation-default 1024-QAM
  assign modulation 512-QAM range-subcarriers freq-abs 724050000 width 12000000
  assign modulation 4096-QAM range-subcarriers freq-abs 644000000 width 70000000
```

Video

Video Architecture

Source: 2017
BRKSPG-2505

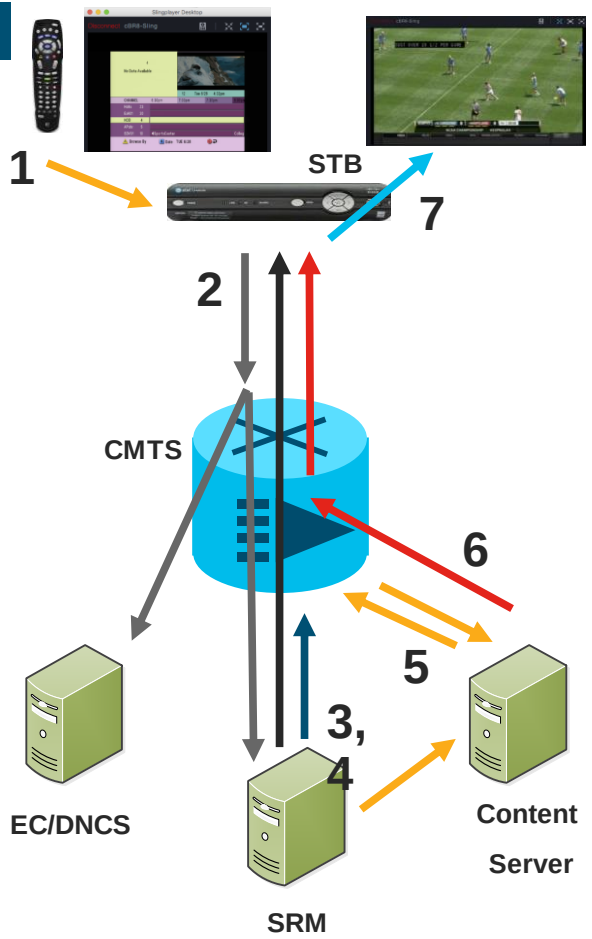


Video Services

Not Video Over DOCSIS

Video Session Setup (Cisco/SA)

- 1 Customer STB selects programming
- 2 STB communicates to EC/SRM to request content
- 3 SRM requests session creation to RFGW-10
  - Source Specific Multicast (SDV) or Unicast (VOD)
- 4 SRM transmits to STB the session information
- 5 RFGW-10 obtains content from Content Server
  - Add Encryption if RFGW-10 assigned edge encryption (VOD)
  - RFGW-10 initiates the SSM / SRM instructs source to start
- 6 RFGW-10 forwards content on the appropriate SG
- 7 Set Top tunes to appropriate QAM Carrier
  - Decodes program with the provided encryption keys and program information



Video Services

Session states

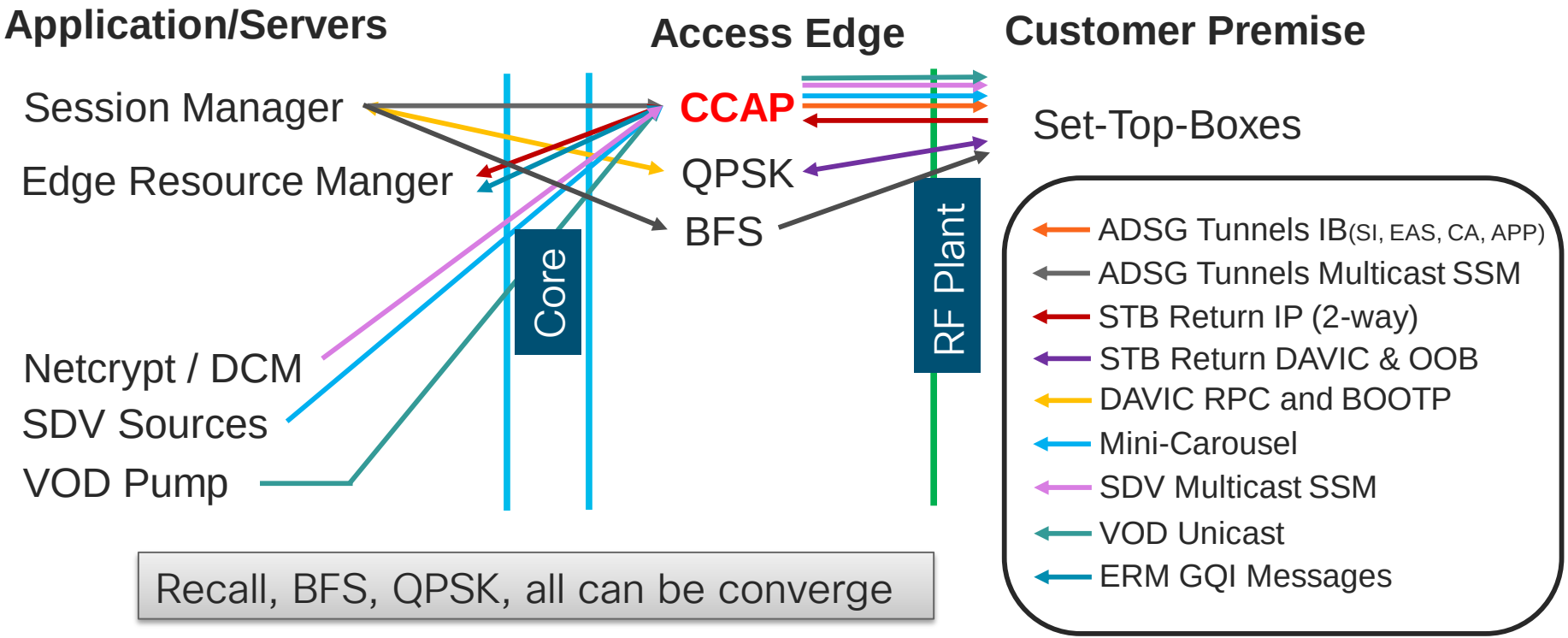
- Disconnect/Connect and interactions with SRM

	LED “Active”	LED “No Active”	LED De-Configured
SRM Functional and “In Service” State	Normal operations	LED continues to pin up existing sessions. No new sessions.	All sessions destroyed.
SRM Unresponsive	LED continues to pin up existing sessions. No new sessions.	LED continues to pin up existing sessions. No new sessions.	All sessions destroyed
SRM “Release” or “Out Of Service” and then “In Service”	LED instructed to remove all sessions and rebuild	LED never gets the order and continues sessions.	All sessions destroyed

How does cBR8 fit in your Video architecture?

Mid level by **Function**

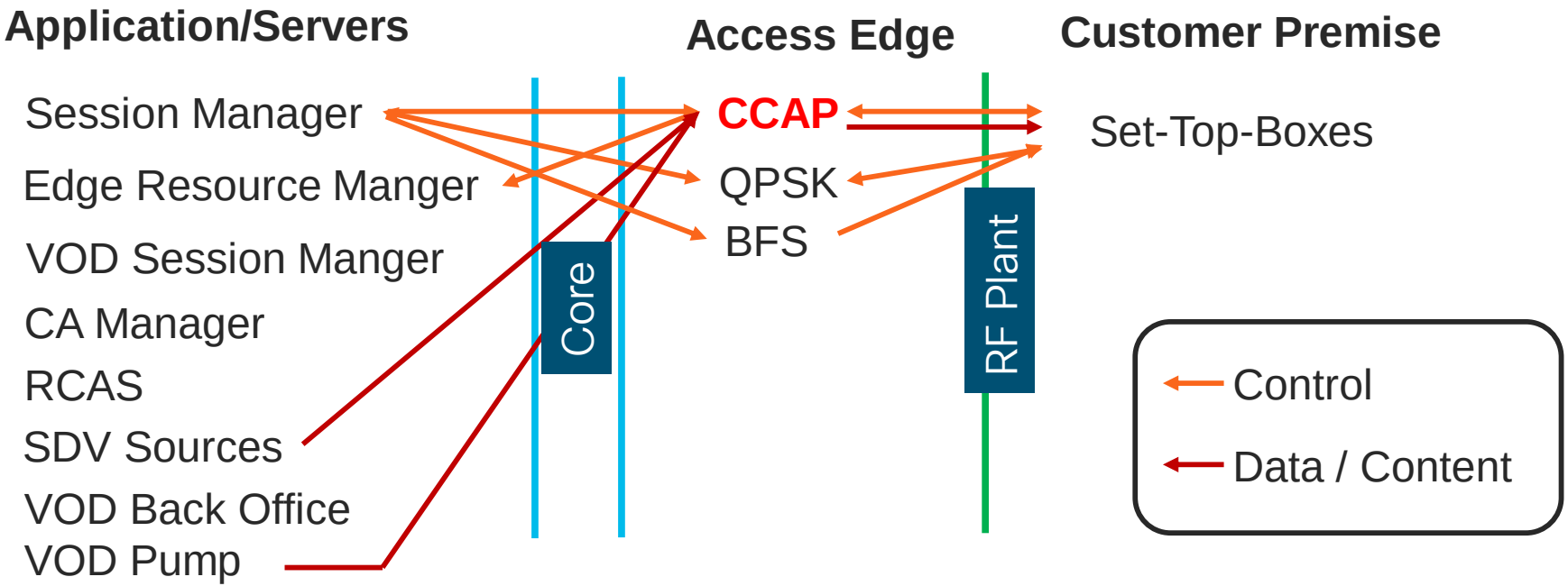
A bit more details now…



Recall, BFS, QPSK, all can be converge

How does cBR8 fit in your Video architecture?

High level by **Function**



What is the cBR8 Responsible for?

Not Video Over DOCSIS

Check out BRKSPV-2303

- For **VIDEO** services:
  - Advanced DOCSIS Set-Top Gateway (ADSG)
    - cBR8 forwards DSG tunnel traffic from your controller to each Video SG
    - DSG tunnel data is used for STB control: System Information (SI), Emergency Messaging (EAS), Conditional Access (CA), and additional In-Band data such as BFS carousel and application data
  - Set-Top-Box Return Path (part of 2-way)
    - DOCSIS STB signals the VSRM over IP and the first "hop" is the cBR8 Bundle
    - *DAVIC STB signals the QPSK (MOD/DEMOD)*
  - Switch Digital Video (SDV)
    - Responsible for pinning up and tearing down sessions as required by the VSRM
    - Multicast PIM Join towards the multicast source and then forwards it out the Video QAM(s)
  - Video on Demand (VOD)
    - Similar to SDV but with unicast sources
    - **Edge Encryption** with PME or PowerKey

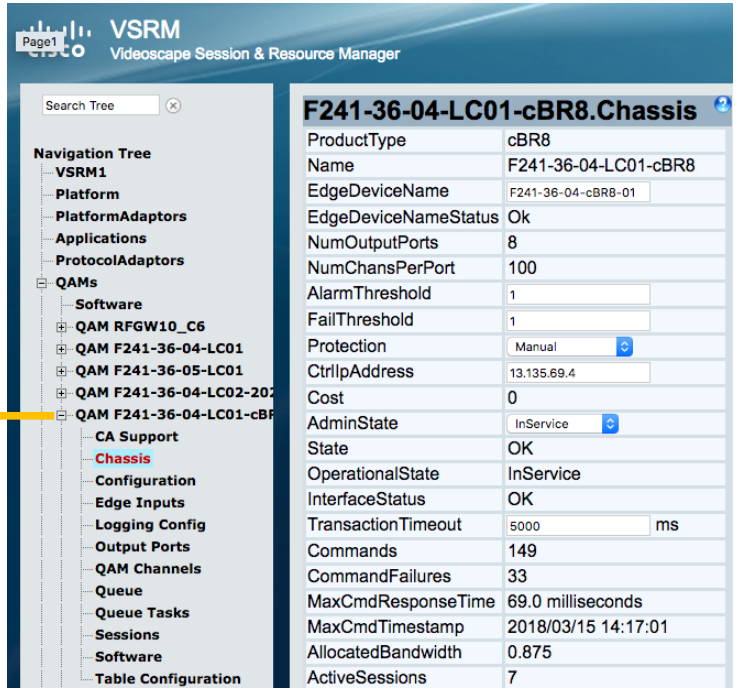
What is the cBR8 Responsible for?

- Continued
  - **Broadcast Video / Linear Content**
    - Table Based Sessions
    - Can be done by RFGW-1s
  - **Broadcast File System (BFS)**
    - Table Based
    - If EC is Version 8 or later – GQI sessions for BFS
    - IOS-XE 16.7.1 and later

cBR8 Configuration and VSRM

- Each cBR8 Logical Edge Device associates to an VSRM “QAM”
  - TSID and Output port range - Virtual Carrier Groups
  - Source Mac-address of the LED
  - Server IP of ERM – Two standard, three possible
  - Management IP – cBR8 LED’s IP
  - Virtual Edge Input – Destination IP for VOD
  - Activate or no activate

