DOCSIS 3.1 OFDMA Channel Configuration

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

- Hardware Compatibility Matrix for the Cisco cBR Series Routers, on page 1
- Information about OFDMA Channel Configuration, on page 2
- How to Configure OFDMA Channel, on page 3
- Feature Information for DOCSIS 3.1 OFDMA Channel Configuration, on page 12

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 • PID—CBR-CCAP-SUP-60G • PID—CBR-SUP-8X10G-PIC	**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 Cisco cBR-8 Downstream PHY Modules: • PID—CBR-D30-DS-MOD • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D30-US-MOD • PID—CBR-D31-US-MOD

Information about OFDMA Channel Configuration

OFDMA Channels

DOCSIS 3.1 introduces modes for higher throughput and higher spectral efficiency while still allowing backward compatibility to DOCSIS 3.0. Orthogonal Frequency Division Multiple Access (OFDMA) channel has following features:

- Frequency-range up to 80 MHz—The Cisco IOS XE Fuji 16.7.x supports the configuration of up to 80 MHz OFDMA channel on every port of a line card.
- Upstream spectrum 5 – 85 MHz
- 50 kHz subcarrier spacing
- 25 kHz subcarrier spacing

For a specific subcarrier spacing, the number of subcarriers on an OFDMA channel depends on the channel width.

Channel Width	50 kHz	25 kHz
48 MHz	960	1920
96 MHz	1920	3840

Note When the OFDMA is configured with SC-QAMs on the same port pair, it is recommended to configure no more than 45 MHz OFDMA per port, or 90 MHz per port pair in Cisco IOS XE Everest 16.6.1.

Modulation Profile

A globally configured OFDMA modulation profile defines modulation orders and pilot patterns for different interval usage codes (IUC). It is also used to assign parameters for initial ranging and fine ranging.

OFDMA Channel Exclusion Band

Ranges of frequencies can be excluded from all OFDMA channels on a port using the **ofdma-frequency-exclusion-band** command.

Exclusion and unused bands apply to OFDMA channels only. OFDMA channel never use frequencies in exclusion band. So the legacy SC-QAM channel can be placed in this band. OFDMA channel does not use frequencies in unused band set by **ofdma-frequency-unused-band** command for data traffic, but can send probes in them.

How to Configure OFDMA Channel

Configuring OFDMA Modulation Profile

The OFDMA modulation profile is used to configure initial ranging, fine ranging and data IUC parameters. To define the ofdma modulation profile to be applied to OFDMA channels, follow the steps below:

```
enable
configure terminal
cable mod-profile-ofdma id
subcarrier-spacing value
initial-rng-subcarrier value
fine-rng-subcarrier value
data-iuc id modulation value pilot-pattern value
```

Here is a configuration example:

```
Router# enable
Router# configure terminal
Router(config)# cable mod-profile-ofdma 466
Router(config-ofdma-mod-profile)# subcarrier-spacing 50KHz
Router(config-ofdma-mod-profile)# initial-rng-subcarrier 64
Router(config-ofdma-mod-profile)# fine-rng-subcarrier 128
Router(config-ofdma-mod-profile)# data-iuc 13 modulation 1024-QAM pilot-pattern 2
```

```
Router(config-ofdma-mod-profile)# exit
Router(config)# cable mod-profile-ofdma 423
Router(config-ofdma-mod-profile)# subcarrier-spacing 25KHz
Router(config-ofdma-mod-profile)# initial-rng-subcarrier 64
Router(config-ofdma-mod-profile)# fine-rng-subcarrier 128
Router(config-ofdma-mod-profile)# data-iuc 6 modulation 1024-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 9 modulation 1024-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 10 modulation 512-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 11 modulation 256-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 12 modulation 128-QAM pilot-pattern 9
Router(config-ofdma-mod-profile)# data-iuc 13 modulation 64-QAM pilot-pattern 9
```

