Dynamic Bonding Group

This document describes how to configure Dynamic Bonding Group that helps manage resource of all downstream bonding groups by automatically creating bonding groups.

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

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Hardware Compatibility Matrix for the Cisco cBR Series Routers

Note The hardware components that are introduced in a given Cisco IOS-XE Release are supported in all subsequent releases unless otherwise specified.

Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 Supervisor: • PID—CBR-SUP-250G • PID—CBR-CCAP-SUP-160G	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 CCAP Line Cards: • PID—CBR-LC-8D30-16U30 • PID—CBR-LC-8D31-16U30 • PID—CBR-RF-PIC • PID—CBR-RF-PROT-PIC • PID—CBR-CCAP-LC-40G • PID—CBR-CCAP-LC-40G-R • PID—CBR-CCAP-LC-G2-R • PID—CBR-SUP-8X10G-PIC • PID—CBR-2X100G-PIC Digital PICs: • PID—CBR-DPIC-8X10G • PID—CBR-DPIC-2X100G Cisco cBR-8 Downstream PHY Module: • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D31-US-MOD

Note Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

Information About Dynamic Bonding Group

Dynamic Bonding Group (DBG) helps manage the resource of all downstream bonding groups, including automatically creating and reclaiming the downstream bonding groups.

Overview of Dynamic Bonding Group

To reduce the effort required in configuring and managing RCC, the DBG feature implements the automatic creating and reclaiming of the downstream bonding groups. DBG creates the bonding group automatically depending on the channel's load usage. With DBG, the modem is assigned the downstream bonding group without any static RCC configuration. The load balancing feature leverages DBG to balance traffic among all channels. DBG also accommodates primary channel and CM capacity distributions automatically.

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Dynamic Bonding Group supports the following:

- Support 896 bonding groups per CLC for CBR-CCAP-LC-40G and CBR-CCAP-LC-40G-R cards.
- Support creating DBGs and reclaiming DBG.
- Support DOCSIS 3.0 and DOCSIS 3.1 channel types.
- Support DOCSIS 3.0 and DOCSIS 3.1 load balance.
- Supports DBG interoperation — Modem registration and load balancing.
- Enhance dynamic load balance — Fixed primary channel movement.
- Enhance raider FPGA SQF — Fairness in channel utilization.

How to configure Dynamic Bonding Group

Enable Dynamic Bonding Group

Table 2: Feature History

Feature Name	Release Information	Feature Description
Configure the time interval between DBG unused and reclaim.	Cisco IOS XE Dublin 17.12.1w	In this release, you can use the **cable dynamic-bonding-group** *reclaim-hold-interval* command to configure a time interval in seconds between DBG unused and reclaim. Configuring this command has the following benefits: • Reduces the chance of receiving the **AOM download to CPP stuck** or **AOM download to CPP queue** error messages. • Increasing the hold interval can help you avoid **DBG reclaim** or **DBG create** requests.
Ability to create 8-channel DBG with contiguous frequency channels	Cisco IOS XE Bengaluru 17.6.1x	Some CMs change to downstream partial mode when moving on the DBG with disconnected frequency channels. This feature allows you to create 8-channel DBG with contiguous frequency channels for load balance purpose.

To enable DBG, run the following commands:

```
ROUTER# config t
Enter configuration commands, one per line. End with CNTL/Z.
ROUTER(config)# cable dynamic-bonding-group
ROUTER(config)# end
ROUTER#
ROUTER#
ROUTER# show run
ROUTER# show running-config | in dynamic-bonding
cable dynamic-bonding-group
```

Sometimes an 8-channel DBG is created with discontinuous frequency channels (such as 0–5 and 8–9) for load balance purpose. In this case, dual tuner 8-channel CM with BRCM3380 chipset may change to downstream partial mode when moving on the DBG with discontinuous frequency channels. To avoid this

issue, you can force the cBR-8 router to create 8-channel DBG with contiguous frequency channels using the following command:

```
ROUTER# config terminal
Enter configuration commands, one per line. End with CNTL/Z.
ROUTER(config)# cable dynamic-bonding-group eight-contiguous-channel
```

