

# Cable Modems Dropping Offline in a 2-way Cable Network

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## Introduction

This document explains some troubleshooting steps used to determine the cause of Cable Modems dropping offline. Since, in the majority of cases, the cause will be a plant issue or low carrier-to-noise ratio, these issues will be the major emphasis of this document.

## Before You Begin

### Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

### Prerequisites

There are no specific prerequisites for this document.

### Components Used

The information in this document is based on these software and hardware versions:

- Cisco hardware uBR7246 VXR (NPE300) processor (revision C)
- Cisco IOS® software (UBR7200-K1P-M), Version 12.1(9)EC
- CVA122 Cisco IOS Software 12.2(2)XA

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Why Do Cable Modems Drop Offline?

A Cable Modem requires three main things to remain online once it is connected and operational:

- Clean RF plant with a carrier-to-noise consistently above 25 dB in the Upstream, and above 35 in the downstream.
- Unicast polls from the CMTS every 30 seconds (keepalives). These are unicast transmit opportunities for this modem's assigned SID, in which it can send a RNG-REQ to the CMTS. If the cable modem does not receive a unicast transmit opportunity within T4 seconds (30 seconds) it has to time out and re-initialise it's MAC layer. So if there is a problem (RF) in the downstream, the cable modem might not "see" this unicast transmit opportunity, and drop offline.
- If the CMTS does not get a reply from the CM to the unicast transmit opportunity, the CMTS will poll the modem 16 times in short succession in order to try and get an answer. The modem is considered offline by the CMTS if there is no reply after these retries.

## RF Plant Quality

According to DOCSIS specifications, the RF plant needs to comply to following requirements for Upstream and Downstream to ensure continued operation:

- The configuration parameters
- The downstream and upstream frequencies used
- The noise measurements in dB. Make certain that they are correct and within the allowed limits. A table of the noise limits is included below:

### Specifications UPSTREAM

#### DOCSIS Specifications<sup>1</sup>

#### System/Channel

Frequency range

5 to 42 MHz (North America)

5 to 65 MHz (Europe)

Transit delay from the most distant CM to the nearest CM or CMTS.

< 0.800 millisecond (msec)

Carrier to noise ratio

25 dB

Carrier to ingress power ratio

> 25 dB

Carrier to interference ratio

> 25 dB (QPSK<sup>2</sup>)<sup>3</sup>

> 25 dB (16 QAM4)<sup>3</sup>

Carrier hum modulation

< -23 dBc<sup>5</sup> (7%)

Burst noise

Not longer than 10  $\mu$ sec at a 1 kHz average rate for most cases.

Amplitude ripple

0.5 dB/MHz

Group delay ripple

200 ns/MHz

Micro reflections (single echo)

-10 dBc @ < 0.5  $\mu$ sec

-20 dBc @ < 1.0  $\mu$ sec

-30 dBc @ > 1.0  $\mu$ sec

Seasonal/diurnal signal level variation

Not greater than 8 dB min to max.

### **Digital Signal Levels**

From cable modem (upstream)

+8 to +58 dBmV (QPSK)

+8 to +55 dBmV (16 QAM)

Input amplitude to modem card (upstream)

-16 to +26 dBmV, depending on symbol rate.

Signal as relative to adjacent video signal

-6 to -10 dBc

<sup>1</sup>DOCSIS specifications are baseline settings for a DOCSIS-compliant, two-way data-over-cable system.

<sup>2</sup> QPSK = Quadrature Phase-Shift Keying: a method of modulating digital signals onto a radio-frequency carrier signal using four phase states to code two digital bits.

<sup>3</sup> These settings are measured relative to the digital carrier. Add 6 or 10 dB, as determined by your company's policy and derived from the initial cable network setup, relative to the analog video signal.

<sup>4</sup> QAM = Quadrature Amplitude Modulation: a method of modulating digital signals onto a radio-frequency carrier signal involving both amplitude and phase coding.

<sup>5</sup> dBc = decibels relative to carrier.

## Specification DOWNSTREAM

### DOCSIS Specifications<sup>1</sup>

#### **System/Channel**

RF channel spacing (bandwidth)

6 MHz

Transit delay<sup>2</sup>

0.800 millisecond (msec)

Carrier to noise ratio

35 dB

Carrier-to-interference ratio for total power (discrete and broadband ingress signals).