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

Verifying OFDMA Modulation Profile Configuration

To display the OFDMA modulation profile details, use the **show cable modulation-profile ofdma** command as shown in the example below:

```
Router# show cable modulation-profile ofdma
Mod  Subc     IUC type   Act  Preamble  Bit       Pilot
     Spacing             subc Symbols   Loading   Pattern
421  25KHz    3  (IR)    64      4
              4  (FR)    192     1
              13 (data)                 16-QAM    8

423  25KHz    3  (IR)    64      4
              4  (FR)    128     1
              6  (data)                 1024-QAM  8
              10 (data)                 512-QAM   8
              11 (data)                 256-QAM   8
              12 (data)                 128-QAM   9
              13 (data)                 64-QAM    9

461  50KHz    3  (IR)    32      4
              4  (FR)    192     1
              13 (data)                 16-QAM    1

466  50KHz    3  (IR)    64      4
              4  (FR)    128     1
              13 (data)                 1024-QAM  2
```

Configuring OFDMA Channel

To configure the OFDMA channel, follow the steps below:

```
enable
configure terminal
controller Upstream-Cable slot/subslot/port
us-channel id docsis-mode ofdma
us-channel id subcarrier-spacing value
us-channel id frequency-range start-value end-value
us-channel id modulation-profile id
```

us-channel *id* **cyclic-prefix** *value* **roll-off-period** *value*
us-channel *id* **symbols-per-frame** *value*
us-channel *id* **data-iuc** *id* **band** *start-value end-value* **modulation** *value* **pilot-pattern** *value*

Here is a configuration example:

```
Router# enable
Router# configure terminal
Router(config)# controller Upstream-Cable 1/0/4
Router(config-controller)# us-channel 12 docsis-mode ofdma
Router(config-controller)# us-channel 12 subcarrier-spacing 25KHz
Router(config-controller)# us-channel 12 frequency-range 40000000 85000000
Router(config-controller)# us-channel 12 modulation-profile 423
Router(config-controller)# us-channel 12 cyclic-prefix 640 roll-off-period 224
Router(config-controller)# us-channel 12 symbols-per-frame 9
Router(config-controller)# us-channel 12 data-iuc 9 band 50000000 60000000 modulation 512-QAM
 pilot-pattern 8
Router(config-controller)# no us-channel 12 shutdown
```

Note

- OFDMA use us-channel range 12 – 15.
- Change docsis-mode to **ofdma** to enable OFDMA configuration options. These options are enabled by default on us-channel 12 – 15.
- It is recommended to configure no more than 4 active SC-QAMs while an OFDMA channel is present.
- A maximum of one OFDMA channel can be configured per controller.
- OFDMA channel must be placed between 40 and 85 Mhz.
- Values of the options are often interdependent, changing one value may change other values or make them invalid.
- It is recommended to set subcarrier spacing and frequency range first. Frequency range must be increment of 50 kHz.
- Overlapping frequencies between SC-QAM and OFDMA are not currently allowed.

