DOCSIS 3.1 OFDM Channel Configuration

This document describes how to configure the OFDM channel on the Cisco cBR Series Converged Broadband Router.

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 OFDM Channel Configuration

OFDM Channels

DOCSIS 3.1 introduces modes for higher throughput and higher spectral efficiency while still allowing backward compatibility to DOCSIS 3.0. The OFDM Channel support includes two OFDM channel per port with channel bandwidth from 24 MHz to 192 MHz wide.

From the Cisco IOS XE Gibraltar 16.10.1d release, the Cisco cBR router supports two OFDM channels per service group for an RPD downstream port. You can configure the channels using the **cable downstream controller-profile** configuration.

cBR-8 routers support 158 SC-QAMs for a single OFDM channel and 128 SC-QAMs for multiple OFDM channels. The max-carrier attribute is automatically set to 158 by default. However, you should set the max-carrier to a value of 128 or below to configure multiple OFDM channels. The Cisco cBR router does not support any value above 128 if you are configuring multiple OFDM channels.

Each OFDM channel supports a control profile, an NCP profile, and up to five data profiles. Profiles support one or more modulations.

You can configure the guard band of an OFDM channel to potentially trade-off some performance margin using command **guardband-override**. By default, Cisco cBR-8 routers use the default guard band, which is based on the roll off and spacing in OFDM channel profile.

DOCSIS 3.1 OFDM support also allows the user to configure the RF-channels 158–162 under the mac-domain as primary channel.

OFDM Channel Configuration

Table 2: Feature History

Feature Name	Release Information	Feature Description
Support for the Configuration of 4 OFDM Channels	Cisco IOS XE Dublin 17.12.1	In this release, you can configure 4 OFDM Channels per Service Group (SG) on cBR-8 routers. 2Gx1G Service Tiers are supported by configuring 4 OFDM channels in each downstream (DS) SG. This feature is supported on KOBOL-R and Cylon-R line cards.

Max-carrier Configuration

Max-carrier configuration specifies the maximum number of SCQAM channels of the controller. The combinations of SCQAM and OFDM channels per controller are:

1 OFDM + 158 SCQAM;

2 OFDM + 128 SCQAM;

3 OFDM + 96 SCQAM;

4 OFDM + 64 SCQAM;

```
Router(config)#cable downstream controller-profile 10
Router(config-controller-profile)#max-carrier 158
Router(config-prof-rf-chan)#rf-chan 158
Router(config-prof-rf-chan)#docsis-channel-id 159
Router(config-prof-rf-chan)#9000000 width 96000000 plc 795000000
Router(config-prof-rf-chan)#rf-chan 159
Router(config-prof-rf-chan)#docsis-channel-id 160
Router(config-prof-rf-chan)#5000000 width 96000000 plc 891000000

Error: Max-carrier 158 > 128 can support only one OFDM channel.
Reduce max-carrier to 128 or lower to use 2nd OFDM channel.
```

Sample Configuration for Max OFDM Channels

The following example shows a sample configuration:

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

Router(config)#cable downstream controller-profile 104
Router(config-controller-profile)#max-carrier 64
Router(config-controller-profile)#max-ofdm-spectrum 480000000
Router(config-controller-profile)#rf-chan 0 63
Router(config-prof-rf-chan)#type DOCSIS
Router(config-prof-rf-chan)#qam-profile 1
Router(config-prof-rf-chan)#frequency 231000000
Router(config-prof-rf-chan)#rf-output NORMAL
Router(config-prof-rf-chan)#docsis-channel-id 1
Router(config-prof-rf-chan)#rf-chan 158
Router(config-prof-rf-chan)#docsis-channel-id 159
Router(config-prof-rf-chan)#ofdm channel-profile 2 start-frequency 789000000 width 96000000
 plc 795000000
Router(config-prof-rf-chan)#rf-chan 159
Router(config-prof-rf-chan)#docsis-channel-id 160
Router(config-prof-rf-chan)#ofdm channel-profile 2 start-frequency 885000000 width 96000000
 plc 891000000
Router(config-prof-rf-chan)#rf-chan 160
Router(config-prof-rf-chan)#docsis-channel-id 161
Router(config-prof-rf-chan)#ofdm channel-profile 2 start-frequency 981000000 width 96000000
 plc 987000000
The DS controller profile 104 should be applied to RPDs which have capability to support
the same or more number of OFDM channels.

Router(config-prof-rf-chan)#rf-chan 161
Router(config-prof-rf-chan)#docsis-channel-id 162
Router(config-prof-rf-chan)#ofdm channel-profile 20 start-frequency 1077000000 width 96000000
 plc 1083000000
The DS controller profile 104 should be applied to RPDs which have capability to support
the same or more number of OFDM channels.

Router(config-prof-rf-chan)#rf-chan 162
Router(config-prof-rf-chan)#docsis-channel-id 163
Router(config-prof-rf-chan)#ofdm channel-profile 2 start-frequency 1173000000 width 96000000
 plc 1179000000
Error: Max 4 ofdm channels per controller permitted.
Router(config-prof-rf-chan)#end
```

Use the following command to see the running configuration:

```
Router#sh run | s cable downstream controller-profile 104
```

```
cable downstream controller-profile 104
 max-carrier 64
 max-ofdm-spectrum 480000000
 rf-chan 0 63
  type DOCSIS
  qam-profile 1
  frequency 231000000
  rf-output NORMAL
  docsis-channel-id 1
 rf-chan 158
  docsis-channel-id 159
  ofdm channel-profile 2 start-frequency 789000000 width 96000000 plc 795000000
 rf-chan 159
  docsis-channel-id 160
  ofdm channel-profile 2 start-frequency 885000000 width 96000000 plc 891000000
 rf-chan 160
  docsis-channel-id 161
  ofdm channel-profile 2 start-frequency 981000000 width 96000000 plc 987000000
 rf-chan 161
  docsis-channel-id 162
  ofdm channel-profile 20 start-frequency 1077000000 width 96000000 plc 1083000000
 rf-chan 162
  docsis-channel-id 163
Router#
```

Use the following command verify the configuration:

```
Router#show cable downstream controller-profile 104
Downstream controller-profile 104, type RPHY
Description:
  Admin:  UP
  MaxOfdmSpectrum: 480000000
  MaxCarrier: 64
  Mode: normal
  Free freq block list has 3 blocks:
    45000000  - 227999999
    612000000 - 788999999
    1173000000 - 1217999999
  DS Splitting: No
  OFDM frequency exclusion bands: None