Enable DS-Resiliency and Configure Resiliency Bonding Group

To make sure that the modem remains w-online with maximum downstream capability when several rf channels are impaired, enable ds-resiliency feature by running the following commands:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cable resiliency ds-bonding
Router(config)# end
Router#
Router# show running-config | in resiliency
cable resiliency ds-bonding
Router#
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface wideband-Cable 3/0/1:30
Router(config-if)# cable ds-resiliency
Wideband-Cable3/0/1:30 is set to WB resiliency bonding group.
Remove any existing bundle and rf-channel configuration.
Router(config-if)#end
Router#
Router#show running-config interface wideband-Cable 3/0/1:30
Building configuration...
Current configuration : 61 bytes
!
interface Wideband-Cable3/0/1:30
cable ds-resiliency
end
```

Enable ACFE

Enable ACFE feature to make sure that modem registration is not blocked because of QoS failures:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cable acfe enable
Router(config)# end
Router# show running-config | in acfe
cable acfe enable
```

Configure Interface Mac-Domain and Fiber-Node

Note The recommended size of service group is 32 or 48. The recommended primary channel distribution is one primary channel for contiguous four channels, such as 0, 4, 8, 12, 16, 20, 24, 28 and so on.

To set up interface mac-domain and fiber-node, run the following commands:

```
Router# show running-config interface c3/0/1
Building configuration...
Current configuration : 963 bytes
!
interface Cable3/0/1
downstream Integrated-Cable 3/0/1 rf-channel 0
downstream Integrated-Cable 3/0/1 rf-channel 4
downstream Integrated-Cable 3/0/1 rf-channel 8
downstream Integrated-Cable 3/0/1 rf-channel 12
downstream Integrated-Cable 3/0/1 rf-channel 16
downstream Integrated-Cable 3/0/1 rf-channel 20
downstream Integrated-Cable 3/0/1 rf-channel 24
downstream Integrated-Cable 3/0/1 rf-channel 28
upstream 0 Upstream-Cable 3/0/1 us-channel 0
upstream 1 Upstream-Cable 3/0/1 us-channel 1
upstream 2 Upstream-Cable 3/0/1 us-channel 2
upstream 3 Upstream-Cable 3/0/1 us-channel 3
upstream 4 Upstream-Cable 3/0/1 us-channel 4
upstream 5 Upstream-Cable 3/0/1 us-channel 5
upstream 6 Upstream-Cable 3/0/1 us-channel 6
upstream 7 Upstream-Cable 3/0/1 us-channel 7
cable upstream bonding-group 1
upstream 0
upstream 1
attributes 80000002
cable upstream bonding-group 2
upstream 2
upstream 3
attributes 80000000
cable bundle 255
end

Router# show cab
Router# show cable fib
Router# show cable fiber-node 1
Fiber-Node 1
     Channel(s) : downstream Integrated-Cable 3/0/1: 0-31
     Channel ID(s): 1  2  3  4  5  6  7  8  9  10 11 12 13 14
                    15 16 17 18 19 20 21 22 23 24 25 26 27 28
                    29 30 31 32
     Upstream-Cable 3/0/1
         FN Config Status: Configured (status flags = 0x01)
         MDD Status: Valid
Router# show running-config | sec fiber-node 1
  cable fiber-node 1
   downstream Integrated-Cable 3/0/1
   upstream Upstream-Cable 3/0/1
```