Verifying OFDMA Channel Configuration

To display the OFDMA channel configuration, use the **show controllers upstream-Cable us-channel** command as shown in the example below:

```
Router# show controllers upstream-Cable 1/0/4 us-channel 12
USPHY OFDMA support: FULL


Controller 1/0/4 upstream 12  AdminState:UP OpState: UP
  ofdma mode enabled
  Channel Freq Range 35.500 MHz to 79.500 MHz
  Channel Subcarrier Index Range Cfg: 74, 953 Op: 74, 953
  Channel SC0 Freq Cfg: 31.800 MHz Op: 31.800 MHz
  #Excl bands: 2
  (   0,   73), ( 954, 2047),
  #Unused bands: 0
  Cyclic Prefix Size 96,  Rolloff Period Size 64
```

```
Subcarrier Spacing 50KHz,  Symbols Per Frame 18 Subcarrier Per Minislot: 8

Modulation Profile (ID 466, Subcarrier Spacing 50KHz)
  IUC type   Cfg   Act  Preamble Bit       Pilot
             subc  subc Symbols  Loading   Pattern
  3  (IR)    64    64     4       -         -
  4  (FR)    128   128    1       -         -
  13 (data)  -     -      -     1024-QAM    2
Calculated Data burst profile:
IUC  Group   Bit       Pilot   Start  Consec
             Loading   Pattern Mslot  Mslot
13   0       1024-QAM  2       0       109

#Total mslots:110 #Fine Rng capable:95 #Initial Rng capable:103
 Initial Rng - Freq 50.000MHz mslotOffset:36 #mslot in frame:8
Minislot mapping:  mslot#(start_sc start_freq(Mhz) end_sc end_freq(Mhz)
 mslot type(E-Edge; B-Body; S-Share with SCQAM;
 I-Initial rng capable; F-Fine rng capable)
 (next Fine Rng capable minislot if current is not capable))
0  (  74, 35.500,   81, 35.850, EIF ( - )), 1  (  82, 35.900,   89, 36.250, BIF ( - )),
2  (  90, 36.300,   97, 36.650, BIF ( - )), 3  (  98, 36.700,  105, 37.050, BIF ( - )),
4  ( 106, 37.100,  113, 37.450, BIF ( - )), 5  ( 114, 37.500,  121, 37.850, BIF ( - )),
6  ( 122, 37.900,  129, 38.250, BIF ( - )), 7  ( 130, 38.300,  137, 38.650, BIF ( - )),
8  ( 138, 38.700,  145, 39.050, BIF ( - )), 9  ( 146, 39.100,  153, 39.450, BIF ( - )),
10 ( 154, 39.500,  161, 39.850, BIF ( - )), 11 ( 162, 39.900,  169, 40.250, BIF ( - )),
12 ( 170, 40.300,  177, 40.650, BIF ( - )), 13 ( 178, 40.700,  185, 41.050, BIF ( - )),
14 ( 186, 41.100,  193, 41.450, BIF ( - )), 15 ( 194, 41.500,  201, 41.850, BIF ( - )),
16 ( 202, 41.900,  209, 42.250, BIF ( - )), 17 ( 210, 42.300,  217, 42.650, BIF ( - )),
18 ( 218, 42.700,  225, 43.050, BIF ( - )), 19 ( 226, 43.100,  233, 43.450, BIF ( - )),
20 ( 234, 43.500,  241, 43.850, BIF ( - )), 21 ( 242, 43.900,  249, 44.250, BIF ( - )),
22 ( 250, 44.300,  257, 44.650, BIF ( - )), 23 ( 258, 44.700,  265, 45.050, BIF ( - )),
24 ( 266, 45.100,  273, 45.450, BIF ( - )), 25 ( 274, 45.500,  281, 45.850, BIF ( - )),

26 ( 282, 45.900,  289, 46.250, BIF ( - )), 27 ( 290, 46.300,  297, 46.650, BIF ( - )),
28 ( 298, 46.700,  305, 47.050, BIF ( - )), 29 ( 306, 47.100,  313, 47.450, BIF ( - )),
30 ( 314, 47.500,  321, 47.850, BIF ( - )), 31 ( 322, 47.900,  329, 48.250, BIF ( - )),
32 ( 330, 48.300,  337, 48.650, BIF ( - )), 33 ( 338, 48.700,  345, 49.050, BIF ( - )),
34 ( 346, 49.100,  353, 49.450, BIF ( - )), 35 ( 354, 49.500,  361, 49.850, BIF ( - )),
36 ( 362, 49.900,  369, 50.250, BIF ( - )), 37 ( 370, 50.300,  377, 50.650, BIF ( - )),
38 ( 378, 50.700,  385, 51.050, BIF ( - )), 39 ( 386, 51.100,  393, 51.450, BIF ( - )),
