



DOCSIS 3.1 OFDMA Channel Configuration

This document provides information on how to configure DOCSIS 3.1 OFDMA Channel on Remote PHY systems.

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 1](#)
- [Information about OFDMA Channel Configuration, on page 2](#)
- [How to Configure OFDMA Channel, on page 2](#)
- [Troubleshooting Tips, on page 12](#)
- [Feature Information for DOCSIS 3.1 OFDMA Channel Configuration, on page 15](#)

Hardware Compatibility Matrix for Cisco Remote PHY Device



Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Device Software Release are supported in all subsequent releases.

Table 1: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	Cisco 1x2 / Compact Shelf RPD Software 2.1 and Later Releases

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Intelligent Node (iNode)	Cisco 1x2 / Compact Shelf RPD Software 4.1 and Later Releases Cisco Intelligent Remote PHY Device 1x2 <ul style="list-style-type: none"> • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=



Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

Information about OFDMA Channel Configuration

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 96 MHz
- Upstream spectrum 5 – 204 MHz
- 25 KHz and 50 KHz subcarrier spacing

How to Configure OFDMA Channel

Configure 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 451
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 472
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.
- Modulation profiles 421 and 461 are the default modulation profiles for 25 KHz and 50 KHz subcarrier spacing respectively. You can add additional modulation profiles. The modulation profile range is between 401-500.
- You must configure subcarrier spacing, ranging, and data IUC 13 before applying modulation profile to a upstream channel.
- Regular pilot patterns (1-4/8-11) and boosted pilot patterns (5-7/12-14) cannot co-exist on the same upstream channel.
- We recommend that you do not change subcarrier spacing, ranging, and data IUC configuration of a modulation profile that is applied to a channel.

Verify OFDMA Modulation Profile Configuration

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

```

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

```

Configure OFDMA Channel

To configure the OFDMA channel, follow these steps:

```
enable
configure terminal
cable upstream controller-profile id
us-channel id docsis-mode ofdma
us-channel id subcarrier-spacing value
us-channel id modulation-profile id
us-channel id frequency-range start-value end-value
us-channel id initial-rng-frequency-start value
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
```

To use QAM modulation in between specific bandwidth, use the **us-channel *id* data-iuc *id* band *start-value end-value* modulation *value* pilot-pattern *value*** command.

Here is a configuration example:

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



Note

- A maximum of one OFDMA channel can be configured per controller. For this OFDMA channel, the us-channel index must be set to 12. This corresponds with OFDMA channel 0 on an RPD port.
- Change docsis-mode to **OFDMA** to enable OFDMA configuration options. These options are enabled by default on us-channel 12.
- OFDMA channel can be placed between 5 Mhz and 204 Mhz.
- Values of the options are often interdependent, changing one value may change other values or make them invalid.
- We recommend that you set subcarrier spacing and frequency range first. To achieve a higher OFDMA channel traffic throughput, configure OFDMA channel with 25kHz subcarrier spacing.
- Maximum of 4:1 upstream combining for OFDMA channels is supported.
- Remote PHY Shelf Line Card switchover is currently not supported. Modems using OFDMA upstream channels might not be able to use OFDMA channels during a switchover.

Bind Upstream Controllers With RPHY Ports

If the upstream channel profile contains OFDMA channel, you can bind up to four RPD ports with the upstream controller.

```
cable rpd node1
  identifier badb.ad15.1288
  core-interface Te7/1/4
  principal
    rpd-ds 0 downstream-cable 7/0/30 profile 10
    rpd-us 0 upstream-cable 7/0/63 profile 1
    rpd-us 1 upstream-cable 7/0/63 profile 1

cable rpd node2
  identifier badb.ad15.1290
  core-interface Te7/1/4
  principal
    rpd-ds 0 downstream-cable 7/0/31 profile 10
    rpd-us 0 upstream-cable 7/0/63 profile 1
    rpd-us 1 upstream-cable 7/0/63 profile 1
```

Verify 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
Controller RPD US Port List:
DevID RPD ID US Port I/F Name
-----
0 badb.ad13.acfe 0 Te1/1/2 necker-5

