DOCSIS 3.1 Upstream Profile Selection

DOCSIS 3.1 introduces the concept of upstream profiles for OFDMA channels. This document describes how to configure the DOCSIS 3.1 Upstream Profile Selection on the Cisco cBR Series Converged Broadband Router.

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.

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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	**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 • PID—CBR-CCAP-LC-G2-R • PID—CBR-SUP-8X10G-PIC • PID—CBR-2X100G-PIC Digital PICs: • PID—CBR-DPIC-8X10G • PID—CBR-DPIC-2X100G Cisco cBR-8 Downstream PHY Module: • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D31-US-MOD

Note Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

Information about Upstream Profiles

A modulation profile is a list of interval usage codes (IUCs) that are defined for an OFDMA channel. Each IUC will have a modulation order and pilot pattern. Multiple IUCs within a modulation profile allow for different modulation orders on the same OFDMA channel. The CMTS can define multiple profiles for use in an OFDMA channel, where the profiles differ in the modulation orders assigned to each minislot.

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 upstream** command.
- To display detailed profile management data associated with specific cable modem, use the **show cable modem** *[ip-address| mac-address]* **prof-mgmt upstream verbose** command.

The CMTS can assign different data IUCs for different groups of CMs.

A DOCSIS 3.1 CM can only have two active OFDMA Upstream Data Profile IUCs on a given channel.

Default Data IUC

Data IUC 13 is intended to be the most robust IUC and able to be used by all cable modems.

Recommended Interval Usage Code (IUC)

Based on the receive modulation error ratio (RxMER) values collected periodically during upstream probing, the CMTS finds among the existing IUCs up to two that provide the highest speed while having sufficient signal to noise ratio (SNR) margin for the CMTS to receive code words with acceptable error rates. The **show cable modem phy ofdm-profile upstream** command displays the one or two recommended IUCs for each CM.

In Cisco IOS XE Everest 16.6.1 release, data IUC 13 will be one of the IUCs assigned to the CM.

To disable the automatic profile downgrade, use **no cable upstream ofdma-prof-mgmt prof-upgrade-auto** command in global configuration mode.

How to Configure Upstream Profiles

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:

RxMER (in ¼ DB)	QAM	Bit Loading
60	16	4
84	64	6

RxMER (in ¼ DB)	QAM	Bit Loading
96	128	7
108	256	8
122	512	9
136	1024	10
148	2048	11
164	4096	12
184	8192	13
208	16384	14

- To configure a margin to adjust the RxMER to bit loading mapping, use the following command:

  ```
  Router(config)# cable upstream ofdma-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 minislot average RxMER that can be ignored in the recommended profile calculation, use the following command:

  ```
  Router(config)# cable upstream ofdma-prof-mgmt exempt-mslot-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 upstream ofdma-prof-mgmt rxmer-poll-interval interval-in-minutes
  ```

  The CMTS uses upstream probing to collect RxMER data per CM. This occurs during registration and periodically thereafter. The collected RxMER data is averaged per minislot and used to compute the recommended IUCs for each CM.

  The **no cable upstream ofdma-prof-mgmt rxmer-poll-interval** command sets the rxmer-poll-interval to 1440, which is the value to disable the feature. The rxmer data is also not displayed after disabling the feature.

Configuring Codeword Error Threshold

Starting from Cisco IOS XE Gibraltar 16.12.1x release, user can configure a codeword error threshold above which the profile will be downgraded, that is, switch to a lower order QAM.

Compared with the existing profile management scheme, in which the RxMER is read at configured interval, and data IUC is upgraded or downgraded based on RxMER data and configurable criteria, using customized codeword error threshold has several benefits, including:

- React to noise within minimal time window to maintain service quality
- If IUC selected by RxMER causes errors, it can be downgraded quickly
- Downgrade interval is much shorter than RxMER interval

To configure the codeword error threshold, enable this feature first:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade enable
```