40 ( 394, 51.500,  401, 51.850, BIF ( - )), 41 ( 402, 51.900,  409, 52.250, BIF ( - )),
42 ( 410, 52.300,  417, 52.650, BIF ( - )), 43 ( 418, 52.700,  425, 53.050, BIF ( - )),
44 ( 426, 53.100,  433, 53.450, BIF ( - )), 45 ( 434, 53.500,  441, 53.850, BIF ( - )),
46 ( 442, 53.900,  449, 54.250, BIF ( - )), 47 ( 450, 54.300,  457, 54.650, BIF ( - )),
48 ( 458, 54.700,  465, 55.050, BIF ( - )), 49 ( 466, 55.100,  473, 55.450, BIF ( - )),
50 ( 474, 55.500,  481, 55.850, BIF ( - )), 51 ( 482, 55.900,  489, 56.250, BIF ( - )),
52 ( 490, 56.300,  497, 56.650, BIF ( - )), 53 ( 498, 56.700,  505, 57.050, BIF ( - )),
54 ( 506, 57.100,  513, 57.450, BIF ( - )), 55 ( 514, 57.500,  521, 57.850, BIF ( - )),
56 ( 522, 57.900,  529, 58.250, BIF ( - )), 57 ( 530, 58.300,  537, 58.650, BIF ( - )),
58 ( 538, 58.700,  545, 59.050, BIF ( - )), 59 ( 546, 59.100,  553, 59.450, BIF ( - )),
60 ( 554, 59.500,  561, 59.850, BIF ( - )), 61 ( 562, 59.900,  569, 60.250, BIF ( - )),
62 ( 570, 60.300,  577, 60.650, BIF ( - )), 63 ( 578, 60.700,  585, 61.050, BIF ( - )),
64 ( 586, 61.100,  593, 61.450, BIF ( - )), 65 ( 594, 61.500,  601, 61.850, BIF ( - )),
66 ( 602, 61.900,  609, 62.250, BIF ( - )), 67 ( 610, 62.300,  617, 62.650, BIF ( - )),
68 ( 618, 62.700,  625, 63.050, BIF ( - )), 69 ( 626, 63.100,  633, 63.450, BIF ( - )),
70 ( 634, 63.500,  641, 63.850, BIF ( - )), 71 ( 642, 63.900,  649, 64.250, BIF ( - )),
72 ( 650, 64.300,  657, 64.650, BIF ( - )), 73 ( 658, 64.700,  665, 65.050, BIF ( - )),
74 ( 666, 65.100,  673, 65.450, BIF ( - )), 75 ( 674, 65.500,  681, 65.850, BIF ( - )),
76 ( 682, 65.900,  689, 66.250, BIF ( - )), 77 ( 690, 66.300,  697, 66.650, BIF ( - )),
78 ( 698, 66.700,  705, 67.050, BIF ( - )), 79 ( 706, 67.100,  713, 67.450, BIF ( - )),
80 ( 714, 67.500,  721, 67.850, BIF ( - )), 81 ( 722, 67.900,  729, 68.250, BIF ( - )),
82 ( 730, 68.300,  737, 68.650, BIF ( - )), 83 ( 738, 68.700,  745, 69.050, BIF ( - )),
84 ( 746, 69.100,  753, 69.450, BIF ( - )), 85 ( 754, 69.500,  761, 69.850, BIF ( - )),
86 ( 762, 69.900,  769, 70.250, BIF ( - )), 87 ( 770, 70.300,  777, 70.650, BIF ( - )),
```

```
88 ( 778, 70.700,  785, 71.050, BIF ( - )), 89 ( 786, 71.100,  793, 71.450, BIF ( - )),
90 ( 794, 71.500,  801, 71.850, BIF ( - )), 91 ( 802, 71.900,  809, 72.250, BIF ( - )),
92 ( 810, 72.300,  817, 72.650, BIF ( - )), 93 ( 818, 72.700,  825, 73.050, BIF ( - )),
94 ( 826, 73.100,  833, 73.450, BIF ( - )), 95 ( 834, 73.500,  841, 73.850, BI  (0  )),
96 ( 842, 73.900,  849, 74.250, BI  (0  )), 97 ( 850, 74.300,  857, 74.650, BI  (0  )),
98 ( 858, 74.700,  865, 75.050, BI  (0  )), 99 ( 866, 75.100,  873, 75.450, BI  (0  )),
100( 874, 75.500,  881, 75.850, BI  (0  )), 101( 882, 75.900,  889, 76.250, BI  (0  )),
102( 890, 76.300,  897, 76.650, BI  (0  )), 103( 898, 76.700,  905, 77.050, B   (0  )),
104( 906, 77.100,  913, 77.450, B   (0  )), 105( 914, 77.500,  921, 77.850, B   (0  )),
106( 922, 77.900,  929, 78.250, B   (0  )), 107( 930, 78.300,  937, 78.650, B   (0  )),
108( 938, 78.700,  945, 79.050, B   (0  )), 109( 946, 79.100,  953, 79.450, B   (0  )),

Mapped to connector 4 and receiver 108

Bind to Cable1/0/4 US4
MER(SNR) - Unknown - no modems online.
Spectrum Group is unassigned
Nominal Input Power Level 0 dBmV

UCD procedures on lch 0
UCD ucd-proxy-timeout   (0   ) ucd-proxy-wrong-ack (0   )
```