```
jayu2 — jayu2@Jayu2-VM-Ubuntu: ~ — ssh 10
logical-edge-device LED_6 id 6
logical-edge-device LED_1_GQI id 10
  protocol gqi
    mgmt-ip 13.135.69.4
    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
```



ADSG Troubleshooting

Check Client-id and tunnel association

```
CBR8-01# show cable dsg tunnel 2200 client
tunnel client client client          client          vendor
id     listId id     id type         address         group
------ ------ ------ --------------- --------------- ------
2200   22     1      CA System ID    0x0E00
              2      MAC Addr        000a.000a.000a
```

Check cable intf. Tunnel association

```
CBR8-01# show cable dsg tunnel 2200
 tunnel                TG       cfr      tunnel     rule    client service
id  state mac-addr       id     id  state I/F      id state listId class
------------------------ ------ -------- -------- -------- ------ ------
2200   en 0100.0000.0022 60     2200   en C1/0/0   3      en 22
                                         C2/0/0   3      en
                                         C3/0/0   3      en
```

Check your interface is listed

Check tunnel cfrs configuration for all tunnels

```
CBR8-01# show cable dsg tunnel 2200 cfrs
tunnel cfr    cfr    cfr destination ip    source ip        srcPre d_port d_port
id     id     state  pri address           address          length start  end
------ ------ ------ --- ----------------- ---------------- ------ ------ ------
2200   2200   en     1   232.10.10.1       13.135.8.104     32     2200   13821
```

Check DSG tunnel counters for all tunnels

```
CBR8-01# show cable dsg tunnel 2200 statistics
tunnel cfr    cfr    destination ip  source ip       total          total
id     id     state  address         address         forwarded      received
------ ------ ------ --------------- --------------- -------------- ------------
2200   2200   en     232.10.10.1     13.135.8.104    120355774      120355774
```

Make sure incrementing

Multicast Group is correct

ADSG Troubleshooting

Verifications

- Tunnel Groups
- Classifiers
- Client List
- MDD
- DCD
- Timers
- IP Multicast

Show interface cable *slot/subslot/port* dsg downstream

```
CBR8-01#show interface cable 1/0/0 dsg downstream
chan   chan   chan timer init    oper    twoWay oneWay num  num    num  num    num
list   index freq index timeout timeout timer  timer  rule tunnel cfr  client vsp
-----  ----- ---- ----- ------- ------- ------ ------ ---- ------ ---- ------ ---
                 1     2       150     10     150    3    3      3    3      0
```

Show interface cable *slot/subslot/port* dsg downstream tunnel

```
CBR8-01#show interface cable 1/0/0 dsg downstream tunnel
tunnel              TG      cfr       rule   client service
id  state mac-addr       id    id  state id state listId class
----------------------- ----- --------- -------- ------ ---------------
200    en 0100.0000.0002 20    200    en 1     en 2
1200   en 0100.0000.0012 40    1200   en 2     en 12
2200   en 0100.0000.0022 60    2200   en 3     en 22
```

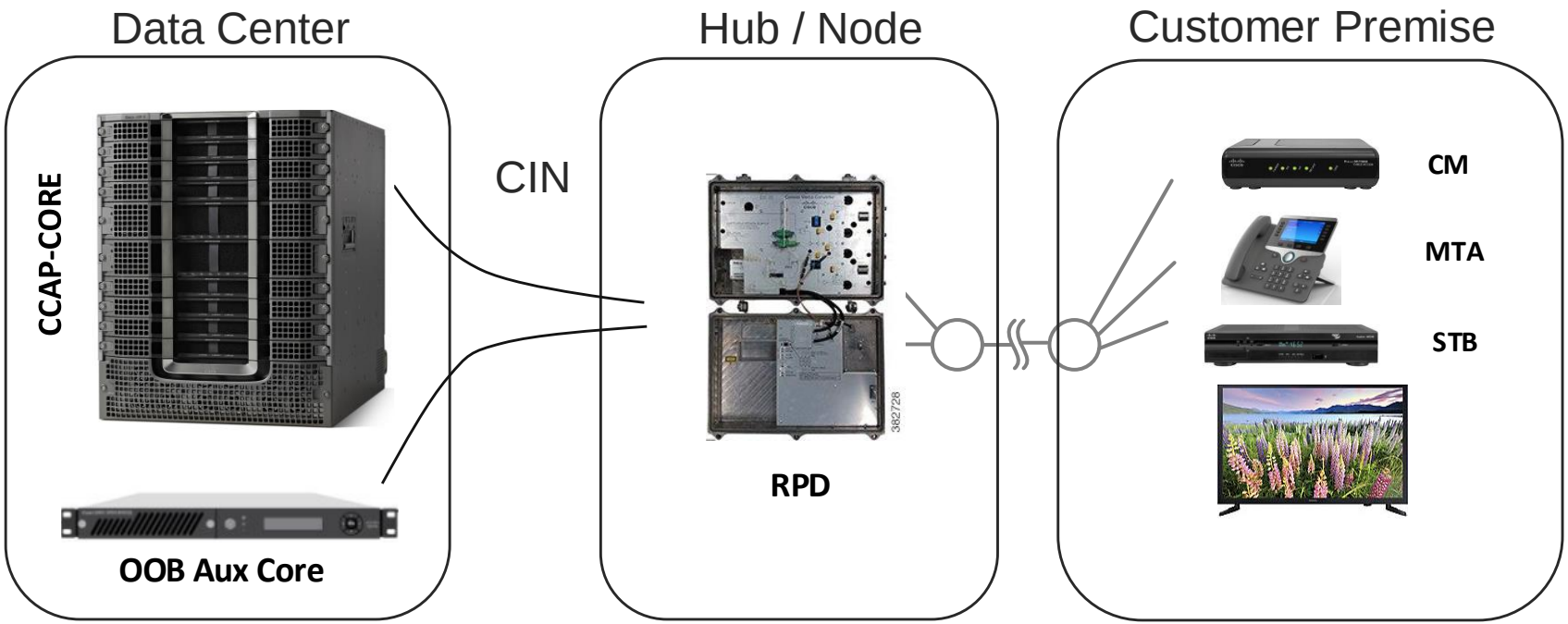
Show interface cable *slot/subslot/port* dsg downstream tg