Then configure the minimum number of codewords required within downgrade interval to consider for downgrade:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade min-cws value
```

Use **show cable modem prof-mgmt upstream** to check whether this feature is enabled:

```
Router#show cable modem 4800.33ef.3dd2 prof-mgmt upstream
Upstream Profile Management Data:
MAC Address            : 4800.33ef.3dd2
Number of US Chan      : 1

Ucid                   : 6
RxMer Exempt Percent   : 0
RxMer Margin qDB       : 0
RxMer Threshold Percent : 2
Start Sc               : 148
End Sc                 : 1907
Num RxMER Measurement  : 1908
Tx Time                : 0h:04m:50s ago
Rx Time                : 0h:04m:50s ago
MER Poll Period   (min) : 5
Auto Profile Upgrade   : Yes
Upgrd Dly Cnt (cur/cfg) : 0/1
Upgrd Dly rcmd IUC     : none
Recommended IUC        : 5
Current IUC            : 5
Downgrade IUC          : 6
RxMER send/recv count  : 1/1
DBC                    : 1/1/0/0/0
                         (send/succeed/err/reject/timeout)
State                  : Ready
Profile Downgrade      : Enabled
Profile Downgrade count : 0
Interval good/cor/uncor : 294/93/0
Downgrade Check Time   : 0h:00m:14s ago
```

After a downgrade, Profile Downgrade count is updated in the command output:

```
Router#show cable modem 4800.33ef.3dd2 prof-mgmt upstream
Upstream Profile Management Data:
MAC Address            : 4800.33ef.3dd2
Number of US Chan      : 1

Ucid                   : 6
RxMer Exempt Percent   : 0
RxMer Margin qDB       : 0
RxMer Threshold Percent : 2
Start Sc               : 148
End Sc                 : 1907
Num RxMER Measurement  : 1908
Tx Time                : 0h:00m:01s ago
Rx Time                : 0h:00m:01s ago
MER Poll Period   (min) : 5
Auto Profile Upgrade   : Yes
Upgrd Dly Cnt (cur/cfg) : 0/1
Upgrd Dly rcmd IUC     : none
Recommended IUC        : 6
Current IUC            : 6
Downgrade IUC          : 9
```

```
RxMER send/recv count   : 3/3
DBC                     : 2/1/0/0/0
                          (send/succeed/err/reject/timeout)
State                   : MER Received
Profile Downgrade       : Enabled
Profile Downgrade count : 1
Interval good/cor/uncor : 222/0/119
Downgrade Check Time    : 0h:00m:03s ago
Holddown Time           : 0h:00m:03s ago
```

The **Holddown Time** will not be displayed in the command output anymore after the configured holddown time is expired. In the following example, after two downgrades, the holddown time was expired, an RxMER was read and checked, and the profile was upgraded back to 5.

```
Router#show cable modem 4800.33ef.3dd2 prof-mgmt upstream
Upstream Profile Management Data:
MAC Address            : 4800.33ef.3dd2
Number of US Chan      : 1

Ucid                    : 6
RxMer Exempt Percent    : 0
RxMer Margin qDB        : 0
RxMer Threshold Percent : 2
Start Sc                : 148
End Sc                  : 1907
Num RxMER Measurement   : 1908
Tx Time                 : 0h:03m:07s ago
Rx Time                 : 0h:03m:07s ago
MER Poll Period   (min) : 5
Auto Profile Upgrade    : Yes
Upgrd Dly Cnt (cur/cfg) : 0/1
Upgrd Dly rcmd IUC      : none
Recommended IUC         : 5
Current IUC             : 5
Downgrade IUC           : 6
RxMER send/recv count   : 6/6
DBC                     : 4/4/0/0/0
                          (send/succeed/err/reject/timeout)
State                   : Ready
Profile Downgrade       : Enabled
Profile Downgrade count : 2
Interval good/cor/uncor : 269/72/0
Downgrade Check Time    : 0h:00m:03s ago
```

Downgrading to Partial Mode

Starting from Cisco IOS XE Gibraltar 16.12.1y release, user can configure a codeword error threshold above which the profile will be downgraded to partial mode, that is disable some of the OFDMA channels when the CM is currently using IUC13 due to MER or downgrade.

To configure the codeword error threshold, enable this feature first:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade enable
```