Example of OFDM configured in the fiber node and added as part of the dynamic bonding group.

```
Router# 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
9219  Wi1/0/4:2    33       36   36        Nov 7  01:56:27.406   MODEM_ONLINE
OPERATIONAL         9216-9247, 9375
9220  Wi1/0/4:3    33       10   10        Nov 7  02:04:31.142   MODEM_ONLINE
OPERATIONAL         9248-9279, 9375
9221  Wi1/0/4:4    8        1    1         Nov 7  02:06:09.949   MODEM_ONLINE
OPERATIONAL         9248-9255

Router# show controller integrated-Cable 1/0/0 rf-channel 158
Load for five secs: 8%/1%; one minute: 8%; five minutes: 8%
```

```
Time source is NTP, *14:07:30.643 EST Fri Nov 17 2017
Chan State Admin Mod-Type  Start       Width     PLC        Profile-ID    dcid  power
output
                          Frequency
158 UP     UP   OFDM      258000000   48000000  279000000       100      159   34.0   NORMAL

Router# show cable fiber-node 10
Load for five secs: 9%/0%; one minute: 9%; five minutes: 8%
Time source is NTP, *13:59:39.571 EST Fri Nov 17 2017

--------------------------------------------------------------------------------

Fiber-Node 10
  Channel(s)    :  downstream Integrated-Cable 1/0/0:  0-63, 158
  Channel ID(s):   1   2   3   4   5   6   7   8   9  10  11  12  13  14
                  15  16  17  18  19  20  21  22  23  24  25  26  27  28
                  29  30  31  32  33  34  35  36  37  38  39  40  41  42
                  43  44  45  46  47  48  49  50  51  52  53  54  55  56
                  57  58  59  60  61  62  63  64 159
  Upstream-Cable 1/0/0
    FN Config Status: Configured (status flags = 0x01)
    MDD Status: Valid
```

Enable Load Balancing for DOCSIS 3.0 and DOCSIS 3.1

To enable DOCSIS load balancing, run the cable load-balance docsis-enable command. When DOCSIS load balancing is enabled, run the cable load-balance docsis30-enable command to enable load balancing for DOCSIS 3.0 and DOCSIS 3.1.

Note The **cable load-balance docsis30-enable** command enables load balancing for DOCSIS 3.0 and DOCSIS 3.1.

Enable DOCSIS 3.0 and DOCSIS 3.1 Static Load Balance

To balance the load of primary channels, enable static load balance by running the following commands:

```
ROUTER# config t
Enter configuration commands, one per line. End with CNTL/Z.
ROUTER(config)# cable load-balance docsis30-enable static
ROUTER(config)# end
ROUTER# show cable load-balance
DOCSIS LB Enabled: Yes
DOCSIS 2.0 LB Enabled: Yes
DOCSIS 3.0 LB Enabled: Yes
DOCSIS 3.0 Static LB Enabled: Yes
DOCSIS 3.0 Dynamic Downstream LB Enabled: No
```

Enable DOCSIS 3.0 and DOCSIS 3.1 General Load Balance Group

To enable general load balance group, run the following commands:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Router(config)# cable load-balance docsis-group fn 1 md c3/0/1
Router(config-lb-group)# no disable
Router(config-lb-group)# end
Router# show cable load-balance
DOCSIS LB Enabled: Yes
DOCSIS 2.0 LB Enabled: No
159
DOCSIS 3.0 LB Enabled: Yes
DOCSIS 3.0 Static LB Enabled: Yes
DOCSIS 3.0 Dynamic Downstream LB Enabled: Yes
DOCSIS 3.0 Dynamic Upstream LB Enabled: Yes
DOCSIS     Status Interval  DCC mask  Policy     Method Threshold

DOCSIS 3.0 General LB
MD       FN   Group ID         S Intv  DCC mask  Policy  Mtd     MD-CM-SG  Threshold
                                                          /UCC                        D/U
M/E/U/P/S
Ca3/0/1  1    2147557888 E 90   0xF8(0)/N 0           u/u        0x91010B   5/10/70/70/50
```

Enable Dynamic Load Balance and Fixed-Primary Channel Movement

Note To reduce service outage while enabling dynamic load balancing, enable fixed primary channel movement.

To balance the load of all of downstream channels based on utilization, enable dynamic load balance by running the following commands:

```
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cable load-balance docsis30-enable dynamic downstream
Router(config)# end
Router#
Router# show cable load-balance
DOCSIS LB Enabled: Yes
DOCSIS 2.0 LB Enabled: No
DOCSIS 3.0 LB Enabled: Yes
DOCSIS 3.0 Static LB Enabled: Yes
DOCSIS 3.0 Dynamic Downstream LB Enabled: Yes
DOCSIS 3.0 Dynamic Upstream LB Enabled: Yes
DOCSIS     Status Interval  DCC mask  Policy     Method Threshold
Group                       /UCC                DS/US  M/E/U/P/S
1          GE     30        0xF8(0)/N 0          m/m    5/10/70/70/50

DOCSIS 3.0 General LB
MD       FN   Group ID   S Intv DCC mask  Policy    Mtd MD-CM-SG   Threshold
                              /UCC                 D/U            M/E/U/P/S
Ca3/0/1  1    2147557888 E 90   0xF8(0)/N 0         u/u 0x91050A   5/10/70/70/50
Router#
Router# config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cable load-balance fixed-primary-channel
Router(config)# end
Router#
Router# show run
Router# show running-config | in fixed
cable load-balance fixed-primary-channel
```

Verifying Dynamic Bonding Group Configuration

To verify that the DBGs are created:

Check the modem's primary wideband interface by using the **show cable modem wideband channel** command:

```
Router# show cable modem 4800.33ee.ebee wideband channel
MAC Address         IP Address         I/F          MAC        DSxUS     Primary
                                                    State                WB
4800.33ee.ebee      30.132.15.246      C3/0/1/UB    w-online   32x2      Wi3/0/1:3
Router# scm 4800.33ee.ebee ver
```

Check the modem's downstream tuner capability by using the **show cable modem verbose | in DS Tuner** command.

```
Router# show cable modem 4800.33ee.ebee verbose | in DS Tuner
DS Tuner Capability : 32
```

Check the related RCC by using the **show cable mac-domain rcc** command:

```
Router# show cable mac-domain c3/0/1 rcc
RCC-ID   RCP             RCs  MD-DS-SG  CMs  WB/RCC-TMPL       D3.0    D3.1
32 00 00 00 00 00  8    0         11   WB (Wi3/0/1:1)    Y       Y
33 00 00 00 00 00  32   0         6    WB (Wi3/0/1:3)    Y       Y
34 00 00 00 00 00  8    0         7    WB (Wi3/0/1:2)    Y Y
35 00 00 00 00 00  8    0         7    WB (Wi3/0/1:4)    Y Y
36 00 00 00 00 00  8    0         7    WB (Wi3/0/1:5)    Y Y
```

Check the dynamically created bonding groups, use the **show cable dynamic-bonding-group summary** command as shown in the example below:

```
Router# 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
24834 Wi3/0/1:1 8       11  11        Sep 14 14:36:35.194 MODEM_ONLINE        OPERATIONAL
24832-24839
24836 Wi3/0/1:3 32      6    6        Sep 14 14:43:24.144 MODEM_ONLINE        OPERATIONAL
24832-24863
24835 Wi3/0/1:2 8       7    7        Sep 14 17:20:37.115 MODEM_ONLINE        OPERATIONAL
24840-24847
24837 Wi3/0/1:4 8       7    7        Sep 14 17:21:37.723 STATIC_LOAD_BALANCE OPERATIONAL
24856-24863
24838 Wi3/0/1:5 8       7    7        Sep 14 17:21:39.761 STATIC_LOAD_BALANCE OPERATIONAL
24848-24855
```

The following examples shows the DBG created with contiguous frequency channels for load balance purpose.

