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 Cisco cBR Series Routers

Note The hardware components 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-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-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 (test)

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

- Upstream spectrum 5 – 85 MHz

- 25 kHz subcarrier spacing

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 Release 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.

Note It is not recommended to use this feature in Cisco IOS XE Everest Release 16.6.1.

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 www.cisco.com/go/cfn 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 Everest 16.6.1	This feature was integrated into Cisco IOS XE Everest 16.6.1 on the Cisco cBR Series Converged Broadband Routers.
DOCSIS 3.1 US OFDMA channel bonding across DOCSIS 3.0 ATDMA channels	Cisco IOS XE Everest 16.6.1	This feature was integrated into Cisco IOS XE Everest 16.6.1 on the Cisco cBR Series Converged Broadband Routers.