Then configure the threshold to consider for downgrading to partial mode:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade partial-threshold value
```

Use **show cable modem partial-mode** to check the reason for downgrading to partial mode:

```
Router#show cable modem 4800.33ef.3dd2 partial-mode
MAC Address    IP Address  I/F       MAC      Prim  RCC  UP-reason/
                                     State    Sid   ID   Failed-tcsf
81d.0f01.1e10  9.2.0.46    C1/0/0/p  w-online 1     1    0x10 / 0x20

Note: 0x01 = Ranging
      0x10 = CWErr Partial Mode
      0x11 = Both
```

Configuring RxMER Downgrade

Comparing to the existing upstream profile managements mechanism, RxMER downgrade has the following benefits:

- Ability to downgrade to partial mode based only on RxMER data
- Configurable desired lowest acceptable IUC
- This allows IUC 13 modulation to be robust for registration and DBC
- Allow certain percentage of subcarriers under threshold
- Re-evaluate RxMER data at next poll interval
- Channel leaves partial-mode and uses recommended IUC when RxMER data is above threshold
- Works independently with codeword error downgrade

By default, RxMER downgrade is disabled, use the following command to enablethis feature:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade rxmer-enable
```

Then configure the data IUC below which the OFDMA channel will be downgraded to partial mode, the default number is 13:

```
Router(config-ofdma-mod-profile)# ofdma-prof-mgmt downgrade rxmer min-iuc value
```

You can also configure the number of minislots that can be below minimum IUC and not trigger downgrade, the default number is 0:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade
rxmer-exempt-mslot-pct value
```

The following example shows how to configure RxMER downgrade in cBR-8:

```
Router(config)# cable upstream ofdma-prof-mgmt rxmer-poll-interval 5
Router(config)# cable upstream ofdma-prof-mgmt prof-upgrade-auto
Router(config)# cable upstream ofdma-prof-mgmt downgrade rxmer-enable
Router(config)# cable mod-profile-ofdma 466
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 256
Router(config-ofdma-mod-profile)# data-iuc 5 modulation 1024-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 9 modulation 512-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 10 modulation 256-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 11 modulation 128-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 12 modulation 64-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# data-iuc 13 modulation 16-QAM pilot-pattern 8
Router(config-ofdma-mod-profile)# ofdma-prof-mgmt downgrade rxmer min-iuc 12
```

To display the count of profile partial downgrade, use the command as shown in the following example:

```
Router# show cable modem 4800.33ef.3dd2 prof-mgmt upstream
Upstream Profile Management Data :
MAC Address             : 4800.33ef.3dd2
Ucid                    : 6
Num RxMER Measurement   : 1908
Tx Time                 : 0h:00m:15s ago
Rx Time                 : 0h:00m:15s ago
MER Poll Period   (min) : 5
Auto Profile Upgrade    : Yes
Recommended IUC         : 13
Current IUC             : 13
Downgrade IUC           : 13
RxMER send/recv count   : 10/10
DBC                   : 0/0/0/0/0                       (send/succeed/err/reject/timeout)
State                   : MER Received
Profile Downgrade Partial count : 1
mslot RxMER(in 1/4 dB):
# msMer    0   : B3B7B4B0 B5ADB1B1 A6A9A5A3 89867A66 3A2C4152 53525D59 595F5C5F 5F636366
# msMer    32 : 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
# msMer    64 : 00000000 00000000
SC RxMER Distribution (Excluded SCs are ignored):*: 2%
>44dB: ***** 10.00%
>42dB: **  4.31%
>39dB:   0.86%
>36dB:   1.55%
>33dB: *  2.41%
>30dB:   1.29%
>27dB: **  5.17%
>24dB: ****  8.27%
>21dB: *  3.96%
>18dB:   1.63%
>15dB:   1.20%
<15dB: ************************** 59.31%
       ----------------------------------------------------100
                         Percent of Subcarriers
```

Manually Configuring OFDMA Modulation Profile Downgrade

Table 2: Feature History

Feature Name	Release Information	Feature Description
Manually Configuring OFDMA Modulation Profile Downgrade	Cisco IOS XE Dublin 17.12.1z	With this release, you can downgrade to the desired interval usage codes (IUC), while configuring the codeword error threshold for a profile. The operator can configure the **data-iuc** *data-iuc-type* **modulation** *modulation* **pilot-pattern** *pilot-pattern-id* **cwerr-downgrade-iuc** *cwerr-downgrade-iuc* keyword under the **cable mod-profile-ofdma** command to enable this feature. The benefit of configuring this command is that you can skip the trial of multiple profiles until it reaches the final IUC13 profile and configure the exact downgrade that you need. The time taken to downgrade the profile to IUC13 is reduced is reduced as some profiles are skipped.

In releases before Cisco IOS XE Dublin 17.12.1z, when a cable modem encounter OFDMA FEC issues, the cBR-8 modem downgrades the assigned profile to the next viable profile based on modulation order. This can result in the trial of up to 7 profiles on the way to IUC13 for a serious issue. Each profile is assigned at the 10-second assessment interval. Downgrade IUC selection is calculated based on the next lowest bitload Data IUC, from the list of available IUCs,

Starting with Cisco IOS XE Dublin 17.12.1z, downgrade IUC selection can be performed as per the **cwerr-downgrade-iuc** configuration.

The process of downgrade IUC selection which calculates the next lower bitload Data IUC from the list of available IUCs, is still applicable if you do not configure **cwerr-downgrade-iuc** .

Configuring OFDMA Modulation Profile Downgrade

Here is a sample configuration for manually configuring IUC downgrade:

```
Router# configure terminal
Router(config)# cable mod-profile-ofdma 461
Router(config-ofdma-mod-profile)# subcarrier-spacing 50KHz
Router(config-ofdma-mod-profile)# initial-rng-subcarrier 32
Router(config-ofdma-mod-profile)# fine-rng-subcarrier 100
Router(config-ofdma-mod-profile)#
data-iuc 5 modulation 1024-QAM pilot-pattern 1 cwerr-downgrade-iuc 10
Router(config-ofdma-mod-profile)#
data-iuc 6 modulation 512-QAM pilot-pattern 1 cwerr-downgrade-iuc 10
Router(config-ofdma-mod-profile)#
data-iuc 9 modulation 256-QAM pilot-pattern 2 cwerr-downgrade-iuc 13
Router(config-ofdma-mod-profile)# data-iuc 10 modulation 128-QAM pilot-pattern 2
cwerr-downgrade-iuc 13
Router(config-ofdma-mod-profile)#
data-iuc 11 modulation 64-QAM pilot-pattern 3 cwerr-downgrade-iuc 13
Router(config-ofdma-mod-profile)# data-iuc 12 modulation 32-QAM pilot-pattern 3
Router(config-ofdma-mod-profile)# data-iuc 13 modulation 16-QAM pilot-pattern 4
Router(config-ofdma-mod-profile)# end
```

Use this command to verify the **cwerr-downgrade-iuc** downgrade configuration for the upstream channel:

```
Router# show controllers upstream-Cable 1/0/14 us-channel 12
USPHY OFDMA support: FULL


Controller 1/0/14 upstream 12  AdminState:UP OpState: UP
  ofdma mode enabled
  Channel Freq Range 18.500 MHz to 28.500 MHz
  Channel Subcarrier Index Range Cfg: 74, 273 Op: 74, 273
  Channel SC0 Freq Cfg: 14.800 MHz Op: 14.800 MHz
  #Excl bands: 2
  (   0,   73), ( 274, 2047),
  #Unused bands: 0
  Cyclic Prefix Size 96,  Rolloff Period Size 0
  Subcarrier Spacing 50KHz,  Symbols Per Frame 18 Subcarrier Per Minislot: 8