```
Router#show cable dynamic-bonding-group summary
 Dynamic bonding group: Enable
 DBG operation with Registration: Enable
 DBG operation with Load-Balance: Enable
 BG ID BG Name      BG Size  CMs  ServFlows Create Time           Create Client        BG
State             RFid list
 24578 Wi3/0/0:1    24       4    4         Sep 26 15:07:22.760   MODEM_ONLINE
OPERATIONAL          24576-24599
 24577 Wi3/0/0:0    8        17   17        Sep 26 16:35:01.240   MODEM_ONLINE
OPERATIONAL          24584-24591
 24579 Wi3/0/0:2    8        7    7         Sep 26 16:53:48.857   DYNAMIC_LOAD_BALANCE
OPERATIONAL          24577-24584
 24580 Wi3/0/0:3    8        6    6         Sep 26 16:56:49.790   DYNAMIC_LOAD_BALANCE
OPERATIONAL          24588-24595
```

```
Router#show derived-config interface wideband-Cable 3/0/0:3
Building configuration...

Derived configuration : 141 bytes
!
interface Wideband-Cable3/0/0:3
 cable bundle 255
 cable rf-channels channel-list 12-19 bandwidth-percent 1
 no snmp trap link-status
end

Router#show derived-config interface wideband-Cable 3/0/0:2
Building configuration...

Derived configuration : 139 bytes
!
interface Wideband-Cable3/0/0:2
 cable bundle 255
 cable rf-channels channel-list 1-8 bandwidth-percent 1
 no snmp trap link-status
end
```

Table 3: Dynamic Bonding Group States

CREATE_WAITING_SUP	Line card sends request to create DBG and waits for SUP to create the bonding group.
HOLD	DBG is created from SUP, or bonding group reverts from reclaim to ready for use.
OPERATIONAL	If modem is used on the bonding group after the HOLD state times out, the DBG state changes to OPERATIONAL.
RECLAIM_HOLD	Ready for reclaim. If no modem is used on the bonding group or match the reclaim in two minutes, the bonding group is reclaimed. The DBG state changes to RECLAIM_HOLD.
RECLAIM_MODEM_MOVING	Ready for reclaim. The modem is moved out of the bonding group.
RECLAIM_WAITING_SUP	Line card sends DBG reclaim request and waits for SUP to reclaim the BG.

To show the detailed channel list information of dynamic bonding group, use the **show derived-config interface wideband** command.

```
Router# show derived-config interface wideband-Cable 3/0/1:1
Building configuration...
Derived configuration: 113 bytes
!
interface Wideband-Cable3/0/1:1
  cable bundle 255
```

```
  cable rf-channels channel-list 0-7 bandwidth-percent 1
end
```

Check the usage of bonding group resource by using the **show cable dynamic-bonding-group quota summary | slot | controller** command.

```
Router# show cable dynamic-bonding-group quota controller 3/0/1
slot/subslot/ctrlr: 3/0/1
Total BG number: 128
Used BG number (static/dynamic): 6(1/5) Available BG number: 122
Available BG list port: 0, 6-29, 31-127
```

Note 128 BGs can be configured on one controller, but only 896 BGs are supported per CLC. All controllers share the 896 BG resources.

Check the reclaimed bonding group by using the **show cable dynamic-bonding-group reclaim-history summary** command:

```
Router# show cable dynamic-bonding-group reclaim-history summary
BG ID BG Name   BG Size Create Time     Create Client Reclaim Time    Reclaim Client RFid
list
24835 Wi3/0/1:2 16      Sep 14 14:40:27 MODEM_ONLINE  Sep 14 14:44:27 DBG_INTERNAL
24832-2484
```

Verifying Static Load Balancing Configuration

To verify if static load balancing is configured:

Check the load of all primary channels by using the **show cable load-balance docsis-group fn 1 md cable load | in In** command.

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 load | in In
Interface           State   Group      Utilization Rsvd NBCM WB/UB Weight
In3/0/1:0(573 MHz)  initial 2147557888 0%(0%/0%)   0%   0    17    37
In3/0/1:4(597 MHz)  initial 2147557888 0%(0%/0%)   0%   0    17    37
In3/0/1:8(621 MHz)  initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:12(645 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:16(669 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:20(693 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:24(717 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:28(741 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
```

This command output lists all primary channels and shows the number of cable modems used with these channels. NBCM is the number of narrow band modems used with a channel while WBCM (WB/UB) is the number of wideband modems used with a channel. The total number of WBCMs should be balanced among all the channels.