Configured RF Channels:
Chan Admin Frequency  Type       Annex Mod  srate Qam-profile  dcid  output
  0    UP   231000000  DOCSIS      B    256  5361  1            1     NORMAL
  1    UP   237000000  DOCSIS      B    256  5361  1            2     NORMAL
  2    UP   243000000  DOCSIS      B    256  5361  1            3     NORMAL
  3    UP   249000000  DOCSIS      B    256  5361  1            4     NORMAL
  4    UP   255000000  DOCSIS      B    256  5361  1            5     NORMAL
  5    UP   261000000  DOCSIS      B    256  5361  1            6     NORMAL
  6    UP   267000000  DOCSIS      B    256  5361  1            7     NORMAL
  7    UP   273000000  DOCSIS      B    256  5361  1            8     NORMAL
  8    UP   279000000  DOCSIS      B    256  5361  1            9     NORMAL
  9    UP   285000000  DOCSIS      B    256  5361  1            10    NORMAL
  10   UP   291000000  DOCSIS      B    256  5361  1            11    NORMAL
  11   UP   297000000  DOCSIS      B    256  5361  1            12    NORMAL
  12   UP   303000000  DOCSIS      B    256  5361  1            13    NORMAL
  13   UP   309000000  DOCSIS      B    256  5361  1            14    NORMAL
  14   UP   315000000  DOCSIS      B    256  5361  1            15    NORMAL
  15   UP   321000000  DOCSIS      B    256  5361  1            16    NORMAL
  16   UP   327000000  DOCSIS      B    256  5361  1            17    NORMAL
  17   UP   333000000  DOCSIS      B    256  5361  1            18    NORMAL
  18   UP   339000000  DOCSIS      B    256  5361  1            19    NORMAL
  19   UP   345000000  DOCSIS      B    256  5361  1            20    NORMAL
  20   UP   351000000  DOCSIS      B    256  5361  1            21    NORMAL
  21   UP   357000000  DOCSIS      B    256  5361  1            22    NORMAL
```

```
22   UP   363000000   DOCSIS      B    256   5361  1            23    NORMAL
23   UP   369000000   DOCSIS      B    256   5361  1            24    NORMAL
24   UP   375000000   DOCSIS      B    256   5361  1            25    NORMAL
25   UP   381000000   DOCSIS      B    256   5361  1            26    NORMAL
26   UP   387000000   DOCSIS      B    256   5361  1            27    NORMAL
27   UP   393000000   DOCSIS      B    256   5361  1            28    NORMAL
28   UP   399000000   DOCSIS      B    256   5361  1            29    NORMAL
29   UP   405000000   DOCSIS      B    256   5361  1            30    NORMAL
30   UP   411000000   DOCSIS      B    256   5361  1            31    NORMAL
31   UP   417000000   DOCSIS      B    256   5361  1            32    NORMAL
32   UP   423000000   DOCSIS      B    256   5361  1            33    NORMAL
33   UP   429000000   DOCSIS      B    256   5361  1            34    NORMAL
34   UP   435000000   DOCSIS      B    256   5361  1            35    NORMAL
35   UP   441000000   DOCSIS      B    256   5361  1            36    NORMAL
36   UP   447000000   DOCSIS      B    256   5361  1            37    NORMAL
37   UP   453000000   DOCSIS      B    256   5361  1            38    NORMAL
38   UP   459000000   DOCSIS      B    256   5361  1            39    NORMAL
39   UP   465000000   DOCSIS      B    256   5361  1            40    NORMAL
40   UP   471000000   DOCSIS      B    256   5361  1            41    NORMAL
41   UP   477000000   DOCSIS      B    256   5361  1            42    NORMAL
42   UP   483000000   DOCSIS      B    256   5361  1            43    NORMAL
43   UP   489000000   DOCSIS      B    256   5361  1            44    NORMAL
44   UP   495000000   DOCSIS      B    256   5361  1            45    NORMAL
45   UP   501000000   DOCSIS      B    256   5361  1            46    NORMAL
46   UP   507000000   DOCSIS      B    256   5361  1            47    NORMAL
47   UP   513000000   DOCSIS      B    256   5361  1            48    NORMAL
48   UP   519000000   DOCSIS      B    256   5361  1            49    NORMAL
49   UP   525000000   DOCSIS      B    256   5361  1            50    NORMAL
50   UP   531000000   DOCSIS      B    256   5361  1            51    NORMAL
51   UP   537000000   DOCSIS      B    256   5361  1            52    NORMAL
52   UP   543000000   DOCSIS      B    256   5361  1            53    NORMAL
53   UP   549000000   DOCSIS      B    256   5361  1            54    NORMAL
54   UP   555000000   DOCSIS      B    256   5361  1            55    NORMAL
55   UP   561000000   DOCSIS      B    256   5361  1            56    NORMAL
56   UP   567000000   DOCSIS      B    256   5361  1            57    NORMAL
57   UP   573000000   DOCSIS      B    256   5361  1            58    NORMAL
58   UP   579000000   DOCSIS      B    256   5361  1            59    NORMAL
59   UP   585000000   DOCSIS      B    256   5361  1            60    NORMAL
60   UP   591000000   DOCSIS      B    256   5361  1            61    NORMAL
61   UP   597000000   DOCSIS      B    256   5361  1            62    NORMAL
62   UP   603000000   DOCSIS      B    256   5361  1            63    NORMAL
63   UP   609000000   DOCSIS      B    256   5361  1            64    NORMAL
Chan Admin Mod-Type   Start       Width    PLC        Profile-ID   dcid  output
                      Frequency
158  UP   OFDM        789000000  96000000  795000000      2        159   NORMAL
159  UP   OFDM        885000000  96000000  891000000      2        160   NORMAL
160  UP   OFDM        981000000  96000000  987000000      2        161   NORMAL
161  UP   OFDM        1077000000 96000000  1083000000    20        162   NORMAL

Router#
```

Note

- If you configure more than four ofdm channels per controller, then the following message is displayed:
  ```
  Error: Max 4 ofdm channels per controller permitted.
  ```

- If you configure more than two, therr, or four ofdm channels per controller, then the following error message is displayed: `The DS controller profile 104 should be applied to RPDs which have capability to support the same or more number of OFDM channels.`

RPD OFDM Capability

Use the following command to obtain how many OFDM channels are supported on the cBR-8 router.

```
Router#show cable rpd 1004.9fb1.0300 capability | i OFDM Channel
Downstream OFDM Channels Per Port : 2
```

The RPD reports the above information.

The number of OFDM channels in DS controller profile should be less than or equal to the RPD's capability. Use the **cable rphy rpd-capability reject-mismatch** to control whether RPDs with OFDM capability mismatch are online or not. This command is enabled by default. If the command is enabled, then RPDs with OFDM capability mismatch do not become online. You can use **no cable rphy rpd-capability reject-mismatch** command to disable this configuration and to accept the capabilities mismatch and let the RPDs come online, but in this case, the RPDs may behave in a nondeterministic manner.

The following example shows you how to configure the **no cable rphy rpd-capability reject-mismatch** command, accept the capabilities mismatch and let the RPDs come online.