  Modulation Profile (ID 461, Subcarrier Spacing 50KHz)
    IUC type   Cfg   Act  Preamble Bit       Pilot     Cwerr Downgrade
               subc  subc Symbols  Loading   Pattern   IUC
    3  (IR)    32    32      4       -         -          -
    4  (FR)    100   100     1       -         -          -
    5  (data)   -     -      -     1024-QAM    1          10
    6  (data)   -     -      -     512-QAM     1          10
```

```
    9  (data)   -     -      -     256-QAM     2          13
    10 (data)   -     -      -     128-QAM     2          13
    11 (data)   -     -      -     64-QAM      3          13
    12 (data)   -     -      -     32-QAM      3          -
    13 (data)   -     -      -     16-QAM      4          -
...
...
...
```

This sample shows a partial output of the command. The last column displays the configured **cwerr-downgrade-iuc** value.

Use this command to display the IUC for a specific modem:

```
Router# show cable modem XXXX.XXXX.XXXX prof-mgmt upstream
MAC Address            : XXXX.XXXX.XXXX
Number of US Chan      : 1
Ucid                    : 13
MD US Chan              : Cable0/0/14/U12
Ctlr US Chan            : UC0/0/14:U12
...
...
...
Recommended IUC         : 5  (1024-QAM)
Current IUC             : 5  (1024-QAM)
Downgrade IUC           : 10  (128-QAM)
RxMER Recommended IUC   : 5  (1024-QAM)
RxMER send/recv count   : 20/20
RxMER retries curr/total: 0/0
Int  tot/good/cor/uncor : 1003/1002/1/0  (18/0)
Downgrade Check Time    : 0h:00m:57s ago
```

This sample shows a partial output of the command. The line highlighted in bold (`Downgrade IUC          : 10  (128-QAM`) displays the configured **cwerr-downgrade-iuc** value.

CWErr Downgrade Statistics Interval Alignment

Table 3: Feature History

Feature Name	Release Information	Feature Description
CWErr Downgrade Statistics Interval Alignment	Cisco IOS XE Dublin 17.15.1w	The OFDMA profile management codeword error downgrade feature, downgrades a modem's OFDMA channel IUC when codeword errors are seen on that channel. Statistics updates include updating the codeword statistics for each modem and channel but are not synchronized to the profile management downgrade processing. With this release, downgrade processing may be synced with the statistic updates. When this is enabled, the downgrade interval is used, but must be in an interval of 10 for statistic synchronized downgrade to be enabled. Command Introduced: **cable upstream ofdma-prof-mgmt downgrade synchronized**.

The OFDMA profile management codeword error downgrade feature downgrades a modem's OFDMA channel IUC when codeword errors are seen on that channel. Statistics updates include updating the codeword statistics for each modem and channel but are not synchronized to the profile management downgrade processing. Downgrade processing can be done earlier by synchronizing the processing with statistics updates.

The downgrade processing is controlled with these configuration commands:

```
cable upstream ofdma-prof-mgmt downgrade enable
 cable upstream ofdma-prof-mgmt downgrade interval value
 cable upstream ofdma-prof-mgmt downgrade threshold value
 cable upstream ofdma-prof-mgmt downgrade hold-down value
 cable upstream ofdma-prof-mgmt downgrade min-cws value
```

See cable upstream ofdma-prof-mgmt downgrade

Configure Statistics Synchronization

Enable the synchronization of statistics using this command:

```
Router(config)# cable upstream ofdma-prof-mgmt downgrade synchronized
```

Configuring this command enables **ofdma-prof-mgmt downgrade** to process the statistics as soon as they are available. The downgrade interval must be a factor of 10. The minimum statistics interval is 10 seconds. In order for this feature to be enabled, configure the interval with factors of 10.

Verify Statistics Synchronization

Starting with Cisco IOS XE Dublin 17.15.1w, the output of the **show cable modem prof-mgmt** *mac-address* **prof-mgmt upstream verbose** is updated to include the profile downgrade sync status. The default is **Enabled** for statistics synchronization.

