



CMTS Operational Monitoring and Verification

Cable Access Business Unit

John Downey

4/24/15

Agenda

- Modem States
- DS & US Partial Mode
- Service Flow State
- IPV4 or 6
- Chassis CPU & Memory
- Linecard CPU & Memory
- New 1x1 Battery Mode
- Utilization Verification

Troubleshooting 101

Seven Layer OSI model

• 7 = Application	all	away
• 6 = Presentation	people	pizza
• 5 = Session	seem	sausage
• 4 = Transport	to	throw
• 3 = Network	need	not
• 2 = Data	data	do
• 1 = Physical	packets	please

- **Start at layer 1**

- **Now move to Layers 2-4**

Modem States

CM Online States

online	CM has registered and is enabled to pass data on network.
online(d)	CM registered, but network access for CPE devices using this CM has been disabled through DOCSIS config file. CM does not forward traffic to/from CPE devices, but CMTS can continue to communicate with CM using DOCSIS messages and IP traffic (such as SNMP commands). Note: If BPI was enabled in DOCSIS config file sent to CM, assume that CM is using BPI encryption, unless other messages show that BPI negotiation and key assignments have failed.
online(pk)	CM registered, but network access for CPE devices using this CM has been disabled through DOCSIS config file. In addition, BPI is enabled and KEK is assigned. Note: This state is equivalent to online(d) and online(pk) states.
online(pt)	CM registered, but network access for CPE devices using this CM has been disabled through DOCSIS config file. In addition, BPI is enabled and TEK is assigned. BPI encryption is now being performed. Note: This state is equivalent to online(d) and online(pt) states.
online(pk)	CM registered, BPI is enabled and KEK is assigned.
online(pt)	CM registered, BPI is enabled and TEK is assigned. BPI encryption is now being performed. Note: If network access was disabled in DOCSIS config file sent to CM, network disabled status takes precedence, and MAC status field shows online(d) instead of online(pt) even when BPI encryption is enabled and operational.
w-online(pt)	CM registered wideband/D3.0 DS bonding. BPI is enabled and TEK is assigned. BPI encryption is now being performed.
p-online(pt)	CM registered D3.0 DS bonding partial mode. BPI is enabled and TEK is assigned. BPI encryption is now being performed.

Note: If an exclamation point (!) appears in front of online states, it indicates that [cable dynamic-secret](#) command has been used with either mark or reject option and CM has failed dynamic secret authentication.

Show Cable Modem

```
10k#scm c8/0/0
```

MAC Address	IP Address	I/F	MAC State	Prim Sid	RxPwr dBmv)	Timing Offset	Num CPE	I P
1859.3353.095e	10.10.0.16	C8/0/0/UB	w-online (pt)	1	1.50	1977	1	N
1859.3353.09e4	10.10.0.10	C8/0/0/UB	w-online (pt)	3	2.00	1975	1	N
1859.3353.0b0e	10.10.0.39	C8/0/0/UB	w-online (pt)	4	1.50	1974	1	N
0018.689c.208e	10.10.0.82	C8/0/0/U1	online (pt)	5	2.00	1972	1	N
1859.3353.0aec	10.10.0.15	C8/0/0/UB	w-online (pt)	7	1.50	1978	1	N
2476.7dff.da3a	10.10.2.8	C8/0/0/UB	w-online (pt)	9	1.50	2263	1	N
1859.3353.0b26	10.10.0.14	C8/0/0/UB	w-online (pt)	12	1.50	1970	0	N
1859.3353.0b18	10.10.0.29	C8/0/0/U2	offline	13	!0.00	1906	0	N

```
10k#show cable privacy hotlist cm
```

MAC Address	Last Ranged	Type	Interface
0000.cadb.2f56	Dec 10 17:06:45	Permanent	C3/0/0
0019.47a0.6038	Dec 10 16:58:26	Permanent	C3/0/0

- May need global command; cable privacy clone-detect

Ping and DOCSIS Ping

- Ping is layer 3 communication and will be short, long, a-short, or a-long burst settings depending on packet size
 - Ping “ip address”
 - Extended ping also good to use
 - Can change source, frame size, amount, ...
- DOCSIS ping is layer 1 to CM using SM burst
 - Can use mac address or IP address
 - Ping docsis
 - Verbose also available
- Good/bad difference between both pings could be mod profile settings
- CSCuh41631 - Ping DOCSIS and Reporting while Modem Doing USCB

Ping

- 10k#ping 10.10.1.250

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.1.250, timeout is 2 seconds:

!!!!!!

- 10k#ping

```
Protocol [ip]:
```

```
Target IP address: 10.10.1.250
```

Repeat count [5]: 100

```
Datagram size [100]: 1500
```

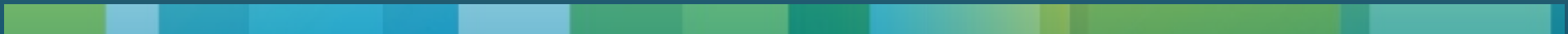
```
Timeout in seconds [2]: 1
```

Extended commands [n]:

Sweep range of sizes [n]:

Type escape sequence to abort.

! !



Ping Docsis

- 10k#ping docsis ?