```
CBR8-01#show interface cable 1/0/0 dsg downstream tg
TG: 20    Chan: 100   State: en  Pri: 0   Vendor:       UCID:
   rule        tunnel                        cfr              In  clients
 id state id  state mac-addr       id  state dest-ip         DCD listId
 -------- ----------------------- ------------------------- --- -------
 1     en 200    en 0100.0000.0002 200    en 232.10.10.2     yes 2
TG: 40    Chan: 100   State: en  Pri: 0   Vendor:       UCID:
 2     en 1200   en 0100.0000.0012 1200   en 232.10.10.3     yes 12
TG: 60    Chan: 100   State: en  Pri: 0   Vendor:       UCID:
 3     en 2200   en 0100.0000.0022 2200   en 232.10.10.1     yes 22
```

Reference Architecture

CCAP with Remote PHY

- DOCSIS 3.1 High Speed Data
- Video Aux Core
- Video OOB for DAVIC



Video Services with RPHY

Considerations

- Controller(s) are now “Downstream-Cable”
- Controllers instantiate **profile(s)**: “cable downstream controller-profile”
- Controller RF-channel Type “Video” are now “Video Sync” or “Video Async”
- Video RF-Channels are either part of an Auxiliary core or part of the Principal core
- cBR8 IOS-XE must be 16.8 and later / RPD version must be 4.1 and later
- Cable Video largely unchanged – Only SDG controllers need to be updated to “rpd downstream-cable”

Video Services with RPHY

Auxiliary Core and Principal Core

- Option 1 – Set up Video within the Principal Core:

Controller Configuration

```
cable downstream controller-profile 36
 multicast-pool 2
 max-ofdm-spectrum 192000000
rf-chan 0 31
  type DOCSIS
  qam-profile 1
  frequency 405000000
  rf-output NORMAL
  docsis-channel-id 1
rf-chan 32 39
  type VIDEO SYNC
  qam-profile 5
  frequency 111000000
  rf-output NORMAL
rf-chan 158
  docsis-channel-id 159
  ofdm channel-profile 7
  start-frequency 690000000 width 192000000 plc 783000000

cable depi multicast pool 2 ip address 225.225.225.0 255.255.255.0
```

Controller-Profile

Instantiation now automatic depending on RPD assignment

Type Video Sync / Async

RPD Configuration

```
cable rpd RPD_1
 description LAB-RPD
 identifier 0000.aabb.ccdd
 core-interface Te1/1/0
  principal
  rpd-ds 0 downstream-cable 1/0/0 profile 36
  rpd-us 0 upstream-cable 1/0/0 profile 1
  rpd-us 1 upstream-cable 1/0/1 profile 1
  network-delay dlm 10
 core-interface Te1/1/6
  rpd-ds 0 downstream-cable 1/0/31 profile 41
 r-dti 6
 rpd-event profile 5
```

Controller Profile 36 under Principal

Aux-Core here – not our profile

Multicast Pool – DEPI-UEPI

Video Services with RPHY

Auxiliary Core and Principal Core

- Option 2 – Set up Video in an Auxiliary Core

Controller Configuration

```
cable downstream controller-profile 20
 multicast-pool 1
 rf-chan 32 39
  type VIDEO SYNC
  qam-profile 5
  frequency 111000000
  rf-output NORMAL
```

RPD Configuration

```
cable rpd RPD_1
 identifier 0000.abcd.1234
 core-interface Te1/1/0
  principal
  rpd-ds 0 downstream-cable 1/0/0 profile 10
  rpd-us 0 upstream-cable 1/0/0 profile 1
 core-interface Te9/1/6
  rpd-ds 0 downstream-cable 9/0/31 profile 20
 r-dti 1
 rpd-event profile 5
```

Notice here the Profile 20 is under the non-principal (Aux) core

Automation – Ansible for LCHA Failovers

Walkthrough

- **Objective:** Leverage Ansible to incrementally LCHA failover defined Cable Line Cards one-by-one and fail back
- **Use-Case:** DDTS which may require Linecard reinitialization unavailable by LCPR. For example, FPGA DDTS requiring FPGA reinitialization.
- **Value:** Typically an operator doing this manually will spend 12-15 minutes per CLC and is extremely tedious.

We will take Cisco.com's Firmware upgrade Ansible script for 16.7.1 and hack it to fit our needs !

Automation – Ansible for LCHA Failovers

Walkthrough

- **Step 1:** Obtain the container for 16.7.1a Firmware Package upgrade on Cisco.com
- **Step 2:** Start the docker container
  - Example: docker run -it ansible1671 /bin/bash
- **Step 3:** Edit the necessary control files within /opt/cbr-8_upgrade_ansible_16.5_or_16.6_to_16.7.1
  - **`hosts`** : Define the chassis IP you wish to perform this on
  - **`secrets.yaml`** : Define authentication credentials – keep secure
  - **`upgrade_vars.yaml`** : Set parameters for upgrade – set your `src_dir` to harddisk and define your `slot_to_upgrade` parameters (range of CLCs to do this on)
- **Step 4:** Copy the `mop_upgrade.yaml` to a different filename `automate-LCHA-Failovers.yaml`

Automation – Ansible for LCHA Failovers

Walkthrough

- **Step 5:** Edit your new `automate-LCHA-Failovers.yaml`
  - Comment out the following sections:
    - `#  - include: tasks/get_target_file.yaml`
    - `#  - include: tasks/check_md5.yaml`
    - `#  - set_fact: script_start_time`
    - `#  - debug: var=script_start_time`
    - `#  - include: tasks/no_secondary_lc.yaml`
    - `#  - include: tasks/sup_cpld_upgrade.yaml`
    - `#  - include: tasks/wait_slot_ok.yaml`
    - `#  - name: wait slot {{slot_standby}} status ok`
    - `#  - include: tasks/change_global_var.yaml`
    - `#  - include: tasks/lc_cpld_upgrade_inter.yaml`
    - `#  - include: tasks/gemini_upgrade_auto_inter_sub.yaml`

Automation – Ansible for LCHA

Walkthrough

- **Step 6:** Edit your new `automate-LCHA-Failovers.yaml`
  - Immediately after the comment out of the Gemini upgrade, add
    - `#  - include: tasks/gemini_upgrade_auto_inter_sub.yaml`
    - `- debug: msg="Start LCHA Failover Tasks"`
    - `- include: tasks/lc_failover_reload_inter.yaml    when: "{{slot_standby}} >= 0"`
    - `- debug: msg="LCHA Failover complete"`
    - `- include: tasks/wait_slot_ok.yaml slot_num={{item}}    with_items: "{{slot_list}}"    when: "{{slot_standby}} < 0"`
  - Continue then to comment out the following sections
    - `#  - include: tasks/recover_secondary_lc.yaml`
    - `#  - include: tasks/save_config.yaml`
    - `#  - include: tasks/check_result.yaml`
    - `#  - debug: msg="slot{{item}} state is wrong, didn't perform upgrade, please fix it and try again!"`

Automation – Ansible for LCHA

Walkthrough

- **Step 7:** Change your working directory to `tasks/`
- **Step 8:** Copy `wait_slot_to_stdby_warm.yaml` to `wait_slot_to_stdby_hot.yaml`
- **Step 9:** Edit `wait_slot_to_stdby_hot.yaml`
  - Change the register to `register: platform_status_end2`
  - Change `platform_status_end` to `platform_status_end2`
  - Change the `find` to "Stdby Hot" `platform_status_end2.stdout[0].find("Stdby Hot") != -1)`
- **Step 10:** Create file `lc_failover_reload_inter.yaml`
  - Edit it to contain
    - `- include: tasks/lc_failover_reload_inter_step1.yaml slot_num={{item}}  with_items: "{{slot_list}}"`

Automation – Ansible for LCHA

- **Step 11:** Create file `lc_failover_reload_inter_step1.yaml`

```
- debug: msg="Debug in LC reload Step1 , slot number is {{ slot_num }}, slot_list is {{ slot_list }}"
- include: tasks/wait_slot_to_stdby_warm.yaml
  with_items: "{{slot_list}}"
  when: "{{slot_standby}} >= 0"
- debug: msg="Debug in LC 0 is ready, proceed to failover"
- name: switchover to slot {{slot_num}}
  ios_command:
  provider: "{{ provider }}"
  timeout: 300
  commands:
    - redundancy linecard switchover from slot {{slot_num}}
- name: wait 60s
  command: sleep 60
- debug: msg="Debug Post failover, wait for original working to come back ready, proceed to failover"
- include: tasks/wait_slot_to_stdby_hot.yaml
  with_items: "{{slot_num}}"
  when: "{{slot_standby}} >= 0"
- debug: msg="Debug Post failback, proceeding"
- name: switchover back to slot {{slot_num}}
  ios_command:
  provider: "{{ provider }}"
  timeout: 300
  commands:
    - redundancy linecard switchover from slot 0
- debug: msg="Debug Failedback"
- name: wait 300s
  command: sleep 300
```

Automation – Ansible for LCHA

Walkthrough

- **Step 12:** Return to the parent directory `/opt/cbr-8_upgrade_ansible_16.5_or_16.6_to_16.7.1`
- **Step 13:** Execute the ansible playbook when desired
  - `ansible-playbook -i hosts automate-LCHA-Failovers.yaml`

1.d – Show Modem “select” Information

```
cBR8-01#scm select ipv6 where dsxus is "33x4"
 ipv6
=========================================
 2001:DB8:FFFF:C:21D:D4FF:FED3:31D2
 2001:DB8:FFFF:C:21D:D4FF:FED3:3122
 2001:DB8:FFFF:C:2273:55FF:FEC6:35BB
cBR8-01#show cable modem select ip where dsxus is
"33x5”
ip
=================================================
13.42.0.64
13.42.0.25
13.42.1.119
13.42.0.24
cBR8-01#show cable modem select mac where dsxus is "33x5”
mac
=================================================
14b7.f80e.3ffc
14b7.f80e.3ee4
6477.7d90.43f2
14b7.f80e.3d2c
```

Show Cable Modem	SQL
show cable modem	select *
scm docsis version d31-capable	select mac where macver like “DOC3.1%”
scm wideband	show cable modem select mac,ip,intf where st is "w-online(pt)"
scm primary	Show cable modem select mac,ip,intf,primds order by primds desc

