Cisco WT−2750 Multipoint Broadband Wireless System Frequently Asked Questions

Document ID: 14240

Contents

Introduction
General
Configuration Headend

Subscriber Unit (SU)