A.B.C.D Modem IP address
H.H.H Modem MAC address
X:X:X:X::X IPv6 address of this modem
name Domain name

- 10k#ping docsis 68ee.9631.b27b ?

repeat Number of maintenance intervals to queue
verbose Line-by-line output
<cr>

- 10k#ping docsis 68ee.9631.b27b repeat 10 verbose

Queueing 10 MAC-layer station maintenance intervals, timeout is 25 msec:
Reply from 68ee.9631.b27b: 16 upstream, 46 ms, tadj=0, padj=0.50, fadj=26
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=68
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=14
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=9
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=36
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=0
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=14
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=31
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=12
Reply from 68ee.9631.b27b: 16 upstream, 50 ms, tadj=0, padj=0.50, fadj=0
Success rate is 100 percent (10/10)

SCM Wideband Channel

- 10k#show cable modem wideband ch

MAC Address	IP Address	I/F	MAC State	DSxUS	Primary WB
1859.3353.0b1e	10.10.0.32	C7/1/0/UB	w-online (pt)	8x4	Wi3/3/2:3
1859.3353.0b10	10.10.0.112	C7/1/0/UB	w-online (pt)	8x4	Wi3/3/2:2
1859.3353.0a5c	10.10.0.11	C7/1/0/UB	w-online (pt)	8x4	Wi3/3/2:4
1859.3353.095e	10.10.0.16	C7/1/0/UB	w-online (pt)	8x4	Wi3/3/2:2
68ee.9631.b27b	10.10.1.250	C7/1/0/UB	w-online (pt)	24x8	Wi3/3/2:1

- 10k#scm c7/1/6 wide ch

MAC Address	IP Address	I/F	MAC State	DSxUS	Primary WB
1859.3353.0b3e	10.10.1.169	C7/1/6/UB	p-online (pt)	4x4	Wi7/1/2:10
38c8.5cb6.63ca	10.10.1.255	C7/1/6/UB	p-online (pt)	4x4	Wi7/1/2:11

- cBR#scm w c | in UB.*x1

- Show modems in Mx1 mode, but still indicated as US bonding mode
 - Could be from US pwr level issues during registration or D3.0 US LB affect

Show Cable Modem Phy

- 10k#show cable modem 0018.689c.14ac phy

MAC Address	I/F	Sid	USPwr (dBmV)	USMER (SNR)	Timing Offset	DSPwr (dBmV)	DSMER (SNR)	Mode	DOCSIS Prov
0018.689c.14ac	C7/1/4/U1	231	32.70	27.25	1486	- 3.60	34.90	atdma	1.1

- DS info not displayed unless remote-query is configured and working properly
- US Tx level not reported unless remote-query working or:
 - CM in US bonding mode

- 10k#scm c7/1/0 phy

MAC Address	I/F	Sid	USPwr (dBmV)	USMER (SNR)	Timing Offset	DSPwr (dBmV)	DSMER (SNR)	Mode	DOCSIS Prov
0018.689c.1b12	C7/1/0/U1	33	41.70	38.86	1493	- 1.10	38.80	atdma	1.1
1859.3353.0b1e	C7/1/0/U0	57	38.00	39.07	1508	0.30	45.50	atdma*	1.1
1859.3353.0b1e	C7/1/0/U1	57	38.75	39.08	1494	0.30	45.50	atdma*	1.1
1859.3353.0b1e	C7/1/0/U2	57	37.75	36.64	1508	0.30	45.50	atdma*	1.1
1859.3353.0b1e	C7/1/0/U3	57	38.00	36.72	1508	0.30	45.50	atdma*	1.1

- * indicates US bonded mode and notice mac address listed 4 times

Show Cable Modem Remote-Query

- 10k#show cable modem remote-query

Remote Query Polling State : Active

IP address	MAC address	S/N	US	DS	Tx Time	SNMP
		Ratio	Power	Power	Offset	Request
10.10.0.112	1859.3353.0b10	44.8	39.5	0.2	1489	YES
10.10.0.83	0018.689c.1a16	42.3	40.7	-1.5	9076	YES
10.10.0.111	1859.3353.0b00	46.5	39.3	0.0	1486	YES

- **Note:** Can't see CMs on certain interfaces, updates can take long time, time offsets misleading
- CSCtn83905 - cable modem remote-query doesn't report any info for ipv6 CMs
- CSCum81956 - add remote-query feature IPv6 support

SCM “mac address” Verbose

• 10k#scm 68ee.9631.b27b ver

..... •

Extended Upstream Transmit Power	:	0dB			
Multi-Transmit Channel Mode	:	Y			
Number of US in UBG	:	8			
Upstream Channel	:	US0	US1	US2	US3
Ranging Status	:	sta	sta	sta	sta
Upstream SNR (dB)	:	39.3	37.0	38.30	37.82
Upstream Data SNR (dB)	:	--	--	--	--
Received Power (dBmV)	:	0.50	0.50	0.50	0.50
Reported Transmit Power (dBmV)	:	39.50	39.50	39.50	39.50
Peak Transmit Power (dBmV)	:	48.00	48.00	48.00	48.00
Phy Max Power (dBmV)	:	48.00	48.00	48.00	48.00
Minimum Transmit Power (dBmV)	:	23.00	23.00	23.00	23.00
Timing Offset (97.6 ns)	:	1767	1768	1767	1767
Initial Timing Offset	:	1767	1511	1511	1511
Rng Timing Adj Moving Avg(0.381 ns)	:	0	0	0	0
Rng Timing Adj Lt Moving Avg	:	0	0	0	0
Rng Timing Adj Minimum	:	0	0	0	0
Rng Timing Adj Maximum	:	256	65792	65536	65536
Pre-EQ Good	:	546	542	542	541
Pre-EQ Scaled	:	0	0	0	0
Pre-EQ Impulse	:	0	0	0	0
Pre-EQ Direct Loads	:	0	0	0	0
Good Codewords rx	:	916	701	707	714
Corrected Codewords rx	:	0	0	0	0
Uncorrectable Codewords rx	:	0	0	0	0
Phy Operating Mode	:	atdma*	atdma*	atdma*	atdma*
Upstream Channel	:	US4	US5	US6	US7
Ranging Status	:	sta	sta	sta	sta
Upstream SNR (dB)	:	36.53	37.75	37.98	38.2