```
Router#show cable rpd 0004.9f31.0979 capability | s Downstream OFDM
Downstream OFDM Channels Per Port        : 2

Router#show cable rpd
MAC Address     IP Address       I/F       State        Role HA  Auth Name

0004.9f31.0979  ---              Te6/1/0   online       Pri  Act N/A  RPD1

Router(config)#cable rpd RPD1
Router(config-rpd)# identifier 0004.9f31.0979
Router(config-rpd)# core-interface Te6/1/0
Router(config-rpd-core)#  principal
Router(config-rpd-core)#rpd-ds 0 downstream-cable 6/0/3 profile 23

2023/01/16 12:27:14.953736374 {rphyman_R0-0}{255}: [errmsg] [1630]: UUID: 0, ra: 0 (ERR):
%RPHYMAN-3-RPD_CAPA_PARAM_MISMATCH_ERROR:
R0/0: rphyman: rpd_capa check, rpd_id: 0004.9f31.0979,  config_value 3 rpdCapa_value 2,
event: NumDsOfdmChannels mismatch, reject RPD online,
please configure OFDM channels equal to its capability..

Router#show cable rpd
MAC Address     IP Address       I/F       State        Role HA  Auth Name
0004.9f31.0979  ---              Te6/1/0   offline      Pri  Act N/A  RPD1
```

After configuring the **no cable rphy rpd-capability reject-mismatch** command, the RPD status displays as **online** as shown in the **show cable rpd** output below.

```
Router(config)#no cable rphy rpd-capability reject-mismatch

2023/01/16 12:32:13.480653142 {rphyman_R0-0}{255}: [errmsg] [1630]: UUID: 0, ra: 0 (warn):
 %RPHYMAN-4-RPD_CAPA_PARAM_MISMATCH_WARNING:
R0/0: rphyman: rpd_capa check, rpd_id: 0004.9f31.0979, config_value 3 rpdCapa_value 2,
event: NumDsOfdmChannels mismatch, accept RPD online,
but it may behave in a non-deterministic manner, suggest configure OFDM channels equal to
its capability.

Router#show cable rpd
MAC Address     IP Address       I/F       State        Role HA  Auth Name
0004.9f31.0979  ---              Te6/1/0   init(gcp)    Pri  Act N/A  RPD1

Router#show cable rpd
MAC Address     IP Address       I/F       State        Role HA  Auth Name
0004.9f31.0979  ---              Te6/1/0   online       Pri  Act N/A  RPD1
```

See cable rphy rpd-capability reject-mismatch.

Static Bonding Group

The Maximum OFDM channels count per Static Bonding Group is 2.

```
Router(config-if)#cable rf-channels channel-list 158-159 bandwidth-percent 50
Router(config-if)#do sh run int wi6/0/3:4
Building configuration...
Current configuration : 135 bytes
!
interface Wideband-Cable6/0/3:4
 cable bundle 1
 cable rf-channels channel-list 158-159 bandwidth-percent 50
 end
Router(config-if)#cable rf-channels channel-list 160-161 bandwidth-percent 20
Error: Static Bonding Group supports only 2 ofdm channels!!
Router(config-if)#do sh run int wi6/0/3:4
Building configuration...
Current configuration : 135 bytes
interface Wideband-Cable6/0/3:4
 cable bundle 1
 cable rf-channels channel-list 158-159 bandwidth-percent 50
 end

Router(config)#cable profile service-group SG
Router(config-profile-sg)#cable bundle 1
Router(config-profile-sg)#mac-domain 0 profile MD1
Router(config-profile-sg-md)#downstream sg-channel 0-3 profile DS1
Router(config-profile-sg-md)#upstream 0 sg-channel 0
Router(config-profile-sg-md)#upstream 1 sg-channel 1
Router(config-profile-sg-md)#upstream 2 sg-channel 2
Router(config-profile-sg-md)#wideband-interface 0 profile BG1
 The WB Profile doesn't exist, please create it.
Router(config-profile-sg)#cable profile wideband-interface BG1
Router(config-profile-sg)#cable downstream attribute-mask 80000000
Router(config-profile-sg)#wideband-interface 0 profile BG1
Router(config-profile-sg-bg)#downstream sg-channel 158-160 rf-bandwidth-percent 20
Error: Static Bonding Group supports only 2 ofdm channels!!
Router(config-profile-sg-bg)#downstream sg-channel 158-159 rf-bandwidth-percent 20
Router(config-profile-sg-bg)#do sh run | i bandwidth
 downstream sg-channel 0-7 rf-bandwidth-percent 1
  downstream sg-channel 8-15 rf-bandwidth-percent 1
  downstream sg-channel 16-23 rf-bandwidth-percent 1
  downstream sg-channel 24-31 rf-bandwidth-percent 1
  downstream sg-channel 24-31 158 rf-bandwidth-percent 1
  downstream sg-channel 24-31 rf-bandwidth-percent 1
  downstream sg-channel 158-159 rf-bandwidth-percent 20
```

Dynamic Bonding Group (DBG)

DBG is a feature that creates WB interface dynamically for LB or registration purposes. Max OFDM channels count per DBG is also 2. You can globally enable DBG using the following configuration.

```
Router# cable dynamic-bonding-group
```

Use **no cable dynamic-bonding-group** to disable DBG.

You can also enable Registration or Load Balance separately.

```
Router# cable dynamic-bonding-group registration
```

```
Router# cable dynamic-bonding-group load-balance
```

Use the no form of the command to disable Registration or Load Balance.

```
Router# no cable dynamic-bonding-group registration

Router# no cable dynamic-bonding-group load-balance
```

The following example is a sample configuration for 64 SCQAM + 4OFDM - SCQAM primary channel

```
Router#show derived-config interface c3/0/0
Building configuration...