> 35 dB

Composite triple beat distortion

< -50 dBc<sup>3</sup>

Carrier to second order

< -50 dBc

Cross-modulation level

< -40 dBc

Amplitude ripple

0.5 dB in 6 MHz

Group delay

75 ns<sup>4</sup> in 6 MHz

Micro reflections bound for dominant echo

-10 dBc @ < 0.5  $\mu$ sec

-15 dBc @ < 1.0  $\mu$ sec

-20 dBc @ < 1.5  $\mu$ sec

-30 dBc @ > 1.5  $\mu$ sec

Carrier hum modulation

< -26 dBc (5%)

Burst noise

Not longer than 25 µsec at a 10 kHz average rate.

Seasonal/diurnal signal level variation

8 dB

Signal level slope (50 to 750 MHz)

16 dB

Maximum analog video carrier level at CM input, inclusive of above signal level variation.

+17 dBmV

Minimum analog video carrier level at CM input, inclusive of above signal level variation.

-5 dBmV

### **Digital Signal Levels**

Input to cable modem (level range, one channel)

-15 to +15 dBmV

Signal as relative to adjacent video signal

-6 to -10 dBc

<sup>1</sup>DOCSIS specifications are baseline settings for an DOCSIS-compliant, two-way data-over-cable system.

<sup>2</sup>Transit delay is defined as the "round trip" from the cable headend to the furthest customer and back.

<sup>3</sup>dBc = decibels relative to carrier.

<sup>4</sup>ns = nanoseconds.

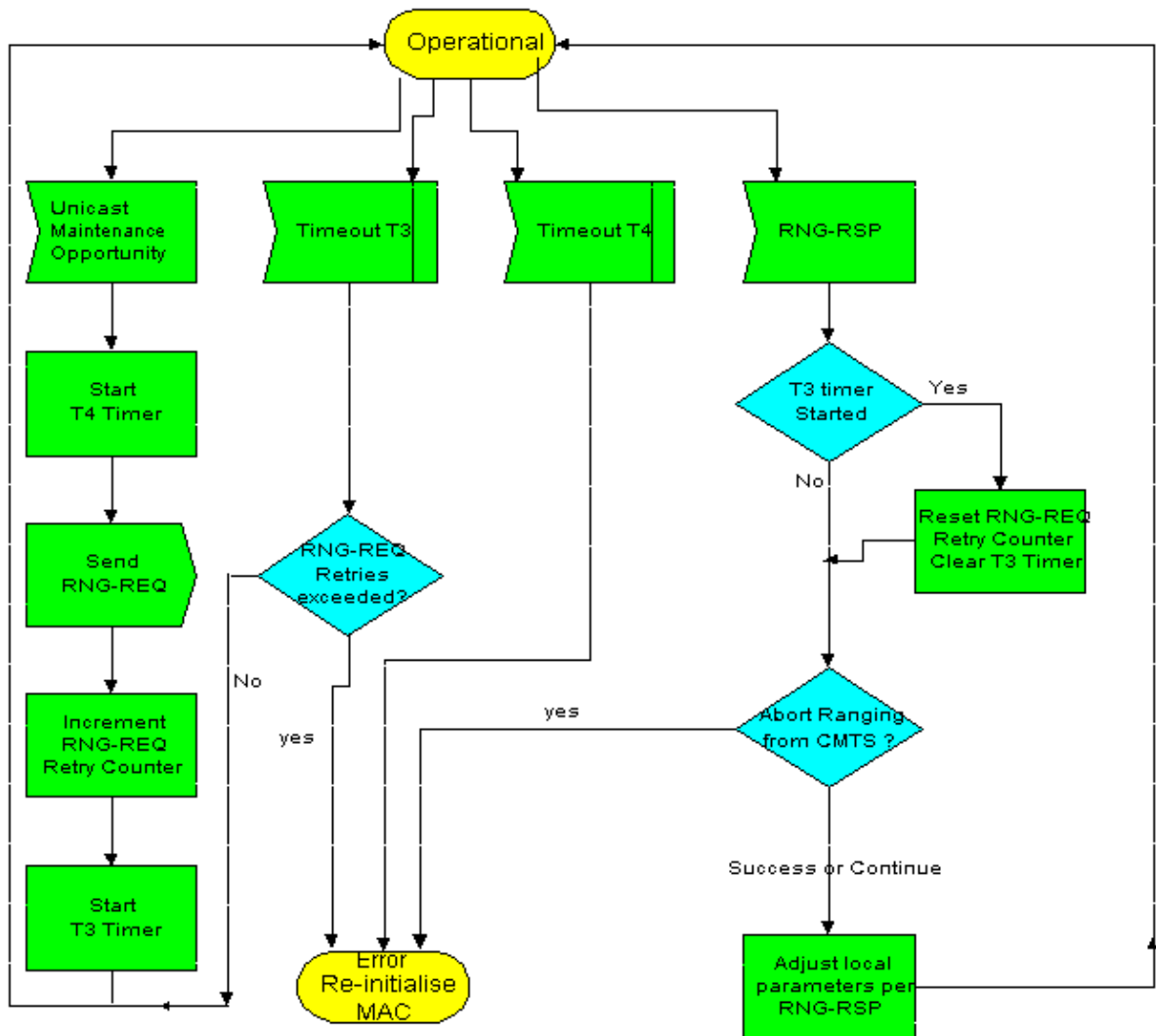
**Note:** For a full set of the specifications for the European Standard, please read RF Specifications.