D3.0 Modems Registered in D2.0 Mode

```
10k#show cable modem wideband registered-traditional-docsis
MAC Address      IP Address      I/F      MAC      Prim RCC MD-DS-SG/
                IP Address      I/F      State      Sid  ID  MD-US-SG
1859.3353.0b18  10.10.0.29    C7/1/1/U0  online(pt) 1270 1   1 / 1
1859.3353.09b0  10.10.0.18    C7/1/1/U1  online(pt) 1253 1   1 / 1
1859.3353.0adc  10.10.0.21    C7/1/1/U3  online(pt) 1255 1   1 / 1
1859.3353.0ad6  10.10.0.28    C7/1/1/U2  online(pt) 1245 1   1 / 1
```

- D3.0 CMs “online” are basically in D2.0/single-ch mode
- May not complain because CM is online, but QoS will suffer
- Could do `scm ver | in Tuner` to see CM capability
- CMs will participate in D2.0 LB
 - Can wreak havoc on load balance
- CMs with high level QoS will “eat” limited capacity and potentially “starve out” legitimate D2.0 CMs
- **Note:** CMs could be w-online but D2.0 on US
 - Lose mtc-mode CCF, but gain US LB & DS LB will use DCC vs DBC

DS & US Partial Mode

Partial Mode & Wideband CM Distribution

- Scm partial-mode
- Scm partial-service
- Scm cm-status
- Show cable resiliency
- Show cable modem resiliency
- Scm wide ch
- Show cable mac-domain cx/y/z rcc
- Scm <mac> wide rcs ver

DS Partial Mode

- “Trigger” command needed to even process cm-status messages
 - `cab rf-change-trigger percent 50 count 10 secondary`
 - This was first attempt at resiliency - very limited in that CMs in p-online were either sending all their traffic down their primary or forcing everyone to go to less DSs once thresholds were met
 - All CMs in p-online leading up to threshold will still be sending their traffic down their primary and only CMs after threshold will actually do subset
 - CMs can come out of p-online automatically when a cm-status message reports “good” and can go back to w-online without intervention
 - Plus, it is easier to track CMs listed as p-online
- `10k(config-if)#cab cm-status enable ?`
 - `<group>` CM-STATUS event list to enable
 - 3 Sequence out of range
 - 6 T4 timeout
 - 7 T3 re-tries exceeded
 - 8 Successful ranging after T3 re-tries exceeded
 - 9 CM operating on battery backup
 - 10 CM returned to A/C power
 - Only 3 is on by default depending on IOS

Resilient Bonding Groups (RBGs)

- Feature was added in SCG IOS and works in conjunction with “trigger” command
 - Much more flexible
 - Recommend higher threshold for “trigger” command
 - Need to keep eye on CMs “thrashing” and CPU affect
- `(config)#cable resiliency ds-bonding`
- `(config)#interface wideband-cable x/y/z:a`
`(config-if)#cable ds-resiliency`
- **Note:** Without “trigger or RBG, CMs should cycle on and off when cm-status bad
 - DDTS – CSCur93878
 - Potential work-around - `no cable cm-status enable 3`
- Once CM picks BG, RBG will not intervene and place it in bigger BG later
 - BGs must be created properly manually and CM should pick biggest it can handle assuming steered properly, if need be
 - When CM locks on primary DS, CM only “sees” BGs that primary is part of

US Partial Mode

- On by default
- Much easier for CMTS to control on US vs DS
 - CMTS schedules minislots and can mark per-CM US up or down

• scm 1859.334e.82c4 ver

MAC Address	:	1859.334e.82c4			
IP Address	:	10.10.0.210			
Prim Sid	:	62			
Host Interface	:	C7/1/4/UB			
MD-DS-SG / MD-US-SG	:	1 / 1			
Primary Wideband Channel ID	:	2726 (Wi7/1/1:5)			
Primary Downstream	:	Mo7/1/1:10 (RfId : 2050)			
Wideband Capable	:	Y			
UDC Enabled	:	N			
Extended Upstream Transmit Power	:	0dB			
Multi-Transmit Channel Mode	:	Y			
Number of US in UBG	:	4			
Upstream Channel	:	US0	US1	US2	US3
Ranging Status	:	sta	sta	sta	sta
Upstream SNR (dB)	:	39.7	39.8	39.3	37.89
Upstream Data SNR (dB)	:	--	--	--	--
Received Power (dBmV)	:	0.00	0.00	0.00	-0.50
Reported Transmit Power (dBmV)	:	32.00	32.00	32.00	32.00
Peak Transmit Power (dBmV)	:	51.00	51.00	51.00	51.00

SCM Partial-Mode & Service

- 10k#show cable modem partial-mode

MAC Address	IP Address	I/F	MAC State	Prim Sid	RCC ID	UP-reason/ Failed-tcs
1859.3353.0b3e	10.10.1.169	C7/1/6/UB	p-online (pt)	72	2	N/A
38c8.5cb6.63ca	10.10.1.255	C7/1/6/UB	p-online (pt)	78	2	N/A
1859.3353.0a18	10.10.0.228	C7/1/7/UB	p-online (pt)	2	1	N/A
1859.3353.09c2	10.10.0.219	C7/1/7/UB	p-online (pt)	5	1	N/A

- 10k#show cable modem partial-service

MAC Address	IP Address	I/F	MAC State	DSxUS	Impaired DS	Impaired US
54d4.6ffb.2e1b	40.4.58.23	C7/1/0/p	p-online (pt)	3x1	Mo1/3/0:1 Mo1/3/0:2	0,1
1859.3353.0b3e	10.10.1.169	C7/1/6/UB	p-online (pt)	4x4	7/1/2:16 7/1/2:17 7/1/2:18 7/1/2:19	
1859.3353.0a18	10.10.0.228	C7/1/7/UB	p-online (pt)	7x3	7/1/2:12	