```
Router # show cable modem b42a.0e85.4da5 prof-mgmt upstream verbose
Upstream Profile Management Data (Verbose):
MAC Address             : b42a.0e85.4da5
Number of US Chan       : 2
Ucid                     : 8
MD US Chan               : Cable3/0/0/U7
Ctlr US Chan             : UC3/0/0:U13
RxMer Exempt Percent     : 0
RxMer Margin qDB         : 0
RxMer Threshold Percent  : 2
Start Sc                 : 74
End Sc                   : 1973
Num RxMER Measurement    : 1900
First/Last Active Sc     : 74/1973
Total Active Scs         : 1900
Tx Time                  : 0h:00m:29s ago   (Jul 23 04:16:13.588)
Rx Time                  : 0h:00m:29s ago   (Jul 23 04:16:13.594)
MER Poll Period   (min)  : 5
Auto Profile Upgrade     : Yes
Upgrd Dly Cnt (cur/cfg)  : 0/1
Upgrd Dly rcmd IUC       : none
Recommended IUC          : 6  (2048-QAM)
Current IUC              : 6  (2048-QAM)
Downgrade IUC            : 10  (512-QAM)
RxMER Recommended IUC    : 6  (2048-QAM)
RxMER send/recv count    : 242/242
RxMER retries curr/total: 0/6
DBC                      : 9/9/0/0/0(send/succeed/err/reject/timeout)
State                    : Ready
Profile Downgrade        : Enabled
Profile Downgrade Sync   : Enabled
```

```
Profile Downgrade count : 6
Profile Downgrade Partial count : 3
Int  tot/good/cor/uncor : 90/0/0/90  (25/0)
Aggr tot/good/cor/uncor : 14/14/0/0
Downgrade Check Time    : 0h:00m:04s ago
```

OFDMA CwErr Downgrade Process

In releases before Cisco IOS XE Dublin 17.15.1z, the OFDMA IUC (Initial Usage Code) CwErr (Codeword Error) downgrade process involves these steps.

- Receiving Channel/Sid stats collected by the hardware every 10 seconds.
- Comparing stats every configured downgrade interval (minimum 10 seconds).
- Waiting for the minimum codewords to be received.
- Changing the IUC via DBC (DOCSIS Bonding Channel) exchange.
- Waiting one downgrade interval to avoid stats including the previous IUC.
- Repeating the cycle up to six times to downgrade through six possible IUCs.

Faster OFDMA CwErr Downgrade

Table 4: Feature History

Feature Name	Release Information	Feature Description
CWErr Downgrade Statistics Interval Alignment	Cisco IOS XE Dublin 17.15.1z	This feature reduces the time taken to perform OFDMA CwErr (Codeword Error) profile downgrades. The enhancement improves this by synchronizing the profile management check time to the hardware statistics updates and shortening the statistics update time to a 5-second interval read for Channel/sid stats. This allows the OFDMA CwErr downgrade process to assess and react faster. Command Introduced: **cable upstream ofdma-prof-mgmt downgrade synchronized**.

The enhancement introduces the ability to shorten the stats collection time from the fixed 10 seconds to 5 seconds, which in turn allows for a faster downgrade assessment interval when configured below 10 seconds. The profile management check time is synchronized with these faster stats updates.

Configure Faster OFDMA CwErr Downgrade

The stats collection time, which was previously fixed at 10 seconds, is made configurable to support faster IUC downgrades. To configure the OFDMA profile management downgrade interval:

```
router(config)# cable upstream ofdma-prof-mgmt downgrade interval seconds
```

The valid range is 5-3600 seconds. A value below 10 seconds configured for the downgrade interval results in 5-second stat collection.

To enable 5-second stats collection specifically:

```
ofdma-prof-mgmt downgrade interval 5
```

Alternatively, setting the interval to 5 seconds will also enable 5-second stats collection:

```
ofdma-prof-mgmt downgrade interval 5
```

For **Profile Downgrade Sync: Enabled**, the o**fdma-prof-mgmt downgrade interval** should be a value of 5 or a multiple of 10 (10, 20, 30 and so on).

Verify Faster OFDMA CwErr Downgrade

You can verify the configuration and status of the OFDMA profile management, including the downgrade settings and sync status, using the `show cable modem` command.

To show profile management upstream data for a specific modem:

```
router#show cable modem mac-address prof-mgmt upstream
```

The output includes fields like "Profile Downgrade", "Profile Downgrade Sync", and "Downgrade Check Time". Here is a sample output.

```
router#show cable modem xxxx.xxxx.xxxx prof-mgmt upstream
Upstream Profile Management Data :
MAC Address            : xxxx.xxxx.xxxx
Number of US Chan      : 2
Ucid                    : 16
MD US Chan              : Cable3/0/0/U15
Ctlr US Chan            : UC3/0/1:U13
RxMer Exempt Percent    : 0
RxMer Margin qDB        : 40
RxMer Threshold Percent : 2
Start Sc                : 74
End Sc                  : 1973
Num Measurement   : 1900
First/LRxMERast Active Sc    : 74/1973
Total Active Scs        : 1900
Tx Time                 : 0h:00m:47s ago   (Feb 20 07:52:58.889)
Rx Time                 : 0h:00m:47s ago   (Feb 20 07:52:58.895)
MER Poll Period   (min) : 5
Auto Profile Upgrade    : Yes
Upgrd Dly Cnt (cur/cfg) : 0/1
Upgrd Dly rcmd IUC      : none
Recommended IUC         : 6  (2048-QAM)
Current IUC             : 6  (2048-QAM)
Downgrade IUC           : 9  (1024-QAM)
RxMER Recommended IUC   : 5  (4096-QAM)
RxMER send/recv count   : 25/25
RxMER retries curr/total: 0/0
DBC                     : 2/2/0/0/0
                          (send/succeed/err/reject/timeout)
State                   : Ready
Profile Downgrade       : Enabled
Profile Downgrade Sync  : Enabled
Profile Downgrade count : 1
Profile Downgrade Partial count : 0
Int  tot/good/cor/uncor : 3000/0/0/3000  (56/1)
Downgrade Check Time    : 0h:00m:01s ago
...
...
...
```

To view the timeline of OFDMA profile management events, including IUC changes and partial state transitions, you can use the `show cable modem mac-address timeline dynamic` command, filtering for the specific modem and ucid.

This output shows timestamps for events like "new iuc", "dbc done", "into partial", and "leave partial", illustrating the speed of the downgrade process with different stat collection intervals (e.g., 5 seconds vs 10 seconds). The output includes fields like "Profile Downgrade", "Profile Downgrade Sync", and "Downgrade Check Time". Here is a sample output.

```
router#show cable modem b42a.0e85.4441 timeline dynamic | s ucid: 16

Feb 25 08:35:29.346     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:35:27.486     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 13
Feb 25 08:35:24.383     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 13 (cwerr)
Feb 25 08:35:22.477     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 12
Feb 25 08:35:19.381     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 12 (cwerr)
Feb 25 08:35:17.488     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 11
Feb 25 08:35:14.382     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 11 (cwerr)
Feb 25 08:35:12.508     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 10
Feb 25 08:35:09.383     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 10 (cwerr)
Feb 25 08:35:07.479     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 9
Feb 25 08:35:04.383     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 9 (cwerr)
Feb 25 08:35:02.478     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 6
Feb 25 08:34:59.382     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 6 (cwerr)
Feb 25 08:34:57.941     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 5
Feb 25 08:34:54.845     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 5 (rxmer)
Feb 25 08:34:54.350     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 leave
 partial (cwerr
Feb 25 08:33:49.385     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:33:44.346     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 leave
 partial (cwerr
Feb 25 08:32:44.345     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:32:39.346     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 leave
 partial (cwerr
Feb 25 08:31:34.349     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:31:29.349     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 leave
 partial (cwerr
Feb 25 08:30:24.350     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:30:19.350     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 leave
 partial (cwerr
Feb 25 08:29:19.347     w-online(pt) ofdma prof mgmt          w-online(pt)  ucid: 16 into
partial (cwerr)
Feb 25 08:29:17.575     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 13
Feb 25 08:29:14.442     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 new
iuc: 13 (cwerr)
Feb 25 08:29:12.504     w-online(pt) ofdma iuc mgmt           w-online(pt)  ucid: 16 dbc
done, iuc: 12
```