The difference between the total number of WBCMs used with any two channels is smaller or equal to the threshold load minimum. The default value of the threshold load minimum is 5.

Check the load of all rf channels by using the **show cable load-balance docsis-group fn 1 md rfch-util** command.

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 rfch-util
Interface  Pstate Pending-In Pending-Out Throughput(Kbps) Util NBCM WBCM
```

```
In3/0/1:0  up     No          No          0                0%   0    17
In3/0/1:1  NA     No          No          0                0%   0    17
In3/0/1:2  NA     No          No          0                0%   0    17
In3/0/1:3  NA     No          No          0                0%   0    17
In3/0/1:4  up     No          No          0                0%   0    17
In3/0/1:5  NA     No          No          0                0%   0    17
In3/0/1:6  NA     No          No          0                0%   0    17
In3/0/1:7  NA     No          No          0                0%   0    17
In3/0/1:8  up     No          No          0                0%   0    13
In3/0/1:9  NA     No          No          0                0%   0    13
In3/0/1:10 NA     No          No          0                0%   0    13
In3/0/1:11 NA     No          No          0                0%   0    13
In3/0/1:12 up     No          No          0                0%   0    13
In3/0/1:13 NA     No          No          0                0%   0    13
In3/0/1:14 NA     No          No          0                0%   0    13
In3/0/1:15 NA     No          No          0                0%   0    13
…….
Average: 0.0
Variance: 0.0
```

This command lists the load information about the primary and secondary channels. WBCM is the number of wideband modems used with a channel.

Check the cable modem's internal state in load balancing using the **show cable load-balance docsis-group fn 1 md modem-list wideband** command.

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 modem-list wideband
Codes: M - Multicast, U - UGS, P - PCMM, F - Max-Failures, X - eXcluded
       L - L2vpn, R - RSVP, S - DS-Resiliency
Primary WB   MAC Address            Primary DS   RCC-ID  Priority        MUPFXLRS State
Wi3/0/1:0    (3)
            c8fb.2631.0e56        In3/0/1:20   41      0       ------ LB_CM_HOLD_EXPIRE_IN
 36
            c8fb.26a6.c3dc        In3/0/1:16   41      0       ------ LB_CM_HOLD_EXPIRE_IN
 37
            c8fb.2631.0d7e        In3/0/1:16   41      0       ------ LB_CM_HOLD_EXPIRE_IN
 43
Wi3/0/1:1 (9)
            c8fb.2631.0c80         In3/0/1:0    32      0        ------ LB_CM_STATIC_MOVING

             c8fb.2631.0cae         In3/0/1:0    32      0        ------ LB_CM_STATIC_READY

            c8fb.2631.0db0         In3/0/1:24   42      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0c10         In3/0/1:28   42      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0d80         In3/0/1:16   41      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0d26         In3/0/1:24   41      0        ------ LB_CM_STATIC_MOVING

            a4a2.4a2d.b4aa         In3/0/1:20   41      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0e5c         In3/0/1:0    32      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0cb0         In3/0/1:0    32      0        ------ LB_CM_STATIC_MOVING
Wi3/0/1:2 (3)
            c8fb.2631.0d2a        In3/0/1:12   34      0       ------ LB_CM_HOLD_EXPIRE_IN
 27
            c8fb.2631.0e5a         In3/0/1:12   34      0        ------ LB_CM_STATIC_MOVING

            c8fb.2631.0bfe         In3/0/1:8    34      0        ------ LB_CM_STATIC_MOVING
Wi3/0/1:3 (2)
            4800.33ea.54be         In3/0/1:28   33      0        ------ LB_CM_DYNAMIC_READY
```

```
            4800.33ee.ebe6         In3/0/1:20   33      0        ------ LB_CM_HOLD_EXPIRE_IN
 1
Wi3/0/1:4 (2)
            c8fb.2631.0e44         In3/0/1:24   42      0        ------ LB_CM_HOLD_EXPIRE_IN
 40
            c8fb.2631.0a44         In3/0/1:28   42      0        ------ LB_CM_HOLD_EXPIRE_IN
 42
```