- 10k#show cable modem 38c8.5cb6.63ca primary-channel

MAC Address	IP Address	Host Interface	MAC State	Prim Sid	Num CPE	Primary Downstream	DS RfId
38c8.5cb6.63ca	10.10.1.255	C7/1/6/UB	p-online (pt)	78	0	Mo7/1/2:7	2071

SCM “mac” Wide RCS-Status

- 10k#scm 38c8.5cb6.63ca wide
rcs-status

CM : 38c8.5cb6.63ca

RF : 7/1/2 4

Status : UP
FEC/QAM Failure : 0
Dup FEC/QAM Failure : 0
FEC/QAM Recovery : 0
Dup FEC/QAM Recovery : 0
MDD Failure : 0
Dup MDD Failure : 0
MDD Recovery : 0
Dup MDD Recovery : 0
Flaps : 0
Flap Duration : 00:00

RF : 7/1/2 5

Status : UP
Flap Duration : 00:00

RF : 7/1/2 6

Status : UP
Flap Duration : 00:00

RF : 7/1/2 16

Status : DOWN
FEC/QAM Failure : 1 Mar 25 18:37:15
Dup FEC/QAM Failure : 0
FEC/QAM Recovery : 0
Dup FEC/QAM Recovery : 0
MDD Failure : 0
Dup MDD Failure : 0
MDD Recovery : 0
Dup MDD Recovery : 0
Flaps : 1
Flap Duration : 12:40

RF : 7/1/2 17

Status : DOWN
FEC/QAM Failure : 1 Mar 25 18:37:15
Flaps : 1
Flap Duration : 12:40

RF : 7/1/2 18

Status : DOWN
FEC/QAM Failure : 1 Mar 25 18:37:15
Flaps : 1
Flap Duration : 12:40

RF : 7/1/2 19

Status : DOWN
FEC/QAM Failure : 1 Mar 25 18:37:15
Flaps : 1
Flap Duration : 12:40

Note: Primary DS not shown

Service Flow State

Stale Service Flows

- Some flows not torn down according to T8 timer
- `cable service flow activity-timeout 300`
 - ✓ Add to CMTS global config so flows with no activity > 300 seconds are torn down if CM/eMTA does not do it automatically
 - **Note:** CSCuc42208 - voice calls drop after 5 minutes on Arris 822A, TG852/862 WB CMs reported in SCE2, SCF3, SCF5
- Manual process to clean up dynamic service flows not passing traffic (US and DS)
 - ✓ Needs to be done on all DS interfaces
- `show int cable 5/0/0 service-flow | inc S\(s\) US.*d`
 - ✓ Will show dynamic service flows (d or s depending on code) that have been up for days
 - ✓ The \ is needed to include (and the .* is a wildcard till a "d" is seen
- `sh int c5/0/0 serv 1321 count verbose`
 - ✓ Used to verify no bit rate before tearing down
- `test cable "docsis" dsd "mac address" "service flow"`
 - ✓ Used for dynamic service flow deletion

Verify Bonded Service Flows

- CMTS bonds service flow, not modem
- CM can report 8x4 when doing scm wide ch command, but that is the physical chs it is using, not necessarily actual bonding taking place
 - Need to look at service flow ver to verify if BE flow is doing full ch bonding or you have 2 flows using 2, 4-ch BGs

```
#sh cab modem 1855.0ff0.17bd wide ch
MAC Address      IP Address  I/F          MAC          DSxUS Primary
                  State      WB
1855.0ff0.17bd 10.10.2.11  C8/0/0/UB    w-online(pt) 16x4  Wi8/0/0:0
```

```
#sh cab modem 1855.0ff0.17bd service-flow ver | in Forward
Forwarding interface: Wideband-Cable8/0/0:0
```

```
#sh cab modem 1855.0ff0.17bd service-flow ver | in Bonding
Upstream Bonding Group          : UBG-800
```

```
#show cable modem wideband forwarding-summary
```

MAC Address	IP Address	Primary	FrwdIF	BG DS	Bonded	CM DS
		Downstream		Config	State	Capab
f81d.0f01.4bf0	10.8.0.140	Do2/0/0:0	Wi2/0/0:2	33	33	34
a84e.3f37.1238	10.8.0.139	Do2/0/5:16	Wi2/0/5:1	33	33	34
1859.334e.8984	10.8.0.75	In6/0/2:0	Wi6/0/2:1	8	8	8
1859.334e.8596	10.8.0.74	In6/0/2:8	Wi6/0/2:2	8	8	8
d43f.cbe1.82dd	10.8.0.143	In6/0/2:16	Wi6/0/2:0	33	33	34