```
cBR8-01#scm 14b7.f80e.3f10 phy

MAC Address    I/F           Sid   USPwr   USMER  Timing  DSPwr   DSMER   Mode    DOCSIS
                                   (dBmV)  (SNR)  Offset  (dBmV)  (SNR)           Prov
                                           (dB)                    (dB)
14b7.f80e.3f10 C2/0/1/U4     345   52.75   ----- 2391   - 9.20  41.60   ofdma   1.1
```

cBR-8 Operational Maintenance

You make networking **possible**

cBR-8 Exec and Filesystem

Navigating and Tools

- IOS-D has some Unix-like Commands
- pwd/cd/dir (but no **ls**)
- Regex Arguments
- Pipe (|) options

Also mkdir / rmdir

```
CBR8-01# pwd
bootflash:/
F241-36-04-cBR8-01# del *
Delete filename [*]?
Delete bootflash:/lost+found?
[confirm]n
Delete of bootflash:/lost+found
aborted!
```

```
CBR8-01# cd XE318
CBR8-01# dir
Directory of bootflash:/XE318/

177761  -rw-         28685264  Mar 30 2016
13:24:57 -04:00  cbrsup-
cciomdsup.03.18.00.S.156-2.S-std.SPA.pkg
7804653568 bytes total (2629476352 bytes free)
```

```
CBR8-01#sh run | section controller
Integrated-Cable 1/0/0
controller Integrated-Cable 1/0/0
 max-carrier 96
 rf-chan 0 15
  type DOCSIS
 rf-chan 16 31
  type VIDEO
```

```
CBR8-01#show cable modem docsis de | count RTR|MTA
Number of lines which match regexp = 82
CBR8-01#show cable modem docsis de | count MTA
Number of lines which match regexp = 31
CBR8-01#show cable modem docsis de | count RTR
Number of lines which match regexp = 81
```

Char	Meaning
.	Matches any single character, including white space
*	Matchers 0 or more sequences of the pattern
+	Matches 1 or more sequences of the pattern
?	Matches 0 or 1 occurrences of the pattern
^	Matches the beginning of the string
$	Matches the end of the string
_	Matches , { } ( ), the beginning of the string, the end of the string, or a space.
\	Delimiter above characters

Argument	Use Case
section	Section indented after match
count	Regex count
begin	Show line and all lines after match
Include	Show only matching line
redirect *path*	Redirect to output file

cBR-8 High Availability

Route Processor

- When and How to use it
- What to expect
  - Time may take up to 30 seconds
  - Modems should not drop offline
  - Uplinks on both SUPs remain functio

Redundancy Switchover History

```
CBR8-01# show redundancy switchover history
Index  Previous  Current  Switchover             Switchover
       active    active   reason                 time
-----  --------  -------  ----------             ----------
   1       48       49    active unit removed    10:30:07 edt Mon
   2       49       48    user forced            15:35:42 edt Wed
```

Initiating a SUP Failover

```
CBR8-01# redundancy force-switchover
Proceed with switchover to standby RP? [confirm]
    Manual Swact = enabled
Connection to 13.42.0.1 closed by remote host.
Connection to 13.42.0.1 closed.
```

Show Redundancy

```
CBR8-01# show redundancy

Redundant System Information :
------------------------------
       Available system uptime = 1 week, 4 days, 21 hours, 44
minutes
Switchovers system experienced = 2
              Standby failures = 0
        Last switchover reason = user forced
                 Hardware Mode = Duplex
    Configured Redundancy Mode = sso
     Operating Redundancy Mode = sso
              Maintenance Mode = Disabled
                Communications = Up
Current Processor Information :
       Active Location = slot 4
        Current Software state = ACTIVE
       Uptime in current state = 7 minutes
                 Image Version = Cisco IOS Software, cBR
Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
15.6(2)S0a, RELEASE SOFTWARE (fc1)
       BOOT = bootflash:/XE318/packages.conf,12;
                  CONFIG_FILE =
        Configuration register = 0x2102
Peer Processor Information :
       Standby Location = slot 5
        Current Software state = STANDBY HOT
       Uptime in current state = 0 minutes
                 Image Version = Cisco IOS Software, cBR
Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Version
15.6(2)S0a, RELEASE SOFTWARE (fc1)
       BOOT = bootflash:/XE318/packages.conf,12;
                  CONFIG_FILE =
        Configuration register = 0x2102
```

cBR-8 High Availabilit

Cable Linecard

- When and How to use it
- Revertive Timer
  - Default is 120 seconds
- What to expect
  - Time may take up to 30 secon
  - Modems should not drop offline
  - Modems now reporting on Slot

Basic Configuration

```
CBR8-01#sh run | sec redund
redundancy
 mode sso
 linecard-group 0 internal-switch
  class 1:N
  member slot 1 primary
  member slot 2 primary
  member slot 0 secondary
  revertive 120
```

Check Redundancy State

```
CBR8-01#show redundancy linecard all
                LC      My          Peer        Peer      Peer
Slot  Subslot   Group   State       State       Slot      Subslot   Role      Mode
-------------------------------------------------------------------------------
 1    -         0       Active      Stdby Warm  0         -         Active    Primary
 2    -         0       Active      Stdby Warm  0         -         Active    Primary
 0    -         0       -           -           Multiple  None      Standby   Secondary
```

Initiate a Failover

```
CBR8-01# redundancy linecard-group switchover from slot 1
Bringing 1:N Secondary slot (0) to Hot Standby for manual switchover.
```

Check Redundancy State Post Failover

```
CBR8-01#sh redundancy line all
Load for five secs: 19%/2%; one minute: 12%; five minutes: 16%
Time source is NTP, 15:43:57.635 edt Wed May 4 2016

                LC      My          Peer        Peer      Peer
Slot  Subslot   Group   State       State       Slot      Subslot   Role      Mode
-------------------------------------------------------------------------------
 1    -         0       Init        Active      0         -         None      Primary
 2    -         0       Active      Unavail     0         -         Active    Primary
 0    -         0       Active      Init        1         -         Active    Secondary
```

Post-Failover Mac-Domains

```
CBR8-01#show cable modem summary total
Interface                       Cable Modem
Description
                Total Reg   Oper  Unreg Offline Wideband initRC initD initIO
initO
C0/0/0/UB       5     5     5     0     0       5        0      0     0      0
C0/0/0/U1       1     1     1     0     0       0        0      0     0      0
C0/0/1/UB       29    29    29    0     0       29       0      0     0      0
```

cBR-8 Linecard Health

Platform

Command	When to Use
show platform [diag]	Monitoring card states
show env power	Monitoring power budgets
show facility-alarm status	Monitoring critical alarms
show cable card *slot/subslot* ds-phy display | inc ver	Monitoring correct firmware versions
hw-module slot {0-9,R0,R1} {reload|start|stop}	Resetting hardware

Show Platform Diag

```
CBR8-01# show platform diag
Chassis type: CBR-8-CCAP-CHASS
Slot: 0, CBR-CCAP-LC-40G
        Running state                 : ok
        Internal state                : online
        Internal operational state    : ok
        Physical insert detect time   : 00:01:18 (2d05h ago)
        Software declared up time     : 00:38:48 (2d04h ago)
        CPLD version                  : 00000021
        Rommon version                : 2011.03.13
        PSOC 0 version                : v4.6
Pic: 0/1, CBR-RF-PROT-PIC
        Internal state                : inserted
        Physical insert detect time   : 00:02:43 (2d05h ago)
        Firmware version:             : 0000071E
```

Show Platform

```
CBR8-01# show platform
Chassis type: CBR-8-CCAP-CHASS
Slot      Type                State                 Insert
time (ago)
--------- ------------------- --------------------- --------
---------
0         CBR-CCAP-LC-40G     ok                    2d05h
0/1       CBR-RF-PROT-PIC     ok                    2d05h
1         CBR-CCAP-LC-40G     booting               2d05h
1/1       CBR-RF-PIC          ok                    2d05h
2         CBR-CCAP-LC-40G     ok                    2d05h
2/1       CBR-RF-PIC          ok                    2d05h
SUP0      CBR-CCAP-SUP-160G   inserted              2d05h
 R0                           ok, standby
 F0                           ok, standby
 4                            ok, standby
 4/1      CBR-SUP-8X10G-PIC   ok                    2d05h
SUP1      CBR-CCAP-SUP-160G   inserted              2d05h
 R1                           ok, active
 F1                           ok, active
 5                            ok, active
 5/1      CBR-SUP-8X10G-PIC   ok                    2d05h
P0        CBR-AC-PS           ok                    2d05h
<SNIP>
P14       CBR-FAN-ASSEMBLY    ok                    2d05h

Slot      CPLD Version        Rommon Version
--------- ------------------- ----------------------------
0         00000021            2011.03.13
1         00000021            2011.03.13
2         00000021            2011.03.13
SUP0      15091511            15.5(3r)S
SUP1      15091511            15.5(3r)S
```

IOS-XE Upgrade and Installation

Consolidated Mode

- Traditional Model
- Mimics Traditional IOS
- IOS-XE automatically extracts and links appropriate packages
- One-Shot Upgrade

Verify MD5

```
CBR8-01#verify /md5 bootflash:cbrsup-universalk9.03.18.00a.S.156-2.S0a-ext.SPA.bin acec1f32a0b8898eceea0f7f31ee5797

.................................Done!