Table 4: Cable Modem States

CM state	Description
LB_CM_STATIC_READY	Modem is ready for static load balance movement.
LB_CM_STATIC_MOVING	Modem is in movement triggered via static LB.
LB_CM_HOLD_EXPIRE_IN	Modem is in hold for the next movement. The default hold time is 600 seconds.
LB_CM_DYANMIC_READY	Modem is ready for dynamic load balance movement.
LB_CM_DYANMIC_MOVING	Modem is in movement triggered via dynamic LB.
LB_CM_DISABLED	Modem is not ready for movement. If the modem failure movement count reaches max-failure threshold, then set the modem in LB_CM_DISABLED to avoid further movement.

Verifying Dynamic Load Balancing Configuration

Check the utilization of all rf channels by using **show cable load-balance docsis-group fn 320 md rfch-util** command.

```
Router# show cable load-balance docsis-group fn 320 md c3/0/0 rfch-util
Interface Pstate   Pending-In   Pending-Out   Throughput(Kbps) Util   NBCM   WBCM
Do3/0/0:0  up      No           No            11754            31%    0      308
Do3/0/0:1  up      No           No            11754            31%    0      296
Do3/0/0:2  up      No           No            11754            31%    0      333
Do3/0/0:3  up      No           No            11754            31%    0      296
Do3/0/0:4  up      No           No            11754            31%    0      297
Do3/0/0:5  up      No           No            11754            31%    0      331
Do3/0/0:6  up      No           No            11754            31%    0      299
Do3/0/0:7  up      No           No            11753            31%    0      268
Do3/0/0:8  up      No           No            11754            31%    0      302
Do3/0/0:9  up      No           No            11754            31%    0      331
Do3/0/0:10 up      No           No            11753            31%    0      308
Do3/0/0:11 up      No           No            11754            31%    0      305
Do3/0/0:12 NA      No           No            12862            34%    0      258
Do3/0/0:13 NA      No           No            12862            34%    0      258
Do3/0/0:14 NA      No           No            12862            34%    0      258
…….
Average: 30.416
Variance: 1.701
```

The traffic among all rf channels is considered balanced when the difference between any two rf channel utilization is under the threshold load. The default value of threshold load is 10%.

To check the potential target bonding group for each of the source bonding group, use the **show cable load-balance docsis-group fn md cable target dbg** and the **show cable load-balance docsis-group fn md** target wide command.

```
Router# show cable load-balance docsis-group fn 320 md c3/0/0 target dbg
Interface    Bg-Id     Size     Group         Target
Wi3/0/0:0    24577     4        2147557695
Wi3/0/0:3    24580     4        2147557695
Wi3/0/0:4    24581     8        2147557695
Wi3/0/0:5    24582     8        2147557695
Wi3/0/0:6    24583     24       2147557695    33% [24576, 24584-24587, 24589-24607]
Wi3/0/0:7    24584     16       2147557695    30% [24576, 24586-24587, 24595-24607]
Wi3/0/0:8    24585     16       2147557695
Wi3/0/0:9    24586     32       2147557695
Wi3/0/0:10   24587     24       2147557695    33% [24576, 24584-24587, 24589-24607]
Wi3/0/0:11   24588     8        2147557695
Wi3/0/0:12   24589     8        2147557695    27% [24596-24603]
Wi3/0/0:13   24590     8        2147557695
Wi3/0/0:14   24591     4        2147557695
```

```
Router# show cable load-balance docsis-group fn 5 md c1/0/4 target wide
Interface     Bg-Id     State     Group         Target
Wi1/0/4:2     9219      up        2147510276    Wi1/0/4:4
Wi1/0/4:3     9220      up        2147510276
Wi1/0/4:4     9221      up        2147510276
```

If no target bonding groups are displayed, no bonding groups are created to balance traffic among rf channels.

