DOCSIS 3.1 Downstream Profile Selection

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DOCSIS 3.1 introduces the concept of downstream profiles for OFDM channels.

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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></td>
<td></td>
<td>Cisco cBR-8 Downstream PHY Modules:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PID—CBR-D30-DS-MOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PID—CBR-D31-DS-MOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cisco cBR-8 Upstream PHY Modules:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PID—CBR-D30-US-MOD</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 60 Gbps, the total number of downstream service flows is limited to 72268, and downstream unicast low-latency flow does not count against the limits.

### Information about Downstream Profiles

A profile is a list of modulation orders that are defined for each of the subcarriers within an OFDM channel. The CMTS can define multiple profiles for use in an OFDM channel, where the profiles differ in the modulation orders assigned to each subcarrier.

You can use the following commands to view the profiles:

- To display the profiles associated with the cable modems (CMs), use the `show cable modem [ip-address| mac-address| cable| slot | subslot | cable-interface-index]/ phy ofdm-profile` command.
- To display detailed profile management data associated with specific cable modem, use the `show cable modem [ip-address| mac-address] prof-mgmt` command.

The CMTS can assign different profiles for different groups of CMs.

### Default Data Profile

The first time a CM registers, it is assigned a default data profile. The default data profile is "profile-data 1". If "profile-data 1" is not configured, "profile-control" is assigned to the CM.
Profile A, with profile ID 0, is also referred to as the control profile.

Recommended Profile

Based on the Receive Modulation Error Ratio (RxMER) values collected from a modem using the `variable` modem `ip opt0` command, and collected automatically and periodically in the background, the CMTS finds among the existing profiles the one that may provide the highest speed, and yet at the same time may have sufficient Signal to Noise Ratio (SNR) margin for the modem to receive code words with acceptable error. This profile is called the recommended profile for that CM. The `show cable modem phy ofdm-profile` command displays the recommended profile for each CM.

A user configurable age is associated with each recommended profile, which can be configured as follows:

```
Router (config)# cable downstream ofdm-prof-mgmt recommend-profile-age age-in-minutes
```

If the recommended profile exceeds this age, it is no longer valid for that CM.

Unfit Profile

When the CMTS receives CM-STATUS Event 16 (DS OFDM Profile Failure), the profile indicated in the CM-STATUS message is marked as 'unfit profile' for this modem.

A user configurable maximum age is associated with each unfit profile, which can be configured as follows:

```
Router (config)# cable downstream ofdm-prof-mgmt unfit-profile-age age-in-minutes
```

If the unfit profile for a modem exceeds this age, it is no longer valid.

How to Configure Profiles

Configuring Profile Downgrade

A CM sends a CM-STATUS Event 16 message to indicate a DS OFDM profile failure. When this indication is received by the CMTS, it takes immediate action to downgrade the modem to a lower profile, as per the profile ordering displayed by the following command:

```
Router# show controllers integrated-Cable 2/0/3 rf-channel 158 prof-order
```

The following table, extracted from [DOCSIS 3.1 MULPI], lists the CM-Status events that will trigger a profile downgrade:

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Event Condition</th>
<th>Status Report Events</th>
<th>Parameters reported by CM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trigger event to &quot;on&quot;</td>
<td>Trigger event to &quot;off&quot;</td>
<td>DCID</td>
</tr>
</tbody>
</table>
### Configuring RxMER to Bit Loading Mapping

There are many ways to map the Receive Modulation Error Ratio (RxMER) values to bit loading values. We use the following mapping recommended in [DOCSIS 3.1 OSSI], as our baseline mapping:

<table>
<thead>
<tr>
<th>RxMER (in $\frac{1}{4}$ DB)</th>
<th>QAM</th>
<th>Bit Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>84</td>
<td>64</td>
<td>6</td>
</tr>
<tr>
<td>96</td>
<td>128</td>
<td>7</td>
</tr>
<tr>
<td>108</td>
<td>256</td>
<td>8</td>
</tr>
<tr>
<td>122</td>
<td>512</td>
<td>9</td>
</tr>
<tr>
<td>136</td>
<td>1024</td>
<td>10</td>
</tr>
<tr>
<td>148</td>
<td>2048</td>
<td>11</td>
</tr>
<tr>
<td>164</td>
<td>4096</td>
<td>12</td>
</tr>
<tr>
<td>184</td>
<td>8192</td>
<td>13</td>
</tr>
</tbody>
</table>
To configure a margin to adjust the RxMER to bit loading mapping, use the following command:

```
Router(config)# cable downstream ofdm-prof-mgmt mer-margin-qdb interval-in-minutes
```

This configured value (quarter-DB) is added to the RxMER values collected by CMTS before using the above mapping table, thus giving a user more control in selecting the recommended profiles.

To specify the percentage of subcarriers that can be ignored in the recommended profile calculation, use the following command:

```
Router(config)# cable downstream ofdm-prof-mgmt exempt-sc-pct percent
```

This provides a way to specify the extent that the outliers can be ignored.

To configure the RxMER poll interval, use the following command:

```
Router(config)# cable downstream ofdm-prof-mgmt rxmer-poll-interval interval-in-minutes
```

The CMTS uses OPT message with bit-0 option to collect RxMER data from CMs, after the initial CM registration and periodically thereafter. The collected RxMER data is used to compute the recommended profile for each CM.

### Verifying the Profile Configuration

To display the profile management related information, use the `show cable modem phy ofdm-profile` and `show cable modem prof-mgmt` commands as shown in the example below:

```
router# show cable modem fc52.8d5e.84bd phy ofdm-profile
MAC Address I/F Chan DCID Curr Recm Dwngd Unfit Prof Prof Prof Prof
fc52.8d5e.84bd C1/0/0/UB In1/0/0:158 159 5 5 4 N/A

router# show cable modem fc52.8d5e.84bd prof-mgmt
MAC Address : fc52.8d5e.84bd
IP Address : ---
RxMer Exempt Percent : 11
RxMer Margin qDB : 20
Automatic Prof Dwngrd : Active
DCID : 159
Configured Profile(s) : 0 1 2 3 4 5
Profile(s) in REG-RSP-MP : 0 1 2 3
Profile(s) in DBC-REQ : 0 3 4 5
Current profile : 5 [4096-QAM]
Percentages of ideal BL vs Curr Prof : 90 (better) 0 (equal)
Downgrade profile : 4
Recommend profile : 5
Unfit profile(s) : N/A
Recommend profile (Expired) : N/A
Unfit profile(s) (Expired) : N/A
Number of SubCarriers : 4096
1st Active SubCarrier : 1126
# of Active SubCarriers: 1844
Tx Time : 0h:03m:47s ago
Rx Time : 0h:03m:47s ago
OFDM Profile Failure Rx: N/A
MER Poll Period (min): 60
Recommend Timeout (min): 120
Unfit Timeout (min): 60
Source : OPT
```
Additional References

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

Feature Information for Downstream Profile Selection

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](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>Downstream Profile Selection</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>DOCSIC3.1 Downstream OFDM Graceful Profile Assignment</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>
</table>