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 minislots 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 uses frequencies that are located in exclusion bands. OFDMA probes are sent on frequencies that are 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 these steps:

```
enable
configure terminal
cable upstream controller-profile id
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)# cable upstream controller-profile 33
Router(config-controller-profile)# cable ofdma-frequency-exclusion-band 48000000 54200000
Router(config-controller-profile)# cable ofdma-frequency-unused-band 50000000 52000000
Router(config-controller-profile)# us-channel 12 docsis-mode ofdma
Router(config-controller-profile)# us-channel 12 subcarrier-spacing 25KHz
Router(config-controller-profile)# us-channel 12 modulation-profile 423
Router(config-controller-profile)# us-channel 12 frequency-range 45000000 70000000
Router(config-controller-profile)# us-channel 12 cyclic-prefix 96 roll-off-period 64
Router(config-controller-profile)# us-channel 12 symbols-per-frame 18
```

Verify Exclusion / Unused Bands

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

```
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 Modulation Profile Per Channel

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

```
enable
configure terminal
cable upstream controller profile id
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)# cable upstream controller profile 33
Router(config-controller-profile)# us-channel 12 docsis-mode ofdma
Router(config-controller-profile)# us-channel 12 subcarrier-spacing 25KHz
Router(config-controller-profile)# us-channel 12 modulation-profile 423
Router(config-controller-profile)# us-channel 12 frequency-range 28000000 70000000
Router(config-controller-profile)# us-channel 12 cyclic-prefix 96 roll-off-period 64
Router(config-controller-profile)# us-channel 12 symbols-per-frame 18
Router(config-controller-profile)# us-channel 12 data-iuc 6 band 60000000 65000000 modulation
128-QAM pilot-pattern 9
Router(config-controller-profile)# no us-channel 12 shutdown
```



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

Verify Override Configuration

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

```
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
.....

```

Bind OFDMA Channel Profile to Controller

To bind OFDMA channel profile to a controller, follow this example:

```

cable virtual-service-group sg-upstream-7-0-63 upstream-cable 7/0/63 profile 1

cable rpd nodel
  identifier badb.ad15.1288
  core-interface Te7/1/4
  principal
    rpd-ds 0 downstream-cable 7/0/30 profile 10
    rpd-us 1 upstream-cable 7/0/63 profile 1

```



Note We recommend using separate channel profiles to debug issues on specific RPD port.

Bind OFDMA Upstream to Cable Interface

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

```

enable
configure terminal
interface Cable slot/subslot/interface
upstream id Upstream-Cable slot/subslot/interface us-channel id
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 8000000
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 following example:

```

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 following example:

```

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)  (dB)   (dB)   Prov
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 following example:

```

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 following example:

```

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

```

Verify DOCSIS 3.1 Upstream OFDMA Channel Bonding with ATDMA Channels

DOCSIS 3.1 Upstream OFDMA channel can be bonded with 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. 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

```

Troubleshooting Tips

Refer to the following troubleshooting tips for configuration errors:

- For getting the eRPD info from the FCC:

```
Router-FCC# show erpd slot 12
Slot Index IPv4 MAC Master Online
12 0 23.13.30.10 7A:BD:45:46:01:A0 Y
12 1 23.13.31.11 7A:BD:45:46:01:A1 Y Y
12 2 23.13.32.11 7A:BD:45:46:01:A2 Y
12 3 23.13.33.12 7A:BD:45:46:01:A3 Y
12 4 23.13.34.12 7A:BD:45:46:01:A4 Y
12 5 23.13.35.10 7A:BD:45:46:01:A5 Y
```

- Connecting to a particular slot from the FCC. For example, connecting to slot 12 from FCC:

```
Router-FCC# select linecard slot 12
Switching to Slot-12...
```

```
Router-Slot-12>en
```