A sample output with DOCSIS 3.1 modems with configured threshold of 14% is shown below. For utilization based load balancing to start on DOCSIS 3.1 modems, the OFDM channel must be 100% utilized and traffic must flow on SC-QAM. The utilization based load balancing balances the traffic flowing on the SC-QAM channels in a D31 modem.

```
Router# show cable load-balance docsis-group fn 5 md c1/0/4 rfch-util
Interface   Pstate Pending-In Pending-Out Throughput(Kbps) Util NBCM WBCM
In1/0/4:0   up     No         No          10632            28%  0    45
In1/0/4:1   NA     No         No          11226            29%  0    41
In1/0/4:2   NA     No         No          11225            29%  0    41
In1/0/4:3   NA     No         No          11225            29%  0    41
In1/0/4:4   down   No         No          11225            29%  0    41
In1/0/4:5   down   No         No          11225            29%  0    41
In1/0/4:6   down   No         No          11225            29%  0    41
In1/0/4:7   down   No         No          11225            29%  0    41
In1/0/4:8   up     No         No          10620            28%  0    43
....
....
In1/0/4:35   NA    No         No          6646             17%  0    6
In1/0/4:36   NA    No         No          6646             17%  0    6
In1/0/4:37   NA    No         No          6647             17%  0    6
In1/0/4:38   NA    No         No          6646             17%  0    6
In1/0/4:39   NA    No         No          6647             17%  0    6
In1/0/4:40   up    No         No          6088             16%  0    6
In1/0/4:41   NA    No         No          6648             17%  0    6
In1/0/4:42   NA    No         No          6647             17%  0    6
In1/0/4:43   NA    No         No          6647             17%  0    6
In1/0/4:44   NA    No         No          6646             17%  0    6
In1/0/4:45   NA    No         No          6646             17%  0    6
In1/0/4:46   NA    No         No          6647             17%  0    6
In1/0/4:47   NA    No         No          6648             17%  0    6
In1/0/4:48   NA    No         No          6648             17%  0    6
In1/0/4:49   NA    No         No          6648             17%  0    6
```

```
In1/0/4:50   NA    No          No          6646             17%  0    6
In1/0/4:51   NA    No          No          6648             17%  0    6
In1/0/4:52   NA    No          No          6647             17%  0    6
In1/0/4:53   NA    No          No          6648             17%  0    6
In1/0/4:54   NA    No          No          6647             17%  0    6
In1/0/4:55   NA    No          No          6648             17%  0    6
In1/0/4:56   NA    No          No          6647             17%  0    6
In1/0/4:57   NA    No          No          6647             17%  0    6
In1/0/4:58   NA    No          No          6646             17%  0    6
In1/0/4:59   NA    No          No          6645             17%  0    6
In1/0/4:60   NA    No          No          6646             17%  0    6
In1/0/4:61   NA    No          No          6646             17%  0    6
In1/0/4:62   NA    No          No          6647             17%  0    6
In1/0/4:63   NA    No          No          6647             17%  0    6
In1/0/4:159  NA    No          No          1819685          100% 0    47
```

Feature Information for Dynamic Bonding Group

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 5: Feature Information for Dynamic Bonding Group

Feature Name	Releases	Feature Information
Dynamic Bonding Group	Cisco IOS XE Fuji 16.7.1	This feature was introduced on the Cisco cBR Series Converged Broadband Routers.