Derived configuration : 1754 bytes
!
interface Cable3/0/0
 downstream Downstream-Cable 3/0/0 rf-channel 0 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 4 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 8 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 12 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 16 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 20 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 24 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 28 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 32 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 36 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 40 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 44 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 48 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 52 profile DS1
 downstream Downstream-Cable 3/0/0 rf-channel 56 profile DS1

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
24577 Wi3/0/0:0    34      12    60        Jun 26 17:12:08.596   MODEM_ONLINE
OPERATIONAL         24608-24639, 24736-24737
24578 Wi3/0/0:1    34      10    50        Jun 26 17:12:19.411   MODEM_ONLINE
OPERATIONAL         24576-24607, 24734-24735
```

Load Balancing (LB)

There are two types of Load Balancing:

- **Static LB**: Balances modem during registration based on the modem count.

- **Dynamic LB**: Balances modem after modem registration based on the traffic or utilization.

Before 4OFDM, LB(SLB and DLB) doesn't change the OFDM channel of the DOCSIS 3.1 modem in modem movement, SLB doesn't move the DOCSIS 3.1 modem when the modem is using OFDM primary channel, and DLB only changes DOCSIS 3.1 modem's SCQAM channel set for balance purpose.

With 4OFDM, LB does balance among 4 OFDM channels, LB changes the modem's OFDM channel set for balance purpose.

There are two rules for DOCSIS 3.1 modem movement in LB.

- If the DOCSIS 3.1 modem uses SCQAM channel as a primary channel, LB only changes the primary channel of the DOCSIS 3.1 modem to SCQAM primary channel, not to OFDM primary channel.

- f the DOCSIS 3.1 modem use OFDM channel as a primary channel, LB only change the primary channel of the DOCSIS 3.1 modem to OFDM primary channel, not to SCQAM primary channel.

The following example shows Load-Balancing SG profile:

```
Router# show cable profile service-group
cable profile service-group SG-64
cable bundle 1
mac—domain O profile MD1
downstream sg-channel 0 4 8 12 20 24 28 32 36 40 44 48 52 56 profile
upstream 1 sg-channel 0
upstream 1 sg-channel 1
upstream 2 sg-channel 2
upstream 3 sg-channel 4
upstream 4 sg-channel 5
upstream 5 sg-channel 6
upstream 6 sg-channel 7
us-bonding-group 1
upstream 0
upstream 1
upstream 2
upstream 3
us-bonding-group 2
upstream 4
upstream 5
upstream 6
upstream 7
attributes 80000000

Router #show cable mac—domain c3/0/O rcc

RCC-ID RCP            RCs MD-DS-SG CMS WB/RCC-TMPL D3.0 D3.1
17     00 00 00 00 00 34  0        10  (Wi3/O/O:O)  N    Y
18     00 00 00 00 00 34  0        12  (Wi3/O/O:1)  N    Y
```

The following example shows DBG Load Balancing:

```
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
24577 Wi3/0/0:0    34       13   65        Jun 26 17:12:08.597   MODEM_ONLINE
OPERATIONAL         24608-24639, 24736-24737
24578 Wi3/0/0:1    34       9    45        Jun 26 17:12:19.412   MODEM_ONLINE
OPERATIONAL         24576-24607, 24734-24735

video-LWR-S-A4#sh derived-config interface Wi3/0/0:0
Building configuration...

Derived configuration : 147 bytes
!
interface Wideband-Cable3/0/0:0
 cable bundle 1
 cable rf-channels channel-list 32-63 160-161 bandwidth-percent 1
 no snmp trap link-status
end

Router#show derived-config interface Wi3/0/0:1
Building configuration...

Derived configuration : 146 bytes
!
interface Wideband-Cable3/0/0:1
 cable bundle 1
 cable rf-channels channel-list 0-31 158-159 bandwidth-percent 1
```

```
 no snmp trap link-status
end
```

The following example shows Static Load Balancing:

```
Router#show cable load-balance
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: Yes
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  Threshold
             /UCC         D/U             M/E/U/P/S
Ca3/0/0  1  2147557376 E 45     0x08 (4) N 0        m/m 0x90012C  5/10/70/70/50
Ca3/0/0  2  2147557377 E 45     0x08 (4) N 0        m/m 0x900130  5/10/70/70/50
Ca3/0/2  5  2147558404 E 90     0x08 (4) N 0        m/m 0x920401  10/20/70/70/50
Ca3/0/2  5  2147558405 E 90     0x08 (4) N 0        m/m 0x920402  10/20/70/70/50

Router#show cable load-balance docsis-group fn 1 md c3/0/0 load | in Do
Do3/0/0:0(453 MHz)   initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:4(477 MHz)   initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:8(501 MHz)   initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:12(525 MHz)  initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:16(549 MHz)  initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:20(573 MHz)  initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:24(597 MHz)  initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:28(621 MHz)  initial 2147557376  97%(90%/97%)  0%  0   12   37
Do3/0/0:32(645 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:36(669 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:40(693 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:44(717 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:48(717 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:52(717 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
Do3/0/0:56(717 MHz)  initial 2147557376  97%(84%/97%)  0%  0   12   37
```

The following example shows Dynamic Load Balancing:

```
Router# cable load-balance docsis-group fn 49 md c8/0/16 rf
Router#show cable load-balance docsis-group fn 49 md c8/0/16 rfch-util
Load for five secs: 42%/4%; one minute: 45%; five minutes: 50%
Time source is NTP, 22:33:50.525 CST Thu Feb 2 2023


Interface     Pstate   Pending-In Pending-Out Throughput(Kbps) Util   NBCM WBCM
Do8/0/16:0    up       No         No          15552            41%    0    7
Do8/0/16:1    NA       No         No          15592            41%    0    7
Do8/0/16:2    NA       No         No          15592            41%    0    7
Do8/0/16:3    NA       No         No          15593            41%    0    7
Do8/0/16:4    up       No         No          15554            41%    0    7
Do8/0/16:5    NA       No         No          15592            41%    0    7
Do8/0/16:6    NA       No         No          15591            41%    0    7
Do8/0/16:7    NA       No         No          15592            41%    0    7
Do8/0/16:8    initial  No         No          15554            41%    0    4
Do8/0/16:9    NA       No         No          15592            41%    0    4
Do8/0/16:10   NA       No         No          15592            41%    0    4
Do8/0/16:11   NA       No         No          15592            41%    0    4
Do8/0/16:12   initial  No         No          15555            41%    0    4
Do8/0/16:13   NA       No         No          15593            41%    0    4
Do8/0/16:14   NA       No         No          15592            41%    0    4
Do8/0/16:15   NA       No         No          15592            41%    0    4
Do8/0/16:16   up       No         No          15558            41%    0    8
Do8/0/16:17   NA       No         No          15601            41%    0    8
Do8/0/16:18   NA       No         No          15601            41%    0    8
Do8/0/16:19   NA       No         No          15602            41%    0    8
Do8/0/16:20   up       No         No          15557            41%    0    8
```