Verified (bootflash:cbrsup-universalk9.03.18.00a.S.156-2.S0a-ext.SPA.bin) = acec1f32a0b8898eceea0f7f31ee5797
```

Point Bootvar to Image

```
CBR8-01(config)# no boot system
CBR8-01(config)# boot system bootflash:cbrsup-universalk9.03.18.00a.S.156-2.S0a-ext.SPA.bin

CBR8-01# copy run start
```

Verify Bootvar

```
CBR8-01#show bootvar

BOOT variable = bootflash:cbrsup-universalk9.03.18.00a.S.156-2.S0a-ext.SPA.bin,12;

Standby BOOT variable = cbrsup-universalk9.03.18.00a.S.156-2.S0a-ext.SPA.bin,12;
```

Reload

```
CBR8-01# reload
```

Recommended Method

IOS-XE Upgrade and Installation

Sub-Package Mode

- IOS-XE loads individual packages
- Activate and Install only the Packages you want
- Allows ISSU Patch Validation

Make Directory (Optional)

```
CBR8-01#mkdir bootflash:/XE318
Create directory filename [XE318]?
Created dir bootflash:/XE318
CBR8-01#cd XE318
CBR8-01#pwd
bootflash:/XE318/
```

Extract Image Packages to directory

Do this for Stby-bootflash too

```
CBR8-01# request platform software package expand file
bootflash:16.32_johuynh.SSA.bin to bootflash:/XE318SP_ECE1 force
Thu May 5 16:35:11 edt 2016 Verifying parameters
Thu May 5 16:35:11 edt 2016 Validating package type
Thu May 5 16:36:00 edt 2016 Copying package files
Thu May 5 16:37:37 edt 2016 SUCCESS: Finished expanding all-in-one software
package.
```

Verify

You can use the <image-name>.conf as well!

```
CBR8-01#dir bootflash:/XE318/
Directory of bootflash:/XE318/
565602  -rw-           12856   May 5 2016 16:42:13 -04:00  cbrsup-packages-universalk9.2016-04-
22_16.32_johuynh.conf
565603  -rw-        35972052   May 5 2016 16:42:17 -04:00  cbrsup-rp-firmware.2016-04-22_16.32_johuynh.SSA.pkg
129284  -rw-           13697   May 5 2016 16:43:24 -04:00  packages.conf
```

Update Bootvar

```
CBR8-01(config)#boot sys bootflash:/XE318/packages.conf
```

In Service Software Upgrade (ISSU)

Hitless IOS-XE Upgrade

- request platform software package install node file *path*
- Requires SUP Switchover
- If LC Firmware Upgrade – Requires CLC reset

Requirements

Dual SUP
Standby SUP is Standby HOT
Auto-boot Enabled
At least 700MB free on Bootflash
Only between same IOS Trains
IOS-XE 3.18.0S and later

Copy Target IOS-XE Bin to the packages directory

```
CBR8-01# copy ftp:<image> bootflash:XE318/<image>
```

Initiate Upgrade

```
CBR8-01# request platform software package install node file
bootflash:XE318/cbrsup-universalk9.2016-03-28_08.17_johuynh.SSA.bin
--- Starting initial file path checking ---
--- Starting config-register verification ---
--- Starting image file expansion ---
STAGE 1: Installing software on standby RP ============================
--- Starting local lock acquisition on R0 ---
--- Starting installation state synchronization ---
--- Starting ISSU compatibility verification ---
--- Starting commit of software changes ---
SUCCESS: Software provisioned.  New software will load on reboot.
STAGE 2: Restarting standby RP ============================
--- Starting standby reload ---
--- Starting wait for Standby RP to reach terminal redundancy state ---
STAGE 3: Installing software on active RP ============================
--- Starting local lock acquisition on R0 ---
--- Starting installation state synchronization ---
--- Starting list of software package changes ---
--- Starting commit of software changes ---
SUCCESS: Software provisioned.  New software will load on reboot.
Write failed: Broken pipe
```

Due to SUP Failover – Re-login here

Smart Software Licensing

Registering the cBR-8

Configuration

•

- license smart register idtoken *IDToken*

Verification and Debugging

- show license status [all]
- show license show-tech
- debug smart_lic {all|error|info}
- debug crypto pki {validation|trans}

Register

```
CBR8-01#license smart deregister
CBR8-01# license smart register idtoken
YzUyOTIzZWYtOTA2OS00ZjQ1LWFhNzMtMGMxZWQxNmI0MTdhLTE0NjYwMTA$
Registration process is in progress. Use the 'show license
status' command to check the progress and result
```

Configuration

```
CBR8-01# sh run  | sec call-home
call-home
 profile "CiscoTAC-1"
  reporting smart-licensing-data
 destinati
https://10
tHandler
  no desti
https://to
snmp-serve
```

Status

```
CBR8-01# show call-home profile CiscoTAC-1
Profile Name: CiscoTAC-1
    Profile status: ACTIVE
    Profile mode: Full Reporting
    Reporting Data: Smart Licensing
    Preferred Message Format: xml
    Message Size Limit: 3145728 Bytes
    Transport Method: http
    Email address(es): callhome@cisco.com
    HTTP  address(es):
https://10.225.198.29:443/Transportgateway/services/DeviceReques
tHandler
```

Smart Software Licensing

TIP: You can force a re-reg on-demand by license smart register idToken command

Common Issues

- cBR-8 Registration Failure
  - ip http client source-interface *interface*
  - ip domain-name {lookup|source-int *intf*}
  - ip domain-name *name*
  - crypto pki trustpoint SLA-TrustPoint
  - revocation {crl|none}
  - aaa-authorization username "callhome"
- Operating Models
  - Direct connect to Cisco cloud
  - Satellite
  - Offline Mode
- Call-Home Best Practices

Registration Status

```
CBR8-01# show license status
Smart Licensing is ENABLED
Registration:
  Status: REGISTERING - REGISTRATION IN PROGRESS
  Export-Controlled Functionality: Not Allowed
  Initial Registration: FAILED on May 16 18:30:07 2016 edt
  Next Registration Attempt: May 16 19:34:41 2016 edt
License Authorization:
  Status: EVAL MODE
  Evaluation Period Remaining: 37 days, 11 hours, 54 minutes, 37 seconds
```

Source and Domain Name

```
CBR8-01# sh run | i ip http client source|ip domain-name
ip domain-name cisco
ip http client source-interface Loopback0
```

Crypto