For a document on how to troubleshoot RF issues in your cable plant, go to the Determining RF or Configuration Issues on the CMTS document. For more information on RF measurements using a spectrum analyzer refer to Connecting the Cisco uBR7200 Series Router to the Cable Headend.

## **Periodic Ranging (CM View)**

The CMTS MUST provide each CM a Periodic Ranging opportunity at least once every T4 seconds. The CMTS MUST send out Periodic Ranging opportunities at an interval sufficiently shorter than T4 that a MAP could be missed without the CM timing out. The size of this "subinterval" is CMTS dependent. The CM MUST reinitialize its MAC after T4 seconds have elapsed without receiving a Periodic Ranging opportunity. The default value for T4 is 30 seconds.

T4 is defined as "wait for unicast ranging opportunity". This is the time a modem will wait to get a dedicated transmit opportunity from the CMTS. The value is defined to be minimum 30 seconds, and maximum 35 seconds per SP-RFiv1.1-I03-991105.



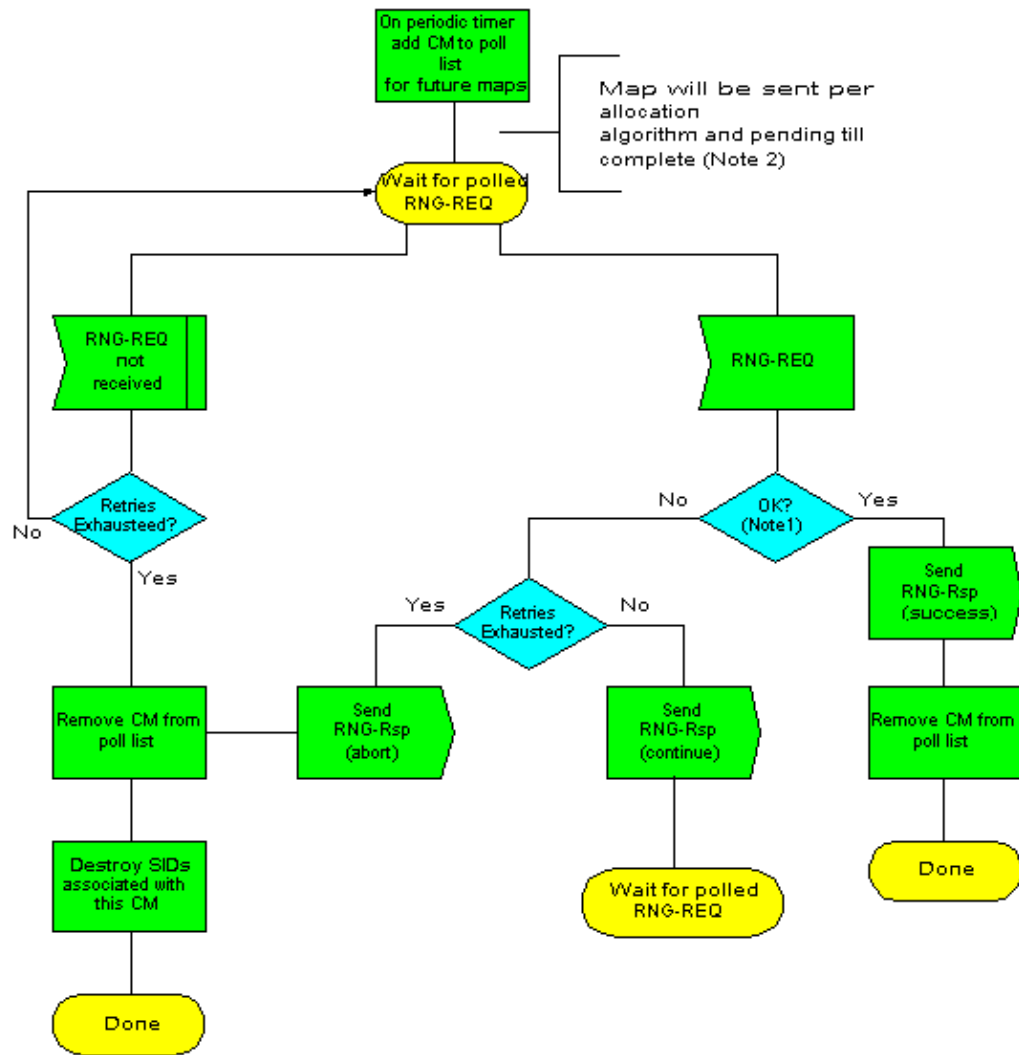
If a UBR9xx modem goes offline because of a T4 timeout, you will see following error messages in the **debug cable mac log**:

```

router#debug cable mac log verbose
....
11:05:07: 39907.082 CMAC_LOG_T4_TIMER
11:05:07: %UBR900-3-RESET_T4_EXPIRED: R04.0 Received Response to
Broadcast Maintenance Request, But no Unicast Maintenance opportunities received. T4 time
11:05:07: 39907.090 CMAC_LOG_RESET_T4_EXPIRED
....
  