```
Do8/0/16:21   NA       No       No       15602        41%    0    8
Do8/0/16:22   NA       No       No       15602        41%    0    8
Do8/0/16:23   NA       No       No       15601        41%    0    8
Do8/0/16:24   up       No       No       15558        41%    0    10
Do8/0/16:25   NA       No       No       15602        41%    0    10
Do8/0/16:26   NA       No       No       15602        41%    0    10
Do8/0/16:27   NA       No       No       15601        41%    0    10
Do8/0/16:28   up       No       No       15558        41%    0    10
Do8/0/16:29   NA       No       No       15601        41%    0    10
Do8/0/16:30   NA       No       No       15601        41%    0    10
Do8/0/16:31   NA       No       No       15601        41%    0    10
Do8/0/16:32   initial  No       No       15558        41%    0    4
Do8/0/16:33   NA       No       No       15600        41%    0    4
Do8/0/16:34   NA       No       No       15601        41%    0    4
Do8/0/16:35   NA       No       No       15601        41%    0    4
Do8/0/16:36   initial  No       No       15558        41%    0    4
Do8/0/16:37   NA       No       No       15601        41%    0    4
Do8/0/16:38   NA       No       No       15601        41%    0    4
Do8/0/16:39   NA       No       No       15601        41%    0    4
Do8/0/16:40   initial  No       No       15557        41%    0    5
Do8/0/16:41   NA       No       No       15600        41%    0    5
Do8/0/16:42   NA       No       No       15600        41%    0    5
Do8/0/16:43   NA       No       No       15601        41%    0    5
Do8/0/16:44   up       No       No       15558        41%    0    5
Do8/0/16:45   NA       No       No       15601        41%    0    5
Do8/0/16:46   NA       No       No       15600        41%    0    5
Do8/0/16:47   NA       No       No       15600        41%    0    5
Do8/0/16:158  NA       No       No       243830       57%    0    8
Do8/0/16:159  NA       No       No       246994       57%    0    8
Do8/0/16:160  NA       No       No       0            0%     0    0
Do8/0/16:161  NA       No       No       0            0%     0    0
Average: 40.38
Variance: 73.575

Router#show cable load-balance docsis-group fn 49 md c8/0/16 load wideband
Load for five secs: 40%/12%; one minute: 45%; five minutes: 49%
Time source is NTP, 22:37:52.939 CST Thu Feb 2 2023
DOCSIS load-balancing wideband load
Interface     Size    Group       Throughput(Kbps)/bw(Mbps)    Avg-Util
Wi8/0/16:3    34      2147639344           951416/2113         63%
Wi8/0/16:4    8       2147639344                0/300          38%
Wi8/0/16:18   8       2147639344                0/300          33%
Wi8/0/16:19   8       2147639344                0/300          38%
Wi8/0/16:20   8       2147639344                0/300          33%
Wi8/0/16:21   34      2147639344           542868/2113         62%
Wi8/0/16:22   8       2147639344                0/300          38%
Wi8/0/16:23   34      2147639344           896826/2062         61%
```

Channel Profile

A globally configured OFDM channel profile contains channel parameters, and the modulation or modulation profile associated with the control, NCP, and data profiles.

Each OFDM channel must specify an OFDM channel profile in its configuration.

Modulation Profile

A globally configured OFDM modulation profile assigns different modulations to ranges of sub-carriers, or lists of individual sub-carriers.

A modulation profile may be assigned to a control, NCP, or data profile in a channel profile.

OFDM Channel Exclusion Band

Ranges of frequencies can be excluded from all OFDM channels on a port using the **ofdm-freq-excl-band** command.

How to Configure OFDM Channel

Configuring OFDM Modulation Profile

To configure the OFDM modulation profile, follow the steps below:

enable
configure terminal
cable downstream ofdm-modulation-profile *id*
description *text*
subcarrier-spacing *value*
width *value*
start-frequency *value*
assign {**modulation-default** *mod_prof_id* | **modulation** *mod_prof_id* {**list-subcarriers** {**freq-abs** | **freq-offset**} *value* | **range-subcarriers** {**freq-abs** | **freq-offset**} *value* **width** *value*}}

✎

Note   Subcarrier spacing must match the subcarrier spacing of each channel profile in which it is configured.

Verifying OFDM Modulation Profile Configuration

To display the OFDM modulation profile details, use the **show cable ofdm-modulation-profiles** command as shown in the example below:

```
Router# show cable ofdm-modulation-profile 10

**** OFDM Modulation Profile Configuration ****

Prof  FFT   Width      Start-freq Modulations
ID    KHz   Hz         Hz
10    50    96000000   627000000  64   default
                                  512  freq-abs  709050000 width   12000000
                                  2048 freq-abs  629000000 width    6000000

Profile Subcarrier Modulations
 Modulation: Start-freq-abs[start-sc] - End-freq-abs[end-sc] Width-freq[num-sc]
 64  : 572600000[   0] -  626950000[1087]   54400000[1088]
 64  : 627000000[1088] -  628950000[1127]    2000000[  40]
 2048: 629000000[1128] -  634950000[1247]    6000000[ 120]
 64  : 635000000[1248] -  709000000[2728]   74050000[1481]
 512 : 709050000[2729] -  721000000[2968]   12000000[ 240]
 64  : 721050000[2969] -  722950000[3007]    1950000[  39]
 64  : 723000000[3008] -  777350000[4095]   54400000[1088]

**** OFDM Modulation Profile Assigned Channel Profiles ****
```

```
Prof  Channel
ID    Profiles
10    30
```

To display the associations between OFDM modulation profiles and OFDM channel profiles, use the **show cable ofdm-modulation-profile** command with **channel-profiles** option as shown in the example below:

```
Router# show cable ofdm-modulation-profile channel-profiles

**** OFDM Modulation Profile Assigned Channel Profiles ****

Prof  Channel
ID    Profiles
8     None
9     28
10    30
192   192
```

To display the OFDM modulation profile configurations, use the **show cable ofdm-modulation-profile** command with **configuration** option as shown in the example below:

```
Router# show cable ofdm-modulation-profile configuration

**** OFDM Modulation Profile Configuration ****

Prof  FFT  Width      Start-freq Modulations              Description
ID    KHz  Hz         Hz                                  (Limited to 20)
8     50   192000000  NA         2048 default
                                 512  freq-off   48000000
                                      width      24000000
9     50   96000000   627000000  512  default              512-1k-4k
                                 1024 freq-abs 635000000
                                      width      74050000
                                 4096 freq-abs 629000000
                                      width       6000000
10    50   96000000   627000000  64   default
                                 512  freq-abs 709050000
                                      width      12000000
                                 2048 freq-abs 629000000
                                      width       6000000
```

Configuring OFDM Channel Profile

To configure the OFDM channel profile, follow the steps below:

enable
configure terminal
cable downstream ofdm-chan-profile *id*
description *text*
cyclic-prefix *value*
interleaver-depth *value*
pilot-scaling *value*
roll-off *value*
subcarrier-spacing *value*
profile-ncp modulation-default *mod_prof_id*
profile-control {**modulation-default** *mod_prof_id* | **modulation-profile** *mod_prof_id*}

```
profile-data channel_data_prof_id {modulation-default mod_prof_id |
modulation-profile mod_prof_id}
```

Verifying OFDM Channel Profile Configuration

To display the OFDM channel profile details, use the **show cable ofdm-chan-profiles** command as shown in the example below:

```
Router# show cable ofdm-chan-profile 20

**** OFDM Channel Profile Configuration ****

Prof  Cycl  Roll  FFT  Intr   Pilot  Modulation (D-Default, P-Profile)
ID    Prfx  Off   KHz  Depth  Scale  Cntrl   NCP    Data Profiles

                                                    1      2      3      4      5

20    1024  128   50   16     48     D:1024  D:16   NA     NA     NA     NA     NA
**** OFDM Channel Profile Assigned Channels ****

Prof  Admin   Controller:channels
ID
20    Up      3/0/1:158          3/0/2:158          3/0/3:158          3/0/5:158

              3/0/6:158          3/0/7:158
```

To display the associations between OFDM channel profiles and OFDM channels, use the **show cable ofdm-chan-profiles** command with **channels** option as shown in the example below:

```
Router# show cable ofdm-chan-profile channels

**** OFDM Channel Profile Assigned Channels ****

Prof  Admin   Controller:channels
ID
20    Up      3/0/1:158          3/0/2:158          3/0/3:158          3/0/5:158

              3/0/6:158          3/0/7:158
30    Up      3/0/4:158
101   Up      3/0/0:158
```

To display the OFDM channel profile configurations, use the **show cable ofdm-chan-profiles** command with **configuration** option as shown in the example below:

```
Router# show cable ofdm-chan-profile configuration

**** OFDM Channel Profile Configuration ****

Prof  Cycl  Roll  FFT  Intr   Pilot  Modulation (D-Default, P-Profile)
  Description
ID    Prfx  Off   KHz  Depth  Scale  Cntrl   NCP    Data Profiles
  (Limited to 20)
                                                    1       2       3      4      5

0     192   128   50   16     48     D:256   D:16   D:1024  NA      NA     NA     NA
  System Profile 0
1     192   128   50   16     48     D:256   D:16   D:1024  D:2048  D:512  NA     NA
  System Profile 1
20    1024  128   50   16     48     D:1024  D:16   NA      NA      NA     NA     NA
30    1024  128   50   16     48     P:10    D:16   NA      NA      NA     NA     NA
```

Configuring OFDM Channel as Primary Channel

To configure an RF-channel in the mac-domain as an OFDM primary channel, use the following commands.

```
enable
configure terminal
interface cable <slot/subslot/port> downstream Integrated-Cable <slot/subslot/port>
rf-channel <ofdm-channel-number: 158-162>
end
```

Verifying OFDM Primary Channel Configuration

To display the OFDM channel configuration details, where the OFDM channel is the primary channel, use the command as shown in the following example:

```
Router#sh run int c3/0/3
Building configuration...

Current configuration : 539 bytes
!
interface Cable3/0/3
 load-interval 30
 downstream Integrated-Cable 3/0/3 rf-channel 0
 downstream Integrated-Cable 3/0/3 rf-channel 158
 upstream 0 Upstream-Cable 3/0/6 us-channel 0
 upstream 1 Upstream-Cable 3/0/6 us-channel 1
 upstream 2 Upstream-Cable 3/0/6 us-channel 2
 upstream 3 Upstream-Cable 3/0/6 us-channel 3
 cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
 cable bundle 1
 cable cm-status enable 3 6-11 16-18 20-27
 cable privacy accept-self-signed-certificate
end
```

You can also use the following command to display the OFDM primary channel configuration details as shown in this example.

```
Router#sh cable mac-domain c3/0/3 cgd-associations
CGD Host  Resource  DS Channels           Upstreams   (ALLUS)   Active DS
Ca3/0/3   3/0/3     0                     0-3         Yes       0
                    158                   0-3         Yes       158
```

The **show cable mac-domain Cable <slot>/<subslot>/<port> mdd** command also displays the OFDM primary channel configuration details as shown in the example.

```
...
Downstream Active Channel List
        Channel ID:             159
        Frequency:              836000000Hz
        Primary Capable:        Primary-Capable
        CM-STATUS Event Bitmask:0x36
                                MDD Timeout
                                QAM FEC failure
                                MDD Recovery
                                QAM FEC recovery
        MAP/UCD Transport Indicator:  Can carry MAPs and UCDs
        OFDM PLC Params Bitmask:
                Tukey raised cosine window: 0.625
```

```
                    Cyclic Prefix: 5.0
                    Sub carrier spacing: 50
```

RF channels use a zero-based numbering scheme, whereas the downstream channel IDs are numbered starting from one. Thus RF channel 158 is equivalent to channel ID 159. The Channel ID in this example is 159. The `MAP/UCD Transport Indicator` shows that MAPs and UCDs are sent only on Primary Channels.

Configuring Port or Controller and Channel

To configure the port/controller and channel, use the following commands:

enable
configure terminal
controller integrated-cable *slot/subslot/port*
max-ofdm-spectrum *value*
ofdm-freq-excl-band start-frequency *value* **width** *value*
rf-chan *start_id* [*end_id*]
ofdm channel-profile *id* **start-frequency** *value* **width** *value* [**plc** *value*]

Note   The range of *start_id* is 158 to 162 in the OFDM channel configuration.

The maximum OFDM spectrum is assigned to OFDM channels, which is used by the the CMTS to calculate default port base power.

Ranges of frequencies can be excluded from all OFDM channels using the **ofdm-freq-excl-band** command.

Verifying Port/Controller and Channel Configuration

To display the RF port details, use the **show controller integrated-cable** command with **rf-port** option as shown in the example below:

```
Router# show controller integrated-cable 3/0/0 rf-port

Admin:  UP  MaxCarrier: 128  BasePower: 33 dBmV  Mode: normal
  Rf Module 0: UP
  Free freq block list has 3 blocks:
    45000000  - 107999999
    624000000 - 644999999
    837000000 - 1217999999
  Rf Port Status: UP
  MaxOfdmSpectrum:  192000000   Equivalent 6MHz channels: 32
  UsedOfdmSpectrum: 192000000   AvailOfdmSpectrum:        0
  DefaultBasePower: 33 dBmV     Equivalent 6MHz channels: 160
  OFDM frequency exclusion bands: None
```

To display the summary information on OFDM channel, use the **show controller integrated-cable** command with **rf-channel** option as shown in the example below:

```
Router# show controller integrated-cable 3/0/0 rf-channel 158

Chan State Admin Mod-Type Start       Width     PLC        Profile-ID    dcid   power
output
                           Frequency
 158   UP   UP    OFDM     627000000   96000000  663000000         20     159    34
```

```
NORMAL
```

To display detailed information on OFDM channel, use the **show controller integrated-cable** command with **rf-channel** and **verbose** options as shown in the example below:

```
Router# show controller integrated-cable 3/0/0 rf-channel 158 verbose

Chan State Admin Mod-Type  Start        Width      PLC          Profile-ID    dcid  power
output
                          Frequency
 158   UP   UP   OFDM      627000000    96000000   663000000        30         159   32
NORMAL
 Resource status:   OK
 License: granted <17:02:35 EDT May 18 2016>
 OFDM channel license spectrum width: 92200000
 OFDM modulation license (spectrum width): 2K (6000000)
 OFDM config state: Configured

 OFDM channel details: [3/0/4:158]
 ----------------------------------------
 OFDM channel frequency/subcarrier range  : 627000000[1088] - 722999999[3007]
 OFDM spectrum frequency/subcarrier range : 572600000[   0] - 777399999[4095]
 Active spectrum frequency/subcarrier range : 628900000[1126] - 721049999[2969]
 OFDM channel center frequency/subcarrier : 675000000[2048]
 PLC spectrum start frequency/subcarrier  : 663000000[1808]
 PLC frequency/subcarrier                 : 665800000[1864]
 Channel width                            : 96000000
 Active Channel width                     : 92200000
 OFDM Spectrum width                      : 204800000
 Chan prof id                             : 30
 Cyclic Prefix                            : 1024
 Roll off                                 : 128
 Interleave depth                         : 16
 Spacing                                  : 50KHZ
 Pilot Scaling                            : 48
 Control modulation profile               : 10
 NCP modulation default                   : 16
 Data modulation default                  : None
 Data modulation profile                  : None
 Lower guardband width in freq/subcarriers : 1900000[38]
 Upper guardband width in freq/subcarriers : 1900000[38]
 Licensed 4K modulation spectrum width    : 0
 Licensed 2K modulation spectrum width    : 6000000

 PLC spectrum frequencies [subcarriers]             :
  663000000[1808] - 668999999[1927]

 PLC channel frequencies [subcarriers]              :
  665800000[1864] - 666199999[1871]   Size: 8 subcarriers

 Excluded frequencies [subcarriers]             :
  572600000[   0] - 628899999[1125]    721100000[2970] - 777399999[4095]
  Count: 2252

 Pilot frequencies [subcarriers]                  :
  *:PLC pilots
  630700000[1162]   634300000[1234]   637900000[1306]   641500000[1378]
  645100000[1450]   648700000[1522]   652300000[1594]   655900000[1666]
  659500000[1738]   663450000[1817]*  664050000[1829]*  664600000[1840]*
  665050000[1849]*  666900000[1886]*  667350000[1895]*  667900000[1906]*
  668500000[1918]*  669100000[1930]   672700000[2002]   676300000[2074]
  679900000[2146]   683500000[2218]   687100000[2290]   690700000[2362]
  694300000[2434]   697900000[2506]   701500000[2578]   705100000[2650]
```

```
         708700000[2722]    712300000[2794]    715900000[2866]    719500000[2938]
         Count: 32

     Active frequencies [subcarriers]                          :
      628900000[1126] - 721099999[2969]
      Count: 1844

     Data frequencies [subcarriers]                            :
      628900000[1126] - 630699999[1161]      630750000[1163] - 634299999[1233]
      634350000[1235] - 637899999[1305]      637950000[1307] - 641499999[1377]
      641550000[1379] - 645099999[1449]      645150000[1451] - 648699999[1521]
      648750000[1523] - 652299999[1593]      652350000[1595] - 655899999[1665]
      655950000[1667] - 659499999[1737]      659550000[1739] - 663449999[1816]
      663500000[1818] - 664049999[1828]      664100000[1830] - 664599999[1839]
      664650000[1841] - 665049999[1848]      665100000[1850] - 665799999[1863]
      666200000[1872] - 666899999[1885]      666950000[1887] - 667349999[1894]
      667400000[1896] - 667899999[1905]      667950000[1907] - 668499999[1917]
      668550000[1919] - 669099999[1929]      669150000[1931] - 672699999[2001]
      672750000[2003] - 676299999[2073]      676350000[2075] - 679899999[2145]
      679950000[2147] - 683499999[2217]      683550000[2219] - 687099999[2289]
      687150000[2291] - 690699999[2361]      690750000[2363] - 694299999[2433]
      694350000[2435] - 697899999[2505]      697950000[2507] - 701499999[2577]
      701550000[2579] - 705099999[2649]      705150000[2651] - 708699999[2721]
      708750000[2723] - 712299999[2793]      712350000[2795] - 715899999[2865]
      715950000[2867] - 719499999[2937]      719550000[2939] - 721099999[2969]
      Count: 1804

     Profiles:
      Number of profiles: 2
      CTRL profile (Profile A): rate: 461916 kbps, usable rate: 368000 kbps
      Active frequencies [subcarriers]:
      Modulation:Start-freq[start-subcarrier] - End-freq[end-subcarrier]
      ------------------------------------------------------------------
      64   :628900000[1126] - 628950000[1127]     2048 :629000000[1128] - 630650000[1161]
      2048 :630750000[1163] - 634250000[1233]     2048 :634350000[1235] - 634950000[1247]
      64   :635000000[1248] - 637850000[1305]     64   :637950000[1307] - 641450000[1377]
      64   :641550000[1379] - 645050000[1449]     64   :645150000[1451] - 648650000[1521]
      64   :648750000[1523] - 652250000[1593]     64   :652350000[1595] - 655850000[1665]
      64   :655950000[1667] - 659450000[1737]     64   :659550000[1739] - 663400000[1816]
      64   :663500000[1818] - 664000000[1828]     64   :664100000[1830] - 664550000[1839]
      64   :664650000[1841] - 665000000[1848]     64   :665100000[1850] - 665750000[1863]
      64   :666200000[1872] - 666850000[1885]     64   :666950000[1887] - 667300000[1894]
      64   :667400000[1896] - 667850000[1905]     64   :667950000[1907] - 668450000[1917]
      64   :668550000[1919] - 669050000[1929]     64   :669150000[1931] - 672650000[2001]
      64   :672750000[2003] - 676250000[2073]     64   :676350000[2075] - 679850000[2145]
      64   :679950000[2147] - 683450000[2217]     64   :683550000[2219] - 687050000[2289]
      64   :687150000[2291] - 690650000[2361]     64   :690750000[2363] - 694250000[2433]
      64   :694350000[2435] - 697850000[2505]     64   :697950000[2507] - 701450000[2577]
      64   :701550000[2579] - 705050000[2649]     64   :705150000[2651] - 708650000[2721]
      64   :708750000[2723] - 709000000[2728]     512  :709050000[2729] - 712250000[2793]
      512  :712350000[2795] - 715850000[2865]     512  :715950000[2867] - 719450000[2937]
      512  :719550000[2939] - 721000000[2968]     64   :721050000[2969] - 721050000[2969]
      Active subcarrier count: 1804, ZBL count: 0
      Discontinuity time [days:hours:mins:secs]: 00:00:54:32 [16:15:02 EDT May 18 2016]