```
CBR8-01# sh run | sec crypto pki trustpoint SLA-TrustPoint
crypto pki trustpoint SLA-TrustPoint
 enrollment terminal
 revocation-check crl
```

OFDM and OFDMA Optimization

You make networking **possible**

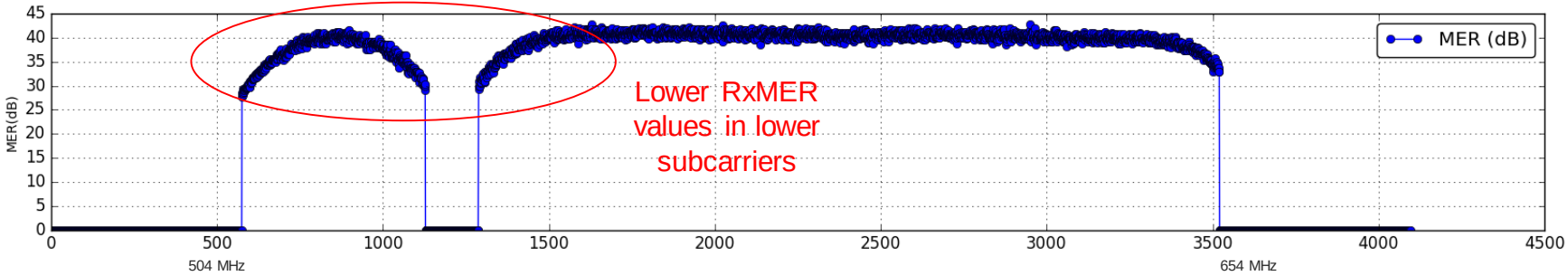
Max Carrier/OFDM to Base Channel Power

Example Supported Ranges in dBmV

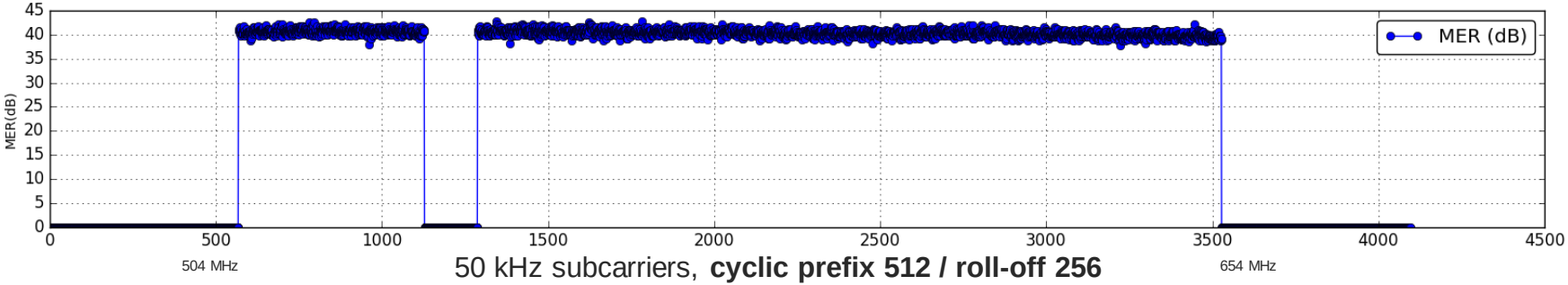
Max Carrier	No OFDM	24 MHz OFDM	48 MHz OFDM	96 MHz OFDM	144 MHz OFDM	192 MHz OFDM	384 MHz OFDM
8	**41 – 50**	39 – 48	37 – 46	35 – 44	34 – 43	32 – 41	29 – 38
16	**37 – 46**	36 – 45	35 – 44	34 – 43	32 – 41	31 – 40	29 – 38
24	**35 – 44**	34 – 43	34 – 43	32 – 41	31 – 40	31 – 40	28 – 37
32	**34 – 43**	33 – 42	32 – 41	31 – 40	31 – 40	30 – 39	28 – 37
48	**31 – 40**	31 – 40	31 – 40	30 – 39	29 – 38	29 – 38	27 – 36
64	**30 – 39**	30 – 39	29 – 38	29 – 38	28 – 37	28 – 37	26 – 35
96	**28 – 37**	28 – 37	27 – 36	27 – 36	27 – 36	26 – 35	25 – 34
128	**26 – 35**	26 – 35	26 – 35	26 – 35	25 – 34	25 – 34	24 – 33
158	**25 – 34**	25 – 34	25 – 34	25 – 34	24 – 33	24 – 33	- NA -

Note: Base Channel Power Range maximum value is 1 dB above DOCSIS DRFI specification

150 MHz OFDM channel 504 MHz – 654 MHz with node plus 5 amplifiers

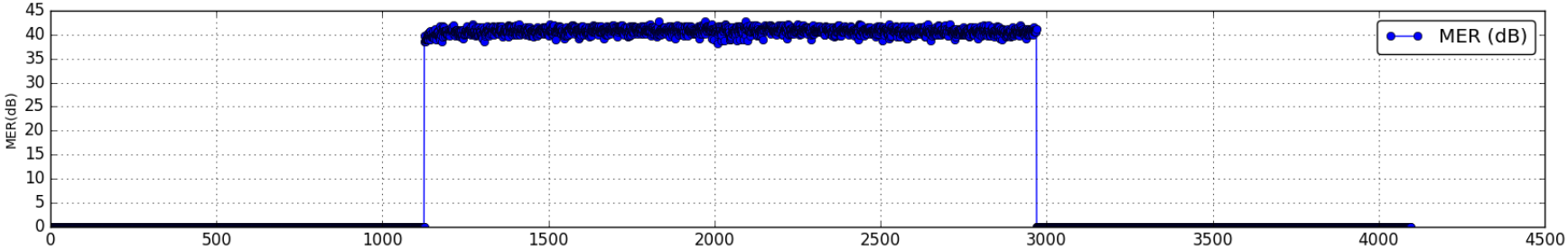


50 kHz subcarriers, **cyclic prefix 192 / roll-off 128**
Channel speed 1342 Mbps @ 4096-QAM (1230 Mbps @ 2048-QAM)

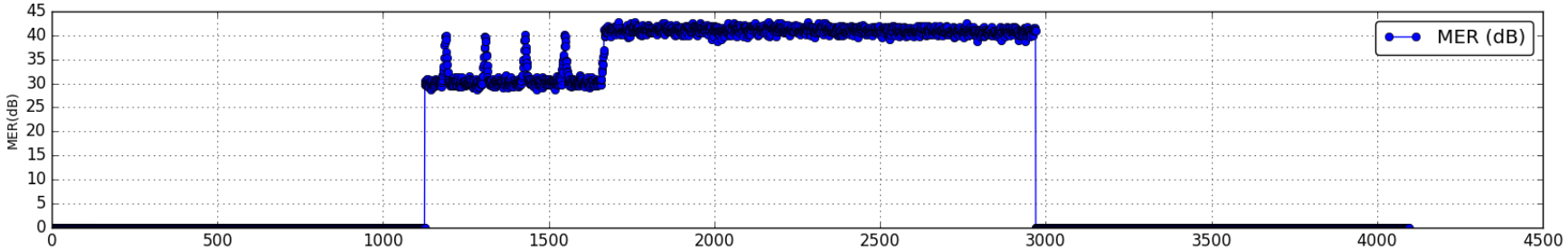


50 kHz subcarriers, **cyclic prefix 512 / roll-off 256**
Channel speed 1265 Mbps @ 4096-QAM

LDPC and frequency interleaving in D3.1 makes channel very robust to impairments



96 MHz OFDM channel running 4096-QAM no uncorrectable FEC codewords
(cBR8 would recommend 2048-QAM profile by default)



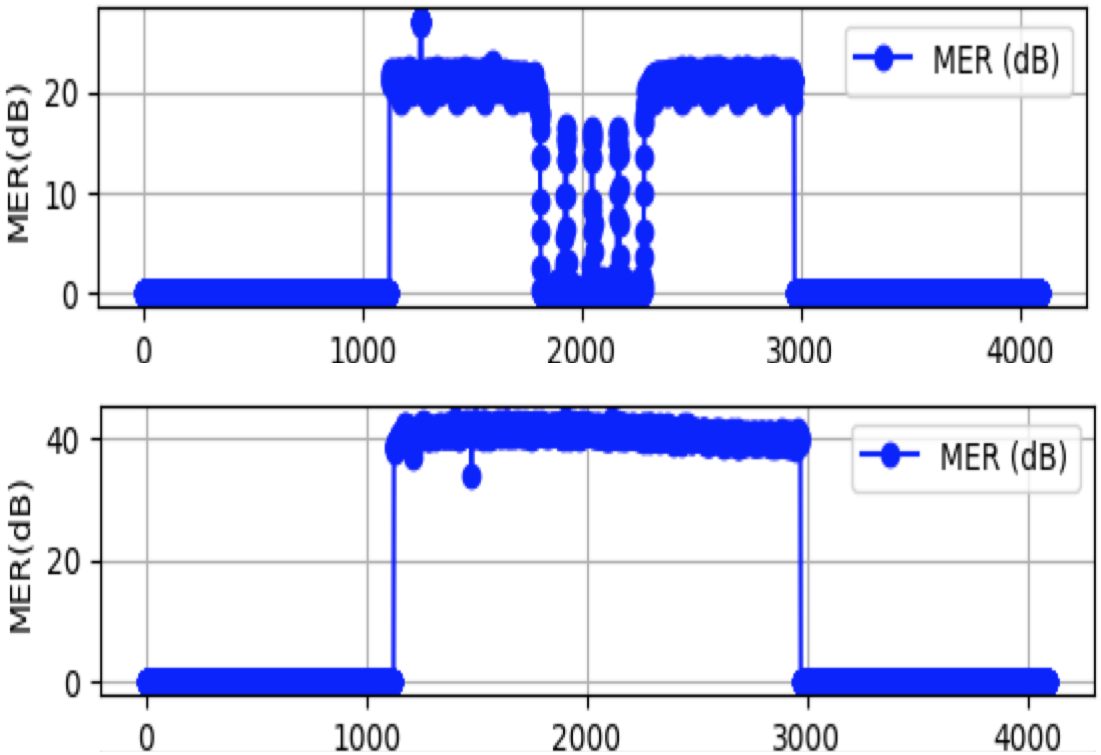
Same 96 MHz OFDM channel (now with 30 MHz interference) still running 4096-QAM no uncorrectable FEC codewords
(cBR8 would recommend 256-QAM profile by default)

Usefulness of RxMER data

RxMER data collection can be very useful in pinpointing plant problems

In this example it was found that some equipment was running tests from over a year ago across 4 channels and was never disabled

In the top diagram you can see the MER for the entire OFDM spectrum is degraded; the bottom diagram shows the spectrum after removing the interfering carriers



OFDM Settings To Maximize Speeds

- **`cyclic-prefix 192`**
  - For larger channels (>= 96 MHz(50), >= 144 (25)) use lowest value (192)
  - For smaller channels (< 96 MHz(50), < 144 (25)) use 256 to allow larger roll-off
- **`pilot-scaling 48`**
  - Keep at lowest setting – default is 48
- **`roll-off 128`**
  - Make as large as possible but must but be less than cyclic prefix value
- **`subcarrier-spacing 25KHZ`**
  - Less overhead for 25 kHz
- **`profile-data 1 modulation-default 1024-QAM`**
  - Make data profile as high as HFC plant will support
- **`profile-ncp modulation-default 64-QAM`**
  - Make NCP as high as plant will support

OFDM Profile Management Settings

- **`cable downstream ofdm-prof-mgmt prof-dwngrd-auto`**
  - Allow automatic profile downgrades after a profile declared unfit (default on)
- **`cable downstream ofdm-prof-mgmt rxmer-poll-interval`**
  - Period of RxMER polling (default 60 mins)
- **`cable downstream ofdm-prof-mgmt exempt-sc-pct`**
  - Percentage of sub-carriers allowed to be below the MER margin (default 2%)
- **`cable downstream ofdm-prof-mgmt recommend-profile-age`**
  - How long to cache recommended profile (default 120 mins)
- **`cable downstream ofdm-prof-mgmt unfit-profile-age`**
  - How long to cache unfit profile (default 60 mins)
- **`cable downstream ofdm-prof-mgmt mer-margin-qdb`**
  - Offset in 1/4 dB for MER margin determination

OFDMA Profile Management Settings

- **`cable upstream ofdma-prof-mgmt prof-upgrade-auto`**
  - Allow automatic profile upgrade (default off*) – default to change in later code
- **`cable upstream ofdma-prof-mgmt rxmer-poll-interval`**
  - Period of RxMER polling (default 60 mins)
- **`cable upstream ofdma-prof-mgmt exempt-mslot-pct`**
  - Percentage of minislots allowed to be below the MER margin (default 2%))
- **`cable upstream ofdma-prof-mgmt mer-margin-qdb`**
  - Offset in 1/4 dB for MER margin determination
- **`cable upstream ofdma-prof-mgmt active-scs-threshold-pct`**
  - Percentage of active subcarriers allowed to be below the MER margin (default 2%))

OFDMA Recommendations (June 2018)

- Use range **40-85 MHz**
- Avoid exclusion bands if possible
  - modem interop because of **dynamic modulation change on SC-QAM**, throughput issues
- When creating USBGs -create at least one SC-QAM (UGS scheduled flow) in USBG **and no more than 4 SC-QAMs in the USBG (4+1)**
- Interface Cable, being with Upstream 6 for the OFDMA upstream
  - Reserve 4 and 5 for D2.0 US later
- Use 25 Khz subcarrier
- Use 64.5 MHz Initial Ranging and subcarrier 256 fine-ranging
- Avoid using more than 45 Mhz spectrum because of current linecard USPHY rate limit settings.
- Modulations 4096 and 2048 QAM Removed
  - Can re-enable for demo purposes
- Go with larger cyclic prefix rollout, testing works better with modem interop issues
- Use LCHA and not LCPR in general

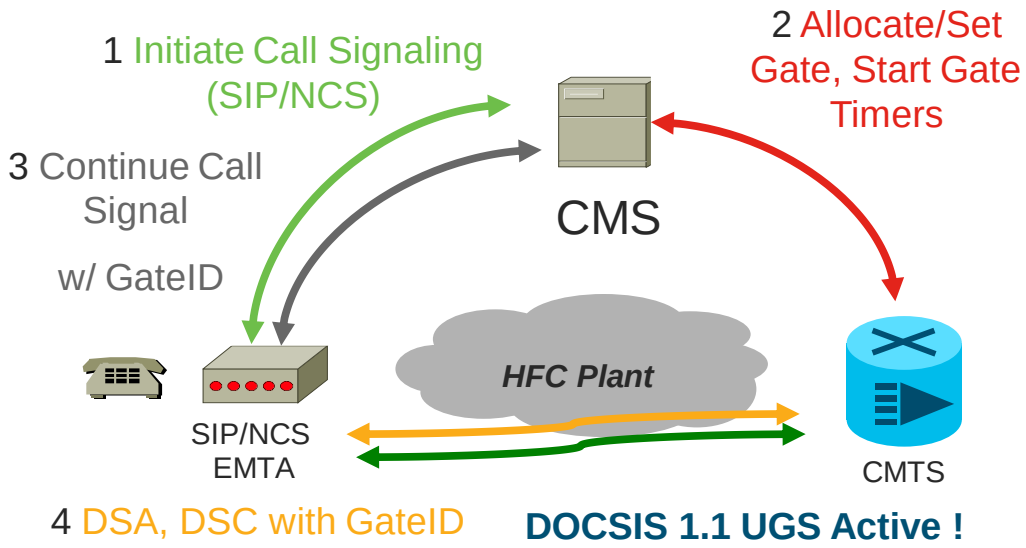
Troubleshooting cBR-8 Voice Services

You make networking **possible**

Voice Services

Common Problems

- 1. No Voice
- 2. Voice Quality
  - Choppy / Jittery / Robotic
- 3. Unable to Make a Call



Voice Services

Commands

- show cable upstream service-flow summary
- show cable modem voice
- show cable modem *mac-address* service-flow [verbose]
- show interface cable *slot/subslot/port* service-flow qos us | include UGS
- show interface cable *slot/subslot/port* service-flow *sflow-id* verbose
- show interface cable *slot/subslot/port* dynamic-service statistics
- show cable admission-control interface *slot/subslot/port* {bonding-group all | upstream *us-number*}
- debug cable dynsrv
- debug cable qos

Voice Services

Dynamic Service Flow

Debug cable dynsrv & Debug cable tlvs