Configure Exclusion / Unused Bands

An OFDMA channel never use frequencies located in exclusion bands. OFDMA probes will be sent on frequencies located in the unused bands. Therefore exclusion bands must be used to prevent interference with SC-QAM channels. To configure the Exclusion / Unused Bands, follow the steps below:

enable
configure terminal
controller Upstream-Cable *slot/subslot/port*
cable ofdma-frequency-exclusion-band *start-value end-value*
cable ofdma-frequency-unused-band *start-value end-value*

Here is a configuration example:

```
Router# enable
Router# configure terminal
Router(config)# controller Upstream-Cable 1/0/2
Router(config-controller)# cable ofdma-frequency-exclusion-band 48000000 54200000
Router(config-controller)# cable ofdma-frequency-unused-band 50000000 52000000
Router(config-controller)# us-channel 12 docsis-mode ofdma
Router(config-controller)# us-channel 12 subcarrier-spacing 25KHz
Router(config-controller)# us-channel 12 modulation-profile 423
Router(config-controller)# us-channel 12 frequency-range 45000000 70000000
Router(config-controller)# us-channel 12 cyclic-prefix 96 roll-off-period 64
Router(config-controller)# us-channel 12 symbols-per-frame 18
```

Verifying Exclusion / Unused Bands

To display the Exclusion / Unused Band configuration, use the **show controllers upstream-Cable us-channel** command as shown in the example below:

```
Router# show controllers upstream-Cable 1/0/2 us-channel 12
USPHY OFDMA support: FULL

Controller Exclusion Freq List:
( 40.000 MHz, 44.200 MHz),
Controller Unused Freq List:
```

```
( 50.000 MHz, 52.000 MHz),

Controller 1/0/9 upstream 12 AdminState:UP OpState: UP
ofdma mode enabled
Channel Freq Range 28.500 MHz to 69.500 MHz
Channel Subcarrier Index Range Cfg: 148, 1787 Op: 148, 1787
Channel SC0 Freq Cfg: 24.800 MHz Op: 24.800 MHz
#Excl bands: 3
( 0, 147), ( 608, 776), (1788, 4095),
#Unused bands: 3
( 596, 607), (1001, 1088), (1777, 1787),
```

Override OFDMA Profile Per Channel

It is possible to override the modulation and pilot pattern used by a particular IUC on a given OFDMA channel as shown with the command below.

enable
configure terminal
controller Upstream-Cable *slot/subslot/port*
us-channel *id* **data-iuc** *id* **band** *start-value end-value* **modulation** *value* **pilot-pattern** *value*

Here is a configuration example:

```
Router# enable
Router# configure terminal
Router(config)# controller Upstream-Cable 1/0/2
Router(config-controller)# us-channel 12 docsis-mode ofdma
Router(config-controller)# us-channel 12 subcarrier-spacing 25KHz
Router(config-controller)# us-channel 12 modulation-profile 423
Router(config-controller)# us-channel 12 frequency-range 28000000 70000000
Router(config-controller)# us-channel 12 cyclic-prefix 96 roll-off-period 64
Router(config-controller)# us-channel 12 symbols-per-frame 18
Router(config-controller)# us-channel 12 data-iuc 6 band 60000000 65000000 modulation 128-QAM
 pilot-pattern 9
Router(config-controller)# no us-channel 12 shutdown
```

Note Override values will be removed from US channel when changing modulation profile, including when profile changes due to changes in subcarrier spacing.