     NCP profile:
      Active frequencies [subcarriers]:
      Modulation:Start-freq[start-subcarrier] - End-freq[end-subcarrier]
      ------------------------------------------------------------------
      16   :628900000[1126] - 630650000[1161]     16   :630750000[1163] - 634250000[1233]
      16   :634350000[1235] - 637850000[1305]     16   :637950000[1307] - 641450000[1377]
      16   :641550000[1379] - 645050000[1449]     16   :645150000[1451] - 648650000[1521]
      16   :648750000[1523] - 652250000[1593]     16   :652350000[1595] - 655850000[1665]
      16   :655950000[1667] - 659450000[1737]     16   :659550000[1739] - 663400000[1816]
```

```
16   :663500000[1818] - 664000000[1828]    16   :664100000[1830] - 664550000[1839]
16   :664650000[1841] - 665000000[1848]    16   :665100000[1850] - 665750000[1863]
16   :666200000[1872] - 666850000[1885]    16   :666950000[1887] - 667300000[1894]
16   :667400000[1896] - 667850000[1905]    16   :667950000[1907] - 668450000[1917]
16   :668550000[1919] - 669050000[1929]    16   :669150000[1931] - 672650000[2001]
16   :672750000[2003] - 676250000[2073]    16   :676350000[2075] - 679850000[2145]
16   :679950000[2147] - 683450000[2217]    16   :683550000[2219] - 687050000[2289]
16   :687150000[2291] - 690650000[2361]    16   :690750000[2363] - 694250000[2433]
16   :694350000[2435] - 697850000[2505]    16   :697950000[2507] - 701450000[2577]
16   :701550000[2579] - 705050000[2649]    16   :705150000[2651] - 708650000[2721]
16   :708750000[2723] - 712250000[2793]    16   :712350000[2795] - 715850000[2865]
16   :715950000[2867] - 719450000[2937]    16   :719550000[2939] - 721050000[2969]
Active subcarrier count: 1804, ZBL count: 0


CCCs:
  OCD CCC: 2
  DPD CCCs:
    Control profile  (Profile A) CCC: 2
        NCP profile  CCC: 2
Resource config time taken: 2286 msecs



JIB channel number: 776
Chan Pr EnqQ  Pipe  RAF    SyncTmr DqQ ChEn   RAF Pipe Phy0 Phy1 Tun# SessId 0[TkbRt MaxP]
    1[TkbRt MaxP]
776  0   384    1   725      0 384 0100 13032   1   0    1    2      0 479610000 4485120
383688000 4485120
776  1   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  2   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  3   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  4   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  5   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  6   384    1  4786      0 384 0100  2190   1   0    1    2      0 479610000 4485120
383688000 4485120
776  7   384    1     0      0 384 0100     0   1   0    1    2      0 479610000 4485120
383688000 4485120


Chan   Qos-Hi   Qos-Lo    Med-Hi   Med-Lo    Low-Hi   Low-Lo
776    368640   245760    368640   245760    614400   368640
Chan   Med Low TB-neg Qos_Exc  Med_Xof  Low_Xof  Qdrops(H-M-L)  Pos    Qlen(Hi-Med-lo) Fl
Tgl_cnt Rdy_sts
 776   0   0     0       0        0        0     0   0    0 Y      0        0      0 0
    0 ff
Chan      Rate   Neg   Pos    LastTS  CurrCr  Pos  [PLC Rate Neg Pos]
 776   10485750 65535 65535 116199669 268431360   Y [MM 86 128 1114][EM 87 128 6204][TR 2
9 3102]
DSPHY Info:
 Local rf port 0 , rf chan 158 pic loss 123
 non short CWs: = 235681130, shorts = 0, stuff bytes = 235639172 bch 235681130
 NCP msgs: = 453809753, PLC encodings = 16902476
 flow0 rcv 70203 flow1 rcv 3 flow0 drops 0 flow1 drops 0
```

Configuration Examples

This section provides examples for configuring the OFDM channel.

Example1: Configuring OFDM Channel

Note The OFDM modulation profile must be configured before the OFDM channel profile which references it.

The following example shows how to configure the OFDM channel:

```
enable
configure terminal
cable downstream ofdm-modulation-profile 9
description 512-1k-4k
subcarrier-spacing 50KHz
width 96000000
start-frequency 627000000
assign modulation-default 512-QAM
assign modulation 1024-QAM range-subcarriers freq-abs 635000000 width 74050000
assign modulation 4096-QAM range-subcarriers freq-abs 629000000 width 6000000
exit
configure terminal
cable downstream ofdm-chan-profile 20
description Data profiles: 2 single mod, 1 mixed mod
cyclic-prefix 192
interleaver-depth 16
pilot-scaling 48
roll-off 128
subcarrier-spacing 50KHz
profile-ncp modulation-default 16-QAM
profile-control modulation-default 256-QAM
profile-data 1 modulation-default 1024-QAM
profile-data 2 modulation-default 2048-QAM
profile-data 3 modulation-profile 9
exit
configure terminal
controller integrated-cable 3/0/0
max-ofdm-spectrum 96000000
ofdm-freq-excl-band start-frequency 683000000 width 10000000
rf-chan 158
power-adjust 0
docsis-channel-id 159
ofdm channel-profile 20 start-frequency 627000000 width 96000000 plc 663000000
```

Example 2: Configuring OFDM Primary Channel in the MAC Domain

```
enable
configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
interface cable 3/0/0
downstream Integrated-Cable 3/0/3 rf-channel 158
end
```

Additional References

Related Document

Document Title	Link
Cisco cBR Converged Broadband Routers Layer 2 and DOCSIS 3.0 Configuration Guide	http://www.cisco.com/c/en/us/td/docs/cable/cbr/configuration/guide/b_cbr_layer2_docsis30.html

MIBs

MIBs	MIBs Link
DOCS-IF31-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature Information for DOCSIS 3.1 OFDM Channel Configuration

Use Cisco Feature Navigator to find information about the platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to the https://cfnng.cisco.com/ link. An account on the Cisco.com page is not required.

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 3: Feature Information for DOCSIS 3.1 OFDM Channel Configuration

Feature Name	Releases	Feature Information
DOCSIS 3.1 OFDM Channel Support	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Full Spectrum 108-1218 MHz Support	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
DOCSIS 3.1 OFDM Primary Channel Support	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Enhanced support for subcarrier spacing, exclusion band, and LCPR	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Hitless OFDM Profile Changes	Cisco IOS XE Everest 16.12.1x	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Ephemeral Profile to Cable Modem Assignment	Cisco IOS XE Everest 16.12.1x	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Profile Management Application Scaling	Cisco IOS XE Everest 16.12.1z	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.