Show Cable Upstream Service-Flow Summary

Interface	Static Upstream Service Flow							Dynamic Upstream Service Flow					Descrip
	Total	PRI	BE	UGS	UGS-AD	RTPS	N-RTPS	BE	UGS	UGS-AD	RTPS	N-RTPS	
C6/0/0/UB1	17	17	0	0	0	17	0	0	0	0	0	0	Cell-1
C6/0/0/UB2	17	17	0	0	0	17	0	0	0	0	0	0	Cell-2
C6/0/0/U0	8	4	4	0	0	4	0	0	0	0	0	0	N/A
C7/1/1/U0	7	7	7	0	0	0	0	0	0	0	0	0	
C7/1/1/U1	7	7	7	0	0	0	0	0	0	0	0	0	
C7/1/1/U2	8	8	7	0	0	0	0	0	0	0	0	0	
C7/1/1/U3	7	7	7	0	0	0	0	0	0	0	0	0	
C7/1/1/UB0	1	1	1	0	0	0	0	0	0	0	0	0	
C7/1/4/U0	8	8	8	0	0	0	0	0	0	0	0	0	
C7/1/4/U1	8	8	8	0	0	0	0	0	0	0	0	0	
C7/1/4/U2	8	8	8	0	0	0	0	0	0	0	0	0	
C7/1/4/U3	8	8	8	0	0	0	0	0	0	0	0	0	
C7/1/4/UB714	16	16	16	0	0	0	0	0	0	0	0	0	
C7/1/6/U0	15	15	15	0	0	0	0	0	0	0	0	0	
C7/1/6/U1	15	15	15	0	0	0	0	0	0	0	0	0	
C7/1/6/U2	17	17	17	0	0	0	0	0	0	0	0	0	
C7/1/6/U3	17	17	17	0	0	0	0	0	0	0	0	0	
C7/1/6/UB716	2	2	2	0	0	0	0	0	0	0	0	0	
C7/1/7/U0	10	10	10	0	0	0	0	0	0	0	0	0	
C7/1/7/U1	11	11	11	0	0	0	0	0	0	0	0	0	
C7/1/7/U2	11	11	11	0	0	0	0	0	0	0	0	0	
C7/1/7/UB717	16	16	16	0	0	0	0	0	0	0	0	0	
C8/0/0/U0	7	7	7	0	0	0	0	0	0	0	0	0	
C8/0/0/U1	8	8	8	0	0	0	0	0	0	0	0	0	
C8/0/0/U2	8	8	8	0	0	0	0	0	0	0	0	0	
C8/0/0/U3	9	9	8	0	0	0	0	0	0	0	0	0	
C8/0/0/UB800	17	17	17	0	0	0	0	0	0	0	0	0	
Total:	305	305	303	0	0	0	0	0	0	0	0	0	

Show Cable Modem TCS Summary

Interface	Cable Modem						TCS	USCB
	Total	Reg	Oper	Unreg	Offline	Wideband		
C5/0/0/U0-1	32	32	32	0	0	32	768	1
C5/0/0/U2-3	94	94	94	0	0	94	3072	2
C5/0/0/U4-5	32	32	32	0	0	32	12288	3
C5/0/0/U6-7	50	50	50	0	0	50	49152	4
C7/1/1/U0.0,1.0,2.0,3.0	16	16	16	0	0	16	3840	711
C7/1/1/U0.0	7	7	7	0	0	0		
C7/1/1/U0.1	1	1	1	0	0	0		
C7/1/1/U1.0	7	7	7	0	0	0		
C7/1/1/U2.0	7	7	7	0	0	0		
C7/1/1/U3.0	8	7	7	1	1	0		
C7/1/7/U0-2	16	16	16	0	0	16	1792	717
C7/1/7/U0	10	10	10	0	0	0		
C7/1/7/U1	11	11	11	0	0	0		
C7/1/7/U2	11	11	11	0	0	0		
C8/0/0/U0-3	17	17	17	0	0	17	3840	800
C8/0/0/U0	7	7	7	0	0	0		
C8/0/0/U1	8	8	8	0	0	0		
C8/0/0/U2	8	8	8	0	0	0		
C8/0/0/U3	9	8	8	1	0	0		
Total:	321	313	313	8	2	67		

SID Depletion

- CMTS has 8175 SIDs per mac domain
- Every US service flow uses a separate unique SID
- Assuming an average of 2.3 SIDs per CM
 - Some are dynamic flows and others are nailed up for signaling & BE
 - That could be limited to ~3500 CMs per service group
- We support more service flows if used for multicast
- D3.0 US bonding can use same SID, but sid cluster setting may allow more
- In worst case scenario; 8 USs in a mac domain, utilizing DSG for settop boxes with typical 2 STBs and 1 CM per house, and stale service flows
 - SID exhaustion could be realized

IPV4 vs IPV6

Chassis CPU & Memory

Route Processor CPU

• Sh Proc cpu sorted 5sec | ex 0.00%

CPU utilization for five seconds: 16%/4%; one minute: 13%; five minutes: 12%

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
149	19869308	3436820	5781	4.15%	3.85%	3.85%	0	CR10K5 Radian Pr
8	529960	89389	5928	1.19%	0.15%	0.08%	0	Check heaps
91	109352	785150	139	0.87%	0.46%	0.12%	0	DHCPD Receive
52	617204	2730778	226	0.63%	0.49%	0.48%	0	Net Background
126	1804728	8159135	221	0.63%	0.39%	0.33%	0	CR10K Request di
134	3804712	616039	6176	0.63%	0.67%	0.67%	0	CR10K5 BCM84754
401	841576	8034391	104	0.47%	0.55%	0.52%	0	L2TP mgmt daemon
33	69472	203568	341	0.47%	0.13%	0.03%	0	ARP Input
139	905896	28229452	32	0.31%	0.24%	0.18%	0	C10K BPE IP Enqu
122	87156	191293	455	0.31%	0.23%	0.11%	0	CMTS SID mgmt ta
102	29500	1755589	16	0.15%	0.11%	0.10%	0	Fault Manager
202	104796	5155843	20	0.15%	0.11%	0.05%	0	IP Input
261	201244	624036	322	0.15%	0.11%	0.10%	0	c10k_periodic_st
343	442032	130862	3377	0.15%	0.09%	0.10%	0	DiagCard0/-1
201	48672	91222	533	0.07%	0.10%	0.03%	0	IP ARP Adjacency
105	59072	360437	163	0.07%	0.11%	0.10%	0	Environment Moni
101	59572	151075	394	0.07%	0.03%	0.02%	0	HC Counter Timer
249	40204	7507403	5	0.07%	0.05%	0.07%	0	DEPI Application
464	55576	1615671	34	0.07%	0.06%	0.02%	0	ReqXmt 7/1: defa
399	56536	756496	74	0.07%	0.10%	0.08%	0	CMTS ACFE Proces