```

This usually points to a problem in the RF, so the troubleshooting should focus on that.

## Periodic Ranging (CMTS View)



Note 1: Measures ranging request is within the tolerance limits of the CMTS for power and tra equalisation (if supported)

Note 2: RNG-REQ pending-till-complete was non zero. The CMTS SHOULD hold off the static maintenance opportunity accordingly unless needed. For example to adjust the CM's power. If opportunities are offered prior to the pending-till-complete expiry, the "OK" test which follow receipt of a RNG-RSP MUST NOT judge the CM's transmit equalisation until pending-till-com expires.

The CMTS will retry polling the CM until it either receives a reply or until the number of retries (default is sixteen) are exhausted. At that time the CM is removed from the poll list and considered offline.

A way to detect if a modem is constantly ranging is to use the **show cable flap-list** command.

## Upstream Utilization Too High

If the upstream utilization is too high, or too many modems are connected to the same upstream, it is possible that some modems will not get the required bandwidth or transmit opportunities to fulfill their periodic ranging requirements, also resulting in a T4 timeout.

Experience teaches us that customers who wish to successfully deploy data over cable networks based upon the DOCSIS standard must take into account many factors for success. One fundamental point that will ensure success is keeping customer return domains within reason. Keeping the homes passed (HHP) per upstream port to a reasonable level can significantly improve deployment success, maintenance costs, and improve customer satisfaction. For best performance it is recommended that 2000 homes passed per fiber node with

~10% penetration yielding 200 subscribing cable modems per upstream port is a highly effective framework by which to deploy.

More on the maximum number of users can be found in What is the Maximum Number of Users per CMTS?.

Use the **show interface cable slot/port upstream n** command as shown below to check for noise within the RF plant. If the uncorrectable errors, noise, and microreflection counters are high and increasing quickly, then this typically indicates there is noise present within the RF plant. You can check the upstream utilization by issuing following command on the CMTS:

```
VXR# show interfaces cable 6/1 upstream 0
Cable6/1: Upstream 0 is up
  Received 22 broadcasts, 0 multicasts, 247822 unicasts
  0 discards, 1 errors, 0 unknown protocol
  247844 packets input, 1 uncorrectable
  0 noise, 0 microreflections
  Total Modems On This Upstream Channel : 5 (5 active)
  Default MAC scheduler
  Queue[Rng Polls] 0/64, fifo queueing, 0 drops
  Queue[Cont Mslots] 0/52, FIFO queueing, 0 drops
  Queue[CIR Grants] 0/64, fair queueing, 0 drops
  Queue[BE Grants] 0/64, fair queueing, 0 drops
  Queue[Grant Shpr] 0/64, calendar queueing, 0 drops
  Reserved slot table currently has 0 CBR entries
  Req IEs 360815362, Req/Data IEs 0
  Init Mtn IEs 3060187, Stn Mtn IEs 244636
  Long Grant IEs 7, Short Grant IEs 1609
  Avg upstream channel utilization : 0%
  Avg percent contention slots : 95%
  Avg percent initial ranging slots : 2%
  Avg percent minislots lost on late MAPs : 0%
  Total channel bw reserved 0 bps
  CIR admission control not enforced
  Admission requests rejected 0
  Current minislot count : 40084 Flag: 0
  Scheduled minislot count : 54974 Flag: 0
VXR#
```

<b>Received broadcasts</b>	Broadcast packets received through this upstream interface
<b>multicasts</b>	Multicast packets received through this upstream interface
<b>Unicasts</b>	Unicast packets received through this interface
<b>Discards</b>	<del>Packets discarded by this interface</del>
<b>Errors</b>	Sum of all errors that prevented upstream transmission of packets
<b>Unknown</b>	Packets received that were generated using a protocol unknown to the Cisco uBR7246 Noise Upstream packets corrupted by line noise
<b>Packets input</b>	Packets received through upstream interface free from errors
<b>Corrected</b>	Error packets received through upstream interface that were corrected

<b>Uncorrectable</b>	Error packets received through upstream interface that could not be corrected
<b>Noise</b>	and Upstream packets corrupted by line noise
<b>Microreflections</b>	Upstream packets corrupted by microreflections
<b>Total Modems On This Upstream Channel</b>	Number of cable modems currently sharing this upstream channel. This field also shows how many of these modems are
<b>Rng Polls</b>	<sup>active</sup> The MAC scheduler queue showing number of ranging polls
<b>Cont Mslots</b>	The MAC scheduler queue showing number of forced contention request slots in MAPS
<b>CIR Grants</b>	The MAC scheduler queue showing number of CIR grants pending
<b>BE Grants</b>	The MAC scheduler queue showing number of best effort grants pending
<b>Grant Shpr</b>	The MAC scheduler queue showing number of grants buffered for traffic shaping
<b>Reserved slot table</b>	At time command issued MAO scheduler had admitted 2 CBR slots in the reserved slot table.
<b>Req IEs</b>	Running counter of request IEs sent in MAPS
<b>Req/Data IEs</b>	<del>Counter of request/data IEs sent in MAPS</del>
<b>Init Mtn IEs</b>	<del>Counter of Initial Maintenance IEs</del>
<b>Stn Mtn IES</b>	Number of station maintenance (ranging poll) IEs
<b>Long Grant IEs</b>	<del>Number of long grant IEs</del>
<b>ShortGrmg IEs</b>	<del>Number of short grant IEs</del>
<b>Avg upstream channel utilization</b>	Average percent of the upstream channel bandwidth being used. If it is closed to 100% see T4 timeouts.
<b>Avg percent contention slots</b>	Average percent of slots available for modems to request bandwidth via contention mechanisms. Also indicates the amount of unused capacity in the network.
<b>Avg percent initial ranging slots</b>	Average percent of slots in initial ranging
<b>Avg percent minislots lost on</b>	<sup>state</sup> Average percent of slots lost because a MAP interrupt was too late

<b>late Maps</b>	
<b>Total channel bw reserved</b>	Total amount of bandwidth reserved by all modems sharing this upstream channel that require bandwidth reservation. The Class of Service for these modems specifies some non-zero value for the guaranteed upstream rate. When one of these modems is admitted on the upstream, this field value is incremented by this guaranteed-upstream rate value.

**Note:** Check the noise and microreflection counters. They should be very low values and, in a normal cable plant, increment slowly. If they are at a high value and increment quickly it typically indicates a problem with the RF plant.

**Note:** Check for uncorrectable errors. These typically indicate a problem with noise within the RF plant. Check the received upstream SNR level.

**Note:** Best to keep this around 200 maximum.

## Configuring the Routing Protocol Causes a Reset of the Cable Modems

Be aware that when configuring a routing protocol on a Cisco uBR7200 series cable interface on older versions of IOS prior to Cisco IOS Software v12.1, the Cisco IOS software must reset the interface to enable the change. This in turn causes all cable modems on that particular downstream to reinitialize, potentially interfering with data transmission on that downstream. Therefore you should use the interface configuration commands, such as `router rip`, on a cable interface only when a minimum of subscribers would be affected.

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## Related Information

- [Determining RF or Configuration Issues on the CMTS](#)
- [Troubleshooting \[uBR7200\]](#)
- [Troubleshooting uBR Cable Modems Not Coming Online](#)
- [Connecting the Cisco uBR7200 Series Router to the Cable Headend](#)
- [Flap List Troubleshooting for the Cisco CMTS](#)
- [RF Specifications](#)
- [Cable Radio Frequency \(RF\) FAQ](#)
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