```
Mar 9 19:28:49.792: DSA-REQ-RECD: OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:49.792: DSA-STATE-CREATED: OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:49.796: Found Upstream Service Flow TLV
Mar 9 19:28:49.796:    Service Flow Reference : 1
Mar 9 19:28:49.796:    QoS Parameter Set Type : 0x2
Mar 9 19:28:49.796:    Scheduling Type : 6
Mar 9 19:28:49.796:    Request/Transmission Policy : 0x17F
Mar 9 19:28:49.796:    Unsolicited Grant Size : 232
Mar 9 19:28:49.796:    Nominal Grant Interval : 20000
Mar 9 19:28:49.796:    Tolerated Grant Jitter : 800
Mar 9 19:28:49.796:    Grants Per Interval : 1
Mar 9 19:28:49.796: Found Upstream Packet Classifier TLV
Mar 9 19:28:49.796:    Classifier Reference : 1
Mar 9 19:28:49.796:    Service-Flow Reference : 1
Mar 9 19:28:49.796:    Rule Priority : 128
Mar 9 19:28:49.796:    Activation State : 0
Mar 9 19:28:49.796:    Found IP Packet Classifier Sub-TLV
Mar 9 19:28:49.796:            Protocol : 17
Mar 9 19:28:49.796:            Source Address : 24.34.240.235
Mar 9 19:28:49.796:            Destination Address : 24.34.240.247
Mar 9 19:28:49.796:            Source Port Start : 53456
Mar 9 19:28:49.796:            Source Port End : 53456
Mar 9 19:28:49.796:            Destination Port Start : 53456
Mar 9 19:28:49.796:            Destination Port End : 53456
```

Mac-add of CM

DSA REQ Received

Admit Service Flow only

US Scheduling type UGS

Std. UGS size for G.711/20ms

20 ms grant interval

Classifier not active yet

RTP port numbers

Voice Services

Debug cable dynsrv & Debug cable tlvs

```
Mar 9 19:28:49.796: Found Downstream Service Flow TLV
Mar 9 19:28:49.796:    Service Flow Reference : 2
Mar 9 19:28:49.796:    QoS Parameter Set Type : 0x2
Mar 9 19:28:49.796:    Traffic Priority : 5
Mar 9 19:28:49.796:    Maximum Sustained Traffic Rate : 87200
Mar 9 19:28:49.796:    Maximum Traffic Burst : 1522
Mar 9 19:28:49.796:    Minimum Reserved Traffic Rate : 87200
Mar 9 19:28:49.796:    Minimum Reserved Rate Packet Size : 218
Mar 9 19:28:49.796: Found Downstream Packet Classifier TLV
Mar 9 19:28:49.796:    Classifier Reference : 2
Mar 9 19:28:49.796:    Service-Flow Reference : 2
Mar 9 19:28:49.796:    Rule Priority : 128
Mar 9 19:28:49.796:    Activation State : 0
Mar 9 19:28:49.796:    Found IP Packet Classifier Sub-TLV
Mar 9 19:28:49.796:            Protocol : 17
Mar 9 19:28:49.796:            Source Address : 24.34.240.247
Mar 9 19:28:49.796:            Destination Address : 24.34.240.235
Mar 9 19:28:49.796: Auth Block:
Mar 9 19:28:49.796: 0x0000: 01 06 01 04 00 00 14 3E
Mar 9 19:28:49.796: Sfref = 1, SFID = 103 <- Service Flow IDs assigned by CMTS
Mar 9 19:28:49.796: Sfref = 2, SFID = 104
Mar 9 19:28:49.796: Cfr-ref = 1, CFID = 33, SF-ref 1, SFID 103
Mar 9 19:28:49.796: Cfr-ref = 2, CFID = 34, SF-ref 2, SFID 104
Mar 9 19:28:49.796: DSA-RSP-SENT: CM->0013.1050.3801 TranscId->89 ConfCode->0
Mar 9 19:28:49.896: DSA-ACK-RECD: OrgMac->0013.1050.3801 OrgId->89 ConfCode->0
Mar 9 19:28:50.196: DSA-REQ End : Transaction over-T8 timer expired. OrgMac->0013.1050.3801 OrgId->89
Mar 9 19:28:50.196: DYN-SRV-STATE-DESTROYED : OrgMac->0013.1050.3801 OrgId->89
```

Admit Service Flow only

DS service flow with high priority

DQOS Gate ID contained here

SFID assigned for US and DS

DSA Response sent and ACK received

Voice Services

Service Flow Verification

Dynamic Service Flow

Alternative: Show interface cable *slot/subslot/port* service-flow sfid verbose

```
CBR8-01# show cable modem 0000.cad6.eeb6 service-flow verbose
Sfid                                    : 143
Mac Address                             : 0000.cad6.eeb6
Type                                    : Secondary(Dynamic)
Direction                               : Downstream
Current State                           : Active
Current QoS Indexes [Prov, Adm, Act]    : [0, 11, 11]
Active Time                             : 24:02
Sid                                     : N/A
Traffic Priority                        : 5
Minimum Reserved Rate                   : 87200 bits/sec
Admitted QoS Timeout                    : 200 seconds
Current Throughput                      : 87254 bits/sec, 50 packets/sec
Application Priority       : 3
Classifiers:
Classifier Id                       : 79
Service Flow Id                     : 143
CM Mac Address                      : 0000.cad6.eeb6
Direction                           : downstream
Activation State                    : active
Classifier Matching Priority        : 128
PHSI                                : 0
Number of matches                   : 72112
IP Classification Parameters:
       IP Source Address            : 14.80.82.7
       Source IP Address Mask       : 255.255.255.255
       Destination IP Address       : 14.80.82.141
       Destination IP Address Mask  : 255.255.255.255
```

DS dynamic service flow

DS Service Flow

High Priority for DS flow

Min Reserve rate

Current throughput

Source IP of DS flow

Destination IP of DS flow

Voice Troubleshooting

Dynamic Service Flow

- show interfaces c1/0/0 dynamic-service statistics
- show cable admission-control interface cable *slot/sub/port* upstream *up-number*

Dynamic Service Flow Statistics

```
CBR8-01# show interfaces c1/0/0 dynamic-service statistics
             Upstream         Downstream
DSA REQ      6647             0
DSA RSP      0                6865
DSA ACK      6823             0
DSC REQ      12014            0
DSC RSP      0                12028
DSC ACK      12025            0
DSD REQ      6627             37
DSD RSP      20               6627
Retransmission counts
             Upstream         Downstream
DSA REQ      9                0
DSA RSP      0                227
DSA ACK      154              0
DSC REQ      0                0
DSC RSP      0                14
DSC ACK      10               0
DSD REQ      6                23
DSD RSP      2                6
```

REQ and RES should be similar (pairing)

Retransmissions are normal, but make sure it's not excessive

Service Flow Reservations and Statistics

```
CBR8-01# show cable admission-control int c1/0/0 up 0
Interface  Cable1/0/0
Upstream # 0

Upstream Bit Rate (bits per second) = 30720000
     Sched Table Rsv-state: Grants 0, Reqpolls 0
     Sched Table Adm-state: Grants 0, Reqpolls 18, Util 0%
     UGS    : 12 SIDs, Reservation-level in bps 0
     UGS-AD : 0 SIDs, Reservation-level in bps 0
     RTPS   : 0 SIDs, Reservation-level in bps 0
     NRTPS  : 18 SIDs, Reservation-level in bps 301410
     BE     : 70 SIDs, Reservation-level in bps 0
Maximum AC reservable bandwidth is not configured
```

Can specify bonding-group too

Use this to check number of Sflows

Voice Troubleshooting

Dynamic Service Flow

- show interfaces c1/0/0 dynamic-service statistics
- show cable admission-control interface cable *slot/subslot/port* upstream *up-number*

Dynamic Service Flow Statistics