Route Processor Memory

- Sh processes memory sorted

```
Processor Pool Total: 3390117548 Used: 751121156 Free: 2638996392
      I/O Pool Total: 159383552 Used: 62036192 Free: 97347360
Transient Pool Total: 16777216 Used: 30180 Free: 16747036
```

PID	TTY	Allocated	Freed	Holding	Getbufs	Retbufs	Process
0	0	760830360	27206128	672439072	0	0	*Init*
128	0	110234512	986256	108885136	0	0	C10K SPUMONI SPA
122	0	32768076	46005896	3308964	0	0	CMTS SID mgmt ta
109	0	2589136	0	2596284	0	0	Dynamic Services
0	0	537102124	589493248	2437636	17463660	8504	*Dead*
126	0	2433801428	3674990568	2189772	0	0	CR10K Request di
193	0	4214988	2101072	2175064	0	0	TurboACL
139	0	221939668	0	1913036	0	0	C10K BPE IP Enqu
401	0	1857459388	1473683796	1841232	0	0	L2TP mgmt daemon
163	0	6844604	5007556	1816608	0	0	tENM
249	0	4243166060	329932572	1111396	0	0	DEPI Application
28	0	1113848	940	713584	0	0	IPC Seat Control
0	0	0	0	705312	0	0	*MallocLite*
201	0	1902088	1544888	590920	0	0	IP ARP Adjacency
39	0	650224	123800	533572	0	0	Entity MIB API
9	0	652284	1291868	506648	524232	726180	Pool Manager
403	0	126282500	126518952	500088	0	0	HCCP_LC_CTRL
345	0	489472	3744	471328	0	0	SEA main process
332	0	8329980	10927544	369296	0	0	CMTS Multicast Q
1	0	468508	1293972	358704	0	0	Chunk Manager
241	0	1101504	785128	329524	0	0	IP RIB Update

Linecard CPU & Memory

Linecard CPU

- Sh contr c7/1/0 proc-cpu sorted | ex 0.00%

CPU utilization for five seconds: 27%/20%; one minute: 26%; five minutes: 26%

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
16	13824104	271753	50870	2.55%	2.12%	2.04%	0	WBCMTS critical
181	7443208	318825	23345	1.19%	1.19%	1.18%	0	SNMP bg sync col
90	715652	272553	2625	0.79%	0.21%	0.50%	0	CMTS MAC Parser
64	4937492	770983	6404	0.79%	0.84%	0.84%	0	DOCSIS Load bala
143	784280	9031731	86	0.23%	0.17%	0.17%	0	IP Input
61	533944	214191	2492	0.23%	0.14%	0.11%	0	CMTS CM MONITOR
77	102584	3671944	27	0.23%	0.22%	0.23%	0	CMTS MAC Timer P
70	171924	350503	490	0.15%	0.08%	0.08%	0	CMTS CHAN STATS
196	442056	112250	3938	0.07%	0.07%	0.07%	0	Compute load avg
65	700052	2055111	340	0.07%	0.13%	0.16%	0	CR10K Request di
198	148408	2272590	65	0.07%	0.07%	0.07%	0	ReqXmt 5/1: defa
205	9448	570609	16	0.07%	0.06%	0.07%	0	HCCP_DATA_KA

- sh contr c8/0/0 proc-cpu sorted | ex 0.00%

CPU utilization for five seconds: 10%/7%; one minute: 10%; five minutes: 10%

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
184	5927116	217342	27270	0.95%	1.01%	1.01%	0	SNMP bg sync col
64	2741024	745642	3676	0.71%	0.70%	0.71%	0	DOCSIS Load bala
16	4265644	271864	15690	0.39%	0.47%	0.49%	0	WBCMTS critical
61	358108	114380	3130	0.15%	0.05%	0.05%	0	CMTS CM MONITOR
77	59508	3523622	16	0.07%	0.05%	0.07%	0	CMTS MAC Timer P
199	438176	108543	4036	0.07%	0.07%	0.07%	0	Compute load avg
70	219028	317086	690	0.07%	0.07%	0.07%	0	CMTS CHAN STATS
146	267164	4109077	65	0.07%	0.04%	0.05%	0	IP Input

Linecard Memory

- sh contr c8/0/0 memory

	Head	Total (b)	Used (b)	Free (b)	Lowest (b)	Largest (b)
Processor	C73EF00	1769738496	454869920	1314868576	1301932116	1299960636
I/O	75F00000	167772160	107608068	60164092	59910688	56092732

Processor memory

Address	Bytes	Prev	Next	Ref	PrevF	NextF	Alloc	PC	what
0C73EF00	0000065540	00000000	0C74EF34	001	-----	-----	028542EC		MallocLite
0C74EF34	0000065540	0C73EF00	0C75EF68	000	285FEC2C	0	0294D170		(coalesced)
0C75EF68	0000065540	0C74EF34	0C76EF9C	001	-----	-----	024D2840		SID_INST_CHUNK
0C76EF9C	0000065540	0C75EF68	0C77EFD0	001	-----	-----	023B8BB0		CM_MCTX_CHUNK
0C77EFD0	0000000356	0C76EF9C	0C77F164	001	-----	-----	023FFCD0		CM Flap Info
0C77F164	0000005764	0C77EFD0	0C780818	001	-----	-----	02751228		CMTS_PARSEINFO
0C780818	0000007204	0C77F164	0C78246C	000	287414DC	0	02751228		(fragment)
0C78246C	0000000356	0C780818	0C782600	001	-----	-----	023FFCD0		CM Flap Info
0C782600	0001159332	0C78246C	0C89D6D4	000	28625354	C8A7BA0	02891078		(coalesced)
0C89D6D4	0000000356	0C782600	0C89D868	001	-----	-----	023FFCD0		CM Flap Info
0C89D868	0000040972	0C89D6D4	0C8A78A4	000	0	0	02CE609C		(coalesced)
0C8A78A4	0000000716	0C89D868	0C8A7BA0	001	-----	-----	02F7B47C		CMTS MAC Parser
0C8A7BA0	0012280984	0C8A78A4	0D45E068	000	C782600	0	02891078		(coalesced)
0D45E068	0000020004	0C8A7BA0	0D462EBC	001	-----	-----	0223D8B4		Manage Chnk Q Elemen