```
Feb 25 08:29:09.389     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 new
iuc: 12 (cwerr)
Feb 25 08:29:07.577     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 dbc
done, iuc: 11
Feb 25 08:29:04.432     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 new
iuc: 11 (cwerr)
Feb 25 08:29:02.483     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 dbc
done, iuc: 10
Feb 25 08:28:59.385     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 new
iuc: 10 (cwerr)
Feb 25 08:28:57.502     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 dbc
done, iuc: 9
Feb 25 08:28:54.386     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 new
iuc: 9 (cwerr)
Feb 25 08:28:52.492     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 dbc
done, iuc: 6
Feb 25 08:28:49.382     w-online(pt) ofdma iuc mgmt          w-online(pt)  ucid: 16 new
iuc: 6 (cwerr)
```

Sync Stats Enabled 5 Seconds

Display the Cable Modem Count per Profile

Feature History

Table 5: Feature History

Feature Name	Release Information	Feature Description
Display CM counts per US IUC and DS profile	Cisco IOS XE Bengaluru 17.6.1x	This feature introduces new commands **show cable modem phy ofdm downstream prof-count** and **show cable modem phy ofdm upstream iuc-count**, it helps tracking and reporting number of Cable Modems being in use per Upstream IUC and Downstream Profile on each controller separately. These counters are indicative of health of the RF plant.

To display the CM count per upstream port and IUC, use the **show cable modem phy ofdm upstream iuc-count** command as shown in the example below:

```
Router#show cable modem phy ofdm upstream iuc-count
                      |<----------- CM Count per profile ----------->|
I/F           IF-INDX  IUC-5  IUC-6  IUC-9 IUC-10 IUC-11 IUC-12 IUC-13
-----------   ------- ------ ------ ------ ------ ------ ------ ------
C1/0/0/U6     488046       3      0      0      0      0      0      3
C1/0/0/U7     488047       3      0      0      0      0      0      3
C9/0/0/U6     501870       1      0      0      0      0      0      1
C9/0/0/U7     501871       1      0      0      0      0      0      1
C9/0/1/U6     501918       1      0      0      0      0      0      2
C9/0/1/U7     501919       1      0      0      0      0      0      2
```

Feature Information for Upstream Profile Selection

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 6: Feature Information for Upstream Profile Selection

Feature Name	Releases	Feature Information
DOCSIS3.1 US Profile Selection	Cisco IOS XE Fuji 16.7.1	This feature was integrated into Cisco IOS XE Fuji 16.7.1 on the Cisco cBR Series Converged Broadband Routers.
Codeword Errors Monitoring	Cisco IOS XE Gibraltar 16.12.1x	This feature was integrated into Cisco IOS XE Gibraltar 16.12.1x on the Cisco cBR Series Converged Broadband Routers.
Downgrading to Partial Mode	Cisco IOS XE Gibraltar 16.12.1y	This feature was integrated into Cisco IOS XE Gibraltar 16.12.1y on the Cisco cBR Series Converged Broadband Routers.
RxMER Downgrade	Cisco IOS XE Gibraltar 16.12.1z	This feature was integrated into Cisco IOS XE Gibraltar 16.12.1z on the Cisco cBR Series Converged Broadband Routers.