```
CBR8-01# show interfaces c1/0/0 dynamic-service statistics
             Upstream        Downstream
DSA REQ      6647            0
DSA RSP      0               6865
DSA ACK      6823            0
DSC REQ      12014           0
DSC RSP      0               12028
DSC ACK      12025           0
DSD REQ      6627            37
DSD RSP      20              6627
Retransmission counts
             Upstream        Downstream
DSA REQ      9               0
DSA RSP      0               227
DSA ACK      154             0
DSC REQ      0               0
DSC RSP      0               14
DSC ACK      10              0
DSD REQ      6               23
DSD RSP      2               6
```

REQ and RES should be similar (pairing)

Retransmissions are normal, but make sure it's not excessive

Service Flow Reservations and Statistics

```
CBR8-01# show cable admission-control int c1/0/0 up 0
Interface  Cable1/0/0
Upstream # 0

Upstream Bit Rate (bits per second) = 30720000
     Sched Table Rsv-state: Grants 0, Reqpolls 0
     Sched Table Adm-state: Grants 0, Reqpolls 18, Util 0%
     UGS     : 12 SIDs, Reservation-level in bps 0
     UGS-AD  : 0 SIDs, Reservation-level in bps 0
     RTPS    : 0 SIDs, Reservation-level in bps 0
     NRTPS   : 18 SIDs, Reservation-level in bps 301410
     BE      : 70 SIDs, Reservation-level in bps 0
Maximum AC reservable bandwidth is not configured
```

Can specify bonding-group too

Use this to check number of Sflows

DS Bonding Resiliency

You make networking **possible**

DS Bonding Resiliency

- Bonded CM operation without resiliency
- DOCSIS 3.0 allows CMTS to transmit on Primary and NP RF channels
- If CM lose connectivity to Primary RF, CM goes offline
- If CM lose connectivity to NP RF, there will be data loss
- CM informs NP RF failure/recovery via CM-STATUS message
- CMTS/CM behavior with DS Bonding Resiliency
- RBG contains all RFs of original BG except the failed RFs
- Move primary DS Service Flow for CM to its dynamic RBG with 2 or more RFs
- Secondary SFs to dynamic RBG if configured with “Cable rf-change-trigger secondary” command
- CM remains in p-online state for tracking

Config and Debugs for DS-Bonding Resiliency

DS Resiliency Configuration

```
cable rf-change-trigger percent 75 count 10
!
cable resiliency ds-bonding
```

Rf-change-trigger % and count of CM

Global Configuration Required

```
interface Wideband-Cable8/1/1:0
cable bundle 1
cable rf-channel 0 bandwidth-percent 1
cable rf-channel 1 bandwidth-percent 1
cable rf-channel 2 bandwidth-percent 1
cable rf-channel 3 bandwidth-percent 1
<SNIP>
cable rf-channel 15 bandwidth-percent 1
```

Static Bonding Group (Not the DS Bonding Resiliency BG)

```
interface Wideband-Cable8/1/1:8
cable ds-resiliency
!
interface Wideband-Cable8/1/1:9
cable ds-resiliency
!
interface Wideband-Cable8/1/1:10
cable ds-resiliency
```

DS Bonding resiliency enabled under BG

Debugs Used

Debugs for wideband resiliency

```
debug cable wbcmts resiliency
debug cable interface c8/1/1 mac-address 001d.d4d3.3122
```

All channels are up in BG

```
SLOT 8/1: Mar 26 16:40:06.183 EDT: CM 001d.d4d3.3122 n_rfch 15 CM_RFID 5215
SLOT 8/1: Mar 26 16:40:06.183 EDT:    r 0 state UP[11] rfid 5208
SLOT 8/1: Mar 26 16:40:06.183 EDT:    r 1 state UP[11] rfid 5209
SLOT 8/1: Mar 26 16:40:06.183 EDT:    r 2 state UP[11] rfid 5210
<SNIP>
SLOT 8/1: Mar 26 16:40:06.183 EDT:    r 14 state UP[11] rfid 5223
SLOT 8/1: Mar 26 16:40:06.183 EDT:    r 15 state UP[11] rfid 5224
```

Debug shows all RF-Channels are UP at the moment

DS Bonding Resiliency Debugs

One DS Channel down

```
SLOT 8/1: Mar 26 16:40:13.203 EDT: handle_wb_rf_resil_event: 001d.d4d3.3122 n_rfch 15, event 2 n_ds_chid 1
SLOT 8/1: Mar 26 16:40:13.203 EDT:      ds_chid 200 mc_info channel_id 200
SLOT 8/1: Mar 26 16:40:13.203 EDT:  send_docsis_resil_event_trap: now sending docsis_resil event trap.
SLOT 8/1: Mar 26 16:40:13.203 EDT:  no permit, bit=80, bitmap=0
SLOT 8/1: Mar 26 16:40:16.191 EDT: CM 001d.d4d3.3122 n_rfch 15 CM_RFID 5215
SLOT 8/1: Mar 26 16:40:16.191 EDT:      r 0 state DOWN_PENDING[41] rfid 5208
<SNIP>
SLOT 8/1: Mar 26 16:40:16.191 EDT:      r 14 state UP[11] rfid 5223
SLOT 8/1: Mar 26 16:40:16.191 EDT:      r 15 state UP[11] rfid 5224
```

Channel went down for CM because of impairments

RBG comes up with remaining channels

```
018110: Mar 26 16:41:26.343 EDT: RESIL-IPC-RP: 001d.d4d3.3122, receiving 757 bytes
018111: Mar 26 16:41:26.343 EDT: RESIL-RP: message type 1
018112: Mar 26 16:41:26.343 EDT: RESIL-RP: tlv_len 740, RESIL-RP: bitmask down: 24
018113: Mar 26 16:41:26.343 EDT: RESIL-RP: current_interface 6952
018114: Mar 26 16:41:26.343 EDT:  RP GOT REQUEST TO MOVE CM
<SNIP>
Original active RF members: 24-39
Needed RF members: 25-39
Down RF members: 24
Avail RF members: 25-39
018139: Mar 26 16:41:26.347 EDT: Find Best DBG: for 8/1/1:0 needed RF member: 25-39
018140: Mar 26 16:41:26.347 EDT: cmts_rf_resil_rp_dbg_get_unused(): WB Index checking match 8/1/1:8
018141: Mar 26 16:41:26.347 EDT: cmts_rf_resil_rp_dbg_get_unused(): WB Index was found to be free 8/1/1:8
Found free DBG to use,requesting create RF member: 25-39
018142: Mar 26 16:41:26.347 EDT:  Creating Dyn WB interface 8/1/1:8 with bundle 1
 Needed RF: 25-39
<SNIP>
018157: Mar 26 16:41:26.351 EDT: WB msg type 169 sent to LC 8/1
018158: Mar 26 16:41:26.351 EDT: %SNMP-5-LINK_UP: LinkUp:Interface Wideband-Cable8/1/1:8 changed state to up
```

Modem Resiliency move necessary

RP to look for RBG for Wi 8/1/1:0

Dynamic WB intf. Created for RBG

WB RBG with remaining chans. Comes up

DS Bonding Resiliency Show Commands

Show cable rf-status

```
 Logical  Suspend  Suspend  Flap  Flap
RF        Status   Status   Fails Count Time
--------  -------  -------  ----- ----- ----
8/1/1 0   DOWN     N/A      0        22     Mar 24 19:15:57
      1   UP       N/A      0        3      Mar 24 19:15:57
      2   UP       N/A      0        0
      <SNIP>
      15  UP       N/A      0        0
```

1st Channel went down

Flap Fail and Count

Show cable resiliency

```
F241-38-05-uBR10K-01#show cable resiliency
              BG   Resil BG                                  RF
Resil BG I/F  ID   State           Count Time            Ctrl  Num
------------- ---- --------------- ----- --------------- ----------
Wi8/1/1:8     6953 Assigned        3     Mar 26 16:41:26 1     1
                                                               2
                                             ...
                                                               15
Wi8/1/1:9     6954 Assigned        1     Mar 26 17:11:32 1     0
                                                               15
```

Current chans in a RBG, 15 channel (no rf-ch 0)

Show cable modem resiliency

```
F241-38-05-uBR10K-01#show cable modem resiliency
                        Orig BG                      Curr BG
I/F     MAC Address     ID   I/F               RFs ID   I/F                RFs
------- --------------- -------------------------- --------------------------
C8/1/1  001d.d4d3.3122  6952 Wi8/1/1:0         16  6953 Wi8/1/1:8          15
C8/1/1  001d.d4d3.31d2  6952 Wi8/1/1:1         16  6954 Wi8/1/1:9          15
```

Resiliency WB running config

```
interface Wideband-Cable8/1/1:8
cable bundle 1
cable ds-resiliency
cable rf-channel 1 bandwidth-percent 1
cable rf-channel 2 bandwidth-percent 1
<SNIP>
cable rf-channel 15 bandwidth-percent 1
```

```
interface Wideband-Cable8/1/1:9
cable bundle 1
cable ds-resiliency
cable rf-channel 0 bandwidth-percent 1
cable rf-channel 2 bandwidth-percent 1
<SNIP>
cable rf-channel 15 banddith-percent 1
```

Show cable modem partial-service

```
F241-38-05-uBR10K-01#show cable modem partial-service
MAC Address     IP Address I/F       MAC             DSxUS
Impaired        Impaired   State     State           DS     US
001d.d4d3.3122  ---        C8/1/1/UB p-online(pt)    15x4
001d.d4d3.31d2  ---        C8/1/1/UB p-online(pt)    15x4
```

Channels in old and new BG for a CM