1x1 Battery & Energy Management Modes

Battery Mode (BM) Introduction

- When feature enabled and CM power outage, CM will enter battery backup mode
- Bonding downgraded to one DS by one US ch
 - Battery 1x1 mode (BM)
- Reduces power usage when CM running on battery ^{PRE}
 - Longer backup for voip and low traffic
- When CM returns to AC power mode, ch bonding returns to original configuration

Battery 1x1 Mode Feature Description

- CM use CM-STATUS to report event 9 “CM on battery backup” and event 10 “CM returned to AC power” to CMTS
- Single-ch US BG & 1-ch DS grp needed to move CM to 1x1
 - For US, each US ch has default single-ch BG
 - For DS, RBGs need to be configured
- Feature uses DBC to move CM from original BG to 1x1
- CMTS uses saved info to restore CM to original BG when power restored

Energy Management Feature Description

- DOCSIS CMs and CMTSs support low power mode referred to as "Energy Management 1x1 Mode"
 - ✓ CM instructed by CMTS (via Dynamic Bonding Change (DBC) message) to switch to Receive Channel Set (RCS) containing single DS ch & Transmit Channel Set (TCS) containing single US ch to operate in EM 1x1 Mode during "idle" times
 - ✓ Data rate demand of that user can be satisfied by available capacity on single US and DS ch pair it is assigned
- When CM requires higher data rate, CMTS instructs CM to return to original RCS/TCS set
- User-configurable thresholds needed in cm config file
- CM must support feature and be enabled in cm file

Energy Management Feature Description (cont)

- CMTS uses DBC to instruct CM to enter/exit Energy Management 1x1 Mode
- EM feature uses Resilient BGs for DS and default single-ch US BGs for US
- CMTS selects one available US BG which has max BW
- When CM enters EM mode, CMTS saves original wideband interface and US TCS
- When CM exits EM mode, it returns to original wideband interface and US ch sets
- **Note:** Battery Backup 1x1 Mode is independent, more simplified feature from EM mode & requires cm-status messages 9 & 10 to be processed

Utilization Verification

Capacity Overhead

- 256-QAM, Annex B raw rate = 42.88 Mbps
- “Usable” refers to layer 2 speed reporting
 - “Primary” = 37.5 (I-CMTS) 36 Mbps (M-CMTS) 46 Mbps Annex A
- Each US in mac domain can decrease usable by .25 Mbps
- Layer 3 reporting could be 5 - 10% less if average frames < 1518B
- “Secondary-only” will be 37.5 Mbps (no DOCSIS overhead)
- Multicast sent down each “Primary”
 - Can be removed with; `cable downstream dsg disable` on Integrated/Modular interfaces
- CIR/admission control = .8 of “Usable”
- “Powerboost” and peak-rate TLV affect

Powerboost - “ERBA”; Enhanced Rate Bandwidth Allocation

- Name trademarked by Comcast as Powerboost
- Command not needed on VXR to do Powerboost
- Needs to be configured on uBR10K with PRE2 or higher for DS Powerboost along with 1.1 CM file DS max burst setting
 - ✓ `cable ds-max-burst burst-threshold {threshold in KB} peak-rate {rate in kbps}`
 - ✓ Burst-threshold for this command defaults to 1000, which is 1 MB
- **Note:** CM needs to reboot for settings to take affect
- **Note:** One may want to set peak rate to 35 Mbps so D3.0 and 2.0 CMs get same peak and not exactly 100%
 - ✓ Trace may appear oscillating slightly up and down
- DOCSIS 3.0 CMs support TLV for per-CM peak rates and command exists to withhold those TLVs if problems persist
 - ✓ `(config)#cable service attribute withhold-tlvs ?`
 - `peak-rate` Peak Traffic Rate TLV 24/25.27

DBS Allocations

- sh contr modular-Cable 7/1/0 mapping rf-channel

Ctrlr	RF channel	MC BW %	MC Rem. Ratio	WB channel	WB BW %	WB Rem. Ratio
7/1/0	0	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	1	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	2	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	3	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	4	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	5	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	6	30	1	7/1/0:1	1	1
				7/1/0:9	1	1
7/1/0	7	30	1	7/1/0:1	1	1
				7/1/0:9	1	1

- sh hw-module bay 3/3/0 mapping rf-channel



Utilization Tracking

- SNMP polling interval for calculating RF ch utilization
 - CLI available starting in SCD2 (and SCC4);
- `10k(config)#cab util-interval ?`
 - `<1-86400>` The time interval in seconds (300 default)
- Use CMTS MIB to monitor DS usage:
 - `CISCO-CABLE-WIDEBAND-MIB > ccwbRFChannelTable > ccwbRFChannelUtilization`
 - Reports average DS utilization across xx secs of “load-interval”
 - Default of 300, but recommend 30 sec
 - Remember, no minislots in DS
 - For M-CMTS solution with Annex B, 6 MHz ch width using 256-qam, use 36 Mbps as usable rate to figure out what to divide by
 - When using this MIB, configure “`cab util-interval <n>`” value to same value or lower before actual snmp polling interval
 - Ex. If snmp polling set to 10 min, can use 9 or 10 for cab util-interval value
 - Setting cab util-interval cmd updates interval for ccwbRFChanUtilInterval