- Checking OFDMA channel information on the eRPDs:

```
Router-Slot-12# show ofdma
NUMBER eRpdIndex: <0-5>
```

```
Router-Slot-12# show ofdma 0
config Driver cached OFDMA channel config
cw-errs Codeword and Codeword error counters
ethertrace Ethertrace packet/file info/counters
fifo FIFO counters
info Show event counters and other interesting info
iuc IUC counters
map Map counters
stats Miscellaneous stats/counters
trap Trap counters
```

```
Router-Slot-12# show ofdma 0
config Driver cached OFDMA channel config
cw-errs Codeword and Codeword error counters
ethertrace Ethertrace packet/file info/counters
fifo FIFO counters
info Show event counters and other interesting info
iuc IUC counters
map Map counters
stats Miscellaneous stats/counters
trap Trap counters
```

NOTE: 0 (port 0, ofdma chan0(12 US controller index)) or 2 (port 1, ofdma chan0(12 US controller index))

```
Router# show ofdma 0 cw-errs
```

```
OFDMA_0: UP (admin UP)
  CW Count      0
  CW Errs      0
```

```

Avg: 0.0000

OFDMA_1: UP (admin DOWN)
  CW Count      0
  CW Errs       0
  Avg: 0.0000

OFDMA_2: UP (admin UP)
  CW Count     901743
  CW Errs      0
  Avg: 0.0000

OFDMA_3: UP (admin DOWN)
  CW Count      0
  CW Errs       0
  Avg: 0.0000
    
```

You can also execute show commands to get other OFDMA related counters IUC, map, stats and so on. For example, to get the BCM driver info and the FW version:

```

Router-Slot-12# show bcm-driver
NUMBER eRpdIndex: <0-5>

Router-Slot-12# show bcm-driver 0
BCM316X driver info: BCM3161 B1 <==== Chip version

SCQAM_0: Req
SCQAM_1: Req
TOP: STATE_1
OFDMA_0: Init_Complete retry:0 UP (admin: UP) <=== port0, OFDMA channel0
OFDMA_1: Init_Complete retry:0 UP (admin: DOWN)
OFDMA_2: Init_Complete retry:0 UP (admin: UP) <=== port1, OFDMA channel0
OFDMA_3: Init_Complete retry:0 UP (admin: DOWN)
DPMI: START

OFDMA Firmware Versions:
TPMI App @ 0.0.58 60c42902851bdaf3cab268f0737db6d9
TPMI PM @ -None- c4d68ff86addc669680d8784ee1e76f0
OFDMA Admin @ 0.0.31 ef4b18b87f8d9e99fb25caf31567f856
OFDMA PW @ 1.0.20 0763dff65fc84dc6b4ba25390ea12fe2
OFDMA CPU/DSP @ 1.11.30, revision 49160 <==== OFDMA FW version
OFDMA CPU0 855edb362b2b401adc25cdc8b8aa0e86
OFDMA CPU1 d4db6848ae90f602b049adbed7a41fff0
OFDMA CPU2 c504a196f4e6eea856897d8611d372ec
OFDMA CPU3 b63e72258cf7d9fd89c285d51aadec6
OFDMA DSP0 354469d1b0e450d0e15a77c1d811d286
    
```

```
Router# show ofdma 0 iuc 0
```

```
IUC Counters OFDMA_0:
```

	IUC	Grants	No Energy	FEC Tot. CWs	FEC Post Pass CWs	FEC Post Fail CWs	MER Min/Max/Avg
1-	Req	3389955616	3389955616	0	0	0	0.0/0.0/0.0
2-	ReqD	0	0	0	0	0	0.0/0.0/0.0
3-	InitM	2389295	2389295	0	0	0	0.0/0.0/0.0
4-	SMaint	0	0	0	0	0	0.0/0.0/0.0
5-	Data	0	0	0	0	0	0.0/0.0/0.0
6-	Data	0	0	0	0	0	0.0/0.0/0.0
9-	Data	0	0	0	0	0	0.0/0.0/0.0
10-	Data	0	0	0	0	0	0.0/0.0/0.0

Troubleshooting Tips

```

11- Data      0      0      0      0      0 0.0/0.0/0.0
12- Data      0      0      0      0      0 0.0/0.0/0.0
13- Data      0      0      0      0      0 0.0/0.0/0.0