Verifying Override Configuration

To display the override configuration, use the **show controllers upstream-Cable us-channel** command as shown in the example below:

```
Router# show controllers upstream-Cable 1/0/2 us-channel 12
 .....
   Modulation Profile (ID 423, Subcarrier Spacing 25KHz)
    IUC type    Cfg   Act  Preamble Bit       Pilot
                subc  subc Symbols  Loading   Pattern
    3   (IR)    64    64      4       -         -
    4   (FR)    128   128     1       -         -
    6   (data)  -     -       -     1024-QAM    8
    10  (data)  -     -       -     512-QAM     8
```

```
   11 (data)  -      -       -      256-QAM      8
   12 (data)  -      -       -      128-QAM      9
   13 (data)  -      -       -      64-QAM       9
  Overwrite Data Profile:
  IUC  Start       End         Start   End     Bit        Pilot
       Freq(MHz)   Freq(MHz)   Subc    Subc    Loading    Pattern
  6      60.0       65.0       1408    1608    128-QAM    9

  Calculated Data burst profile:
  IUC  Group   Bit         Pilot   Start  Consec
               Loading     Pattern Mslot  Mslot
  6    0       1024-QAM    8       0      61
  6    1       128-QAM     9       62     11
  6    2       1024-QAM    8       74     10
  10   0       512-QAM     8       0      84
  11   0       256-QAM     8       0      84
  12   0       128-QAM     9       0      84
  13   0       64-QAM      9       0      84
 ......
```

Apply OFDMA Upstream To Cable Interface

To associate upstream channels with a MAC domain and configure upstream bonding, follow the steps below:

enable
configure terminal
interface Cable *slot/subslot/interface*
cable upstream bonding-group *id*
upstream *id*
attributes *value*
cable bundle *id*

Here is a configuration example:

```
Router# enable
Router# configure terminal
Router(config)# interface Cable 1/0/4
Router(config-if)# downstream Integrated-Cable 1/0/4 rf-channel 0
Router(config-if)# downstream Integrated-Cable 1/0/4 rf-channel 16
Router(config-if)# upstream 0 Upstream-Cable 1/0/0 us-channel 0
Router(config-if)# upstream 1 Upstream-Cable 1/0/0 us-channel 1
Router(config-if)# upstream 2 Upstream-Cable 1/0/0 us-channel 2
Router(config-if)# upstream 3 Upstream-Cable 1/0/0 us-channel 3
Router(config-if)# upstream 6 Upstream-Cable 1/0/0 us-channel 12
Router(config-if)# cable upstream bonding-group 1
Router(config-upstream-bonding)# upstream 0
Router(config-upstream-bonding)# upstream 1
Router(config-upstream-bonding)# upstream 2
Router(config-upstream-bonding)# upstream 3
Router(config-upstream-bonding)# attributes 80000000
Router(config-upstream-bonding)# exit
Router(config-if)# cable upstream bonding-group 2
Router(config-upstream-bonding)# upstream 0
Router(config-upstream-bonding)# upstream 1
Router(config-upstream-bonding)# upstream 2
Router(config-upstream-bonding)# upstream 3
Router(config-upstream-bonding)# upstream 6
Router(config-upstream-bonding)# attributes 80000000
```

```
Router(config-upstream-bonding)# exit
Router(config-if)# cable bundle 1
```

Determine DOCSIS 3.1 Cable Modems and the Cable Modems Using OFDMA Upstreams

To display the DOCSIS 3.1 cable modem, use the **show cable modem docsis version d31-capable** command as shown in the example below:

```
Router# show cable modem docsis version d31-capable
MAC Address    I/F            MAC              Reg Oper DSxUS DS   RCC    US
                              State            Ver Ver        OFDM ID     OFDMA
4800.33ea.7012 C1/0/0/UB      w-online(pt)     3.1 3.1  33x4  1    5      1
203d.66ae.4169 C1/0/0/UB      w-online(pt)     3.1 3.1  33x4  1    5      1
```

To display DOCSIS PHY layer information for the cable modem, use the **show cable modem phy** command as shown in the example below:

```
Router# show cable modem 5039.5584.5bbe phy
MAC Address    I/F        Sid   USPwr  USMER Timing DSPwr  DSMER  Mode   DOCSIS
                             (dBmV) (SNR) Offset (dBmV) (SNR)         Prov
                                    (dB)                (dB)
5039.5584.5bbe C1/0/0/U0  15    38.75  ----- 2282   0.00   -----  ofdma  1.1
```

To display the cable modem using OFDMA upstream, use the **show cable modem phy** command as shown in the example below:

```
Router# show cable modem phy | include ofdma
5039.5584.5bbe C1/0/0/U0     15    38.75  ----- 2282    0.00  -----  ofdma  1.1
0895.2a9b.26f1 C1/0/0/U0     16    28.00  ----- 2146    0.00  -----  ofdma  1.1
```

To display the OFDMA channel capacity and utilization, use the **show interface cable mac-scheduler** command as shown in the example below:

```
Router# show interfaces cable 1/0/2 mac-scheduler 6
     DOCSIS 1.1 MAC scheduler for Cable1/0/2/U6 : rate 279807192
     Max potential performance for each configured IUC type
     IUC: 6     rate: 279807192
     IUC: 10    rate: 263104848
     IUC: 11    rate: 233779840
     IUC: 12    rate: 203019328
     IUC: 13    rate: 173899376
     wfq:None
     us_balance:OFF
     dpon_mode:OFF
     fairness:OFF
     Queue[Rng Polls] flows 0
     Queue[CIR Grants] flows 0
     Queue[BE(07) Grants] flows 0
     Queue[BE(06) Grants] flows 0
     Queue[BE(05) Grants] flows 0
     Queue[BE(04) Grants] flows 0
     Queue[BE(03) Grants] flows 0
     Queue[BE(02) Grants] flows 0
     Queue[BE(01) Grants] flows 0
     Queue[BE(00) Grants] flows 0
     Req Slots 38510548
     Req/Data Slots 1275
     Init Mtn Slots 47832
     Stn Mtn Slots 0
     IUC 5 Slots 0
     IUC 6 Slots 6378
```

```
IUC 9 Slots 0
IUC 10 Slots 254923830
IUC 11 Slots 220
IUC 12 Slots 4006
IUC 13 Slots 251213508
Avg upstream channel utilization : 0%
Avg upstream channel utilization in 30 sec : 0%
Avg percent contention slots : 96%
Avg percent initial ranging slots : 0%
Avg percent minislots lost on late MAPs : 0%

MAP TSS: lch_state 10, init_retries 0
         late_initial_maps 0, late_ucd_maps 0
         mac-phy tss errors 0, missed ccc 0
```

Verifying DOCSIS3.1 Upstream OFDMA channel bonding across DOCSIS3.0 ATDMA channels

Starting from Cisco IOS XE Everest 16.6.1 release, DOCSIS3.1 Upstream OFDMA channel can be bonded with DOCSIS3.0 ATDMA channel. If the user wants to utilize non-best effort flows, it is recommended to bond the OFDMA channel with one or more ATDMA channels. But be aware that in Cisco IOS XE Everest 16.6.1 release, a maximum of 1 OFDMA channel and 4 ATDMA channels can be bonded together.

Below is an output example showing the bonding group 8 has both OFDMA (channel 12) and ATDMA channels (channel 0, 1, 2, 3).

```
interface Cable6/0/0
downstream Integrated-Cable 6/0/0 rf-channel 1
downstream Integrated-Cable 6/0/0 rf-channel 158
upstream 0 Upstream-Cable 6/0/0 us-channel 0
upstream 1 Upstream-Cable 6/0/0 us-channel 1
upstream 2 Upstream-Cable 6/0/0 us-channel 2
upstream 3 Upstream-Cable 6/0/0 us-channel 3
upstream 6 Upstream-Cable 6/0/0 us-channel 12
cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
cable upstream bonding-group 8
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  upstream 6
  attributes 80000000
cable bundle 1
cable privacy accept-self-signed-certificate
end
```

Feature Information for DOCSIS 3.1 OFDMA 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 2: Feature Information for DOCSIS 3.1 OFDMA Channel Configuration

Feature Name	Releases	Feature Information
DOCSIS 3. 1 US 16 OFDMA channel support per line card	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
DOCSIS 3.1 US OFDMA channel bonding across DOCSIS 3.0 ATDMA channels	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.