Utilization Tracking (cont)

- Use CMTS MIB to monitor US usage:
 - Can use `cdxIfUpChannelAvgUtil` to monitor avg US channel utilization
 - May need to monitor minislot utilization instead since US BW could be available, but no available minislots to send BW
 - `cdxIfUpChannelAvgContSlots`
 - BW utilization is typically in Mbps, so divide by:
 - 9 Mbps for 16-qam, 3.2 MHz
 - 27 Mbps for 64-qam, 6.4 MHz

Utilization Tracking (cont)

- Other similar MIB to monitor DS/US usage
 - Use docslfCmtsChannelUtUtilization to monitor avg US/DS ch utilization
 - US utilization percent reports minislots utilized on physical ch
 - DS utilization percent reports percent of ratio between bytes data transmitted vs total number of bytes transmitted in raw BW of mpeg ch
 - Setting cabl util-interval <n> will update utilization interval for docslfCmtsChannelUtilizationInterval
- In SCF and later, MIB ccwbRFChannelUtilization used for polling RF DS ch utilization for 3Gx60, 20x20V, 8x8V, 3G SPA & WB SPA
 - Use ccwbFiberNodeTable to query cable interfaces and RF ch snmp if index
- In SCE and later, MIB docslfCmtsChannelUtUtilization can be used for polling legacy linecards; 5x20, 20x20, WB SPA for RF ch utilization
 - MIB ccwbFiberNodeNBIfIndex pointed to DS or US ch of cable interface or integrated/modular cable snmp if index

Show Controller Output

- cBR8#sh contr integrated-Cable 2/0/0 counter rf-channel

Control	RF Chan	MPEG Packets Tx	MPEG bps	MPEG Mbps	Sync Packets Tx	MAP/UCD Packets Tx	User Mbps
2/0/0	0	11233773307	38809667	38.80	43539665	1743367624	35.68
2/0/0	1	11233556286	38809667	38.80	0	217697	37.81
.....							
2/0/0	7	11233556282	38809667	38.80	0	217697	37.81
2/0/0	8	11233773068	38809667	38.80	43539665	1742875987	35.68
2/0/0	9	11233556295	38809667	38.80	0	217696	37.81
2/0/0	10	11233556291	38809667	38.80	0	217697	37.81
.....							
2/0/0	31	11233556299	38809667	38.80	0	217697	37.80

- cBR8-CPoC#sh contr integrated-Cable 2/0/0 counter ofdm-ch

Contro	Ch#	Profile/PLC	Packets	Bytes	Rate(Mbps)	Utilization(%)
2/0/0	158	Total	5443178	82278447	1512.226	100.0
2/0/0	158	0	4571485	31129641	0.005720	0.0
2/0/0	158	1	5441574	82273356	1512.133	100.0
2/0/0	158	2	2222428	91837370	0.001600	0.0
2/0/0	158	PLC-MMM	6530949	58560842	0.010761	
2/0/0	158	PLC-EM	0	0	0.000000	
2/0/0	158	PLC-TR	0	0	0.000000	

Sh Cab load-balance docsis-group 800 all | in 36

DOCSIS load-balancing load

Interface	State	Grp	Utilization	Rsvd	NBCM	WB/UB	Flows	Weight
		Indx			Total	Total		
Mo8/0/0:0 (477 MHz)	up	1	10% (10%/92%)	0%	3	9	3	36.0
Mo8/0/0:1 (483 MHz)	up	1	5% (5%/92%)	0%	2	9	2	36.0
Mo8/0/0:10 (537 MHz)	up	1	0% (0%/92%)	0%	2	10	3	36.0
Mo8/0/0:11 (543 MHz)	up	1	0% (0%/92%)	0%	2	10	2	36.0
Mo8/0/0:12 (549 MHz)	up	1	0% (0%/92%)	0%	2	10	2	36.0
Mo8/0/0:13 (555 MHz)	up	1	5% (5%/92%)	0%	2	10	2	36.0
Mo8/0/0:14 (561 MHz)	up	1	0% (0%/92%)	0%	2	10	2	36.0
Mo8/0/0:15 (567 MHz)	up	1	10% (10%/92%)	0%	2	10	4	36.0
Mo8/0/0:2 (489 MHz)	up	1	10% (10%/92%)	0%	2	9	2	36.0
Mo8/0/0:3 (495 MHz)	up	1	5% (5%/92%)	0%	2	9	2	36.0
Mo8/0/0:4 (501 MHz)	up	1	10% (10%/92%)	0%	2	9	2	36.0
Mo8/0/0:5 (507 MHz)	up	1	5% (5%/92%)	0%	2	9	2	36.0
Mo8/0/0:6 (513 MHz)	up	1	0% (0%/92%)	0%	2	9	2	36.0
Mo8/0/0:7 (519 MHz)	up	1	5% (5%/92%)	0%	2	9	2	36.0
Mo8/0/0:8 (525 MHz)	up	1	0% (0%/92%)	0%	2	10	2	36.0
Mo8/0/0:9 (531 MHz)	up	1	0% (0%/92%)	0%	1	10	2	36.0

- Utilization based on “load-interval” with default of 300 sec and suggested lowest setting of 30
 - Cable interface setting affects US utilization; Modular/Integrated affects DS utilization
- Policy pure-ds-load recommended when doing DS utilization LB
 - Removes US utilization for DS LB decisions

Thank you.