```

```
Router# show ofdma 0 stats 0
```

```
Stats/Counters OFDMA_0:
```

```

INF1: OFDMA0 is UP, CCC=21
INF2: cwCnt 0, cwErr 0, SS 517891224
IR1 : notDtct 2395752, fail 0, postDecPass 0
IR2 : lastpwrerr +0.0, minPwrErr +0.0, maxPwrErr +0.0
FR1 : notDtct 0, fail 0, postDecPass 0
FR2 : lastpwrerr +0.0, minPwrErr +0.0, maxPwrErr +0.0
MAP1: earlyMap 0, lateMap 0, illegalMap 0, invIUC 0, invRng 0, invGrant 0
MAP2: unmappedMS 85695, mappedMS 2928677806, overlapMS 0, smallData 0
msMer  0: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 24: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 48: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 72: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 96: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 120: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 144: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 168: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 192: 00000000 00000000 00000000 00000000 00000000 00000000
msMer 216: 00000000 00000000 00000000 00000000 00000000 00000000

```

```
Router# show tgc-clock 0 state
```

```

clock state      : SUB_SYNC
current tod      : 1557768203  Mon May 13 17:23:23 2019

```

```

SQAM0: 0xd105e84c
SQAM1: 0xd105f5ae
OFDMA0: 0xd1060ae3 0x7157b1a20c15c6b0
OFDMA2: 0xd106295b 0x7157b1a20c52b730

```

```
US Port 0:
```

```

TOP: 0xd1067bd2, RCVR0: 0xd1068e00, DELTA: 0x122e
TOP: 0xd106c093, RCVR1: 0xd106dc00, DELTA: 0x1b6d
TOP: 0xd106f42e, RCVR2: 0xd1071200, DELTA: 0x1dd2
TOP: 0xd1072dda, RCVR3: 0xd1074e00, DELTA: 0x2026
TOP: 0xd1076864, RCVR4: 0xb106000, DELTA: 0x3a08f79c
TOP: 0xd107a40b, RCVR5: 0xb10a000, DELTA: 0x3a08fbf5
TOP: 0xd107e080, RCVR6: 0xb108000, DELTA: 0x3a089f80
TOP: 0xd10818ff, RCVR7: 0xb10c000, DELTA: 0x3a08a701
TOP: 0xd1087a9a, RCVR8: 0xb10e000, DELTA: 0x3a086566
TOP: 0xd108bc72, RCVR9: 0xb112000, DELTA: 0x3a08638e
TOP: 0xd10971b2, RCVR10: 0xb118000, DELTA: 0x3a080e4e
TOP: 0xd109a953, RCVR11: 0xb11c000, DELTA: 0x3a0816ad

```

```
US Port 1:
```

```

TOP: 0xd109dd9c, RCVR0: 0xd109f600, DELTA: 0x1864
TOP: 0xd10a1b7e, RCVR1: 0xd10a3600, DELTA: 0x1a82
TOP: 0xd10a5c78, RCVR2: 0xd10a7800, DELTA: 0x1b88
TOP: 0xd10a8e96, RCVR3: 0xd10aac00, DELTA: 0x1d6a
TOP: 0xd10ac075, RCVR4: 0xb17a000, DELTA: 0x3a0cdf8b
TOP: 0xd10af8d4, RCVR5: 0xb17e000, DELTA: 0x3a0ce72c
TOP: 0xd10b2ad3, RCVR6: 0xb17c000, DELTA: 0x3a0c952d
TOP: 0xd10b6205, RCVR7: 0xb180000, DELTA: 0x3a0c9dfb
TOP: 0xd10b9dac, RCVR8: 0xb17e000, DELTA: 0x3a0c4254
TOP: 0xd10bd0b8, RCVR9: 0xb182000, DELTA: 0x3a0c4f48
TOP: 0xd10c074b, RCVR10: 0xb180000, DELTA: 0x3a0bf8b5
TOP: 0xd10c3ffa, RCVR11: 0xb184000, DELTA: 0x3a0c0006

```

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://cfng.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
Remote PHY DOCSIS 3.1 OFDMA Channel Support	Cisco Remote PHY Shelf 7200 Software 1.2	This feature was introduced on the Cisco Remote PHY Shelf 7200. One channel per port is supported.

