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 Cisco cBR Series Routers, page 1
- Information about OFDM Channel Configuration, page 2
- How to Configure OFDM Channel, page 3
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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

<table>
<thead>
<tr>
<th>Cisco CMTS Platform</th>
<th>Processor Engine</th>
<th>Interface Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco cBR-8 Converged Broadband Router</td>
<td>Cisco IOS-XE Release 3.15.0S and Later Releases</td>
<td>Cisco IOS-XE Release 3.15.0S and Later Releases</td>
</tr>
<tr>
<td></td>
<td>Cisco cBR-8 Supervisor:</td>
<td>Cisco cBR-8 CCAP Line Cards:</td>
</tr>
<tr>
<td></td>
<td>• PID—CBR-CCAP-SUP-160G</td>
<td>• PID—CBR-LC-8D30-16U30</td>
</tr>
<tr>
<td></td>
<td>• PID—CBR-CCAP-SUP-60G</td>
<td>• PID—CBR-LC-8D31-16U30</td>
</tr>
<tr>
<td></td>
<td>• PID—CBR-SUP-8X10G-PIC</td>
<td>• PID—CBR-RF-PIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PID—CBR-RF-PROT-PIC</td>
</tr>
<tr>
<td>Cisco cBR-8 Downstream PHY Modules:</td>
<td></td>
<td>Cisco cBR-8 Downstream PHY Modules:</td>
</tr>
<tr>
<td>• PID—CBR-D30-DS-MOD</td>
<td>• PID—CBR-D30-US-MOD</td>
<td></td>
</tr>
<tr>
<td>• PID—CBR-D31-DS-MOD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cisco cBR-8 Upstream PHY Modules:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PID—CBR-D30-US-MOD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Effective with Cisco IOS-XE Release 3.17.0S, CBR-CCAP-SUP-60G supports 8 cable line cards. The total traffic rate is limited to 60Gbps, the total number of downstream service flow is limited to 72268, and downstream unicast low-latency flow does not count against the limits.

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. OFDM Channel support includes 1 OFDM channel per port with channel bandwidth from 24 MHz to 192 MHz wide.

Each OFDM channel supports a control profile, an NCP profile, and up to 5 data profiles. Profiles support one or more modulations.

Starting from Cisco IOS-XE release 3.18.1SP, user 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 router use the default guard band, which is based on the roll off and spacing in OFDM channel profile.

Note

OFDM channel can only be used as secondary channel as part of a Wideband group. Primary channel needs to be configured as normal DOCSIS 3.0 primary RF channel.
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-absolute | freq-offset} value | range-subcarriers {freq-absolute | 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 ****
```
### Configuring OFDM Channel Profile

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

1. `enable`
2. `configure terminal`
3. `cable downstream ofdm-chan-profile id`
4. `description text`

---

#### Prof Channel Profile

<table>
<thead>
<tr>
<th>Prof FFT Width Start-freq Modulations</th>
<th>ID</th>
<th>KHz</th>
<th>Hz</th>
<th>Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 50 96000000 62700000</td>
<td>64</td>
<td>default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>512 freq-abs</td>
<td>709050000</td>
<td>width</td>
<td>12000000</td>
<td></td>
</tr>
<tr>
<td>2048 freq-abs</td>
<td>629000000</td>
<td>width</td>
<td>6000000</td>
<td></td>
</tr>
</tbody>
</table>

### Profile Subcarrier Modulations


<table>
<thead>
<tr>
<th>ID</th>
<th>Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>192</td>
<td>192</td>
</tr>
</tbody>
</table>

---

#### OFDM Modulation Profile Assigned Channel Profiles

<table>
<thead>
<tr>
<th>Prof Channel Profile Assigned Channel Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>192</td>
</tr>
</tbody>
</table>

---

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

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

---

#### OFDM Modulation Profile Configuration

<table>
<thead>
<tr>
<th>Prof FFT Width Start-freq Modulations Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>9</td>
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<tr>
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<td></td>
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<tr>
<td>10</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
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 21

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

<table>
<thead>
<tr>
<th>ID</th>
<th>Prfx</th>
<th>Off</th>
<th>Override</th>
<th>KHz</th>
<th>Depth</th>
<th>Scale</th>
<th>Cntrl</th>
<th>NCP</th>
<th>Data Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>1024</td>
<td>128</td>
<td>2400000</td>
<td>50</td>
<td>16</td>
<td>48</td>
<td>D:1024</td>
<td>D:16</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
</tbody>
</table>

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

Prof Admin Controller:channels
ID 21 Up 6/0/4:158

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
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 ****

<table>
<thead>
<tr>
<th>ID</th>
<th>Prfx</th>
<th>Off</th>
<th>Override</th>
<th>KHz</th>
<th>Depth</th>
<th>Scale</th>
<th>Cntrl</th>
<th>NCP</th>
<th>Data Profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1024</td>
<td>128</td>
<td>NA</td>
<td>50</td>
<td>16</td>
<td>48</td>
<td>D:256</td>
<td>D:16</td>
<td>D:1024 NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>1</td>
<td>1024</td>
<td>128</td>
<td>NA</td>
<td>50</td>
<td>16</td>
<td>48</td>
<td>D:256</td>
<td>D:16</td>
<td>D:2048 D:1024</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>1024</td>
<td>128</td>
<td>NA</td>
<td>50</td>
<td>16</td>
<td>48</td>
<td>D:256</td>
<td>D:16</td>
<td>D:4096 D:2048</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D:1024 NA</td>
</tr>
</tbody>
</table>
Configuring Port/Controller and Channel

To configure the port/controller and channel, follow the steps below:

```
1. enable
2. configure terminal
3. controller integrated-cable slot/subslot/port
4. max-ofdm-spectrum value
5. ofdm-freq-excl-band start-frequency value width value
6. rf-chan start_id [end_id]
7. 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 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
62400000 - 644999999
83700000 - 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-port 158
```

```
<table>
<thead>
<tr>
<th>Chan State</th>
<th>Admin</th>
<th>Mod-Type</th>
<th>Start Width</th>
<th>PLC Profile-ID</th>
<th>dcid</th>
<th>power</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL</td>
<td>UP</td>
<td>UP</td>
<td>OFDM 627000000 96000000 663000000 20</td>
<td>159 34</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

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-port 158 verbose
```

```
<table>
<thead>
<tr>
<th>Chan State</th>
<th>Admin</th>
<th>Mod-Type</th>
<th>Start Width</th>
<th>PLC Profile-ID</th>
<th>dcid</th>
<th>power</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL</td>
<td>UP</td>
<td>UP</td>
<td>OFDM 627000000 96000000 663000000 30</td>
<td>159 32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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]
679900000[2146] 683500000[2218] 687100000[2290] 690700000[2362]
### Active frequencies [subcarriers]:
628900000[1126] - 721099999[2969]
Count: 1844

### Data frequencies [subcarriers]:
628900000[1126] - 630699999[1161]
630750000[1163] - 634299999[1233]
634350000[1235] - 637950000[1305]
638750000[1307] - 641450000[1377]
641500000[1379] - 645150000[1449]
645200000[1451] - 648699999[1521]
648750000[1523] - 652350000[1593]
652400000[1595] - 655899999[1665]
655950000[1667] - 659499999[1737]
659500000[1739] - 663499999[1816]
663500000[1818] - 664050000[1828]
664100000[1830] - 664550000[1839]
664600000[1841] - 665050000[1848]
665100000[1850] - 665750000[1863]
666200000[1872] - 666850000[1885]
666900000[1892] - 672650000[2001]
672750000[2003] - 676350000[2075]
676400000[2080] - 679850000[2145]
679900000[2147] - 683550000[2217]
683600000[2220] - 687050000[2289]
687150000[2291] - 701550000[2577]
701550000[2579] - 705150000[2651]
705200000[2654] - 712350000[2795]
712350000[2797] - 715999999[2865]
715900000[2866] - 719500000[2938]
Count: 1804

### Profiles:
Number of profiles: 2
CTRL profile (Profile A): rate: 461916 kbps, usable rate: 368000 kbps
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 subcarrier count: 1804, ZBL count: 0
Discontinuity time [days:hours:mins:secs]: 00:00:54:32 [16:15:02 EDT May 18 2016]
Example: Configuring OFDM Channel

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

The following example shows how to configure OFDM channel:

```
enable
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
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
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

Additional References

Related Document

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Link</th>
</tr>
</thead>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIBs</th>
<th>MIBs Link</th>
</tr>
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<tbody>
<tr>
<td>• DOCS-IF31-MIB</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for DOCSIS 3.1 OFDM Channel Configuration

Use Cisco Feature Navigator to find information about 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 http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note

The table below lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCSIS 3.1 OFDM Channel Support</td>
<td>Cisco IOS-XE Release 3.18.0SP</td>
<td>This feature was introduced on the Cisco cBR Series Converged Broadband Routers.</td>
</tr>
<tr>
<td>Full Spectrum 108-1218 MHz Support</td>
<td>Cisco IOS-XE Release 3.18.0SP</td>
<td>This feature was introduced on the Cisco cBR Series Converged Broadband Routers.</td>
</tr>
<tr>
<td>DOCSIS 3.1 Downstream OFDMA Guardband Enhancements</td>
<td>Cisco IOS-XE Release 3.18.1SP</td>
<td>This feature was introduced on the Cisco cBR Series Converged Broadband Routers.</td>
</tr>
</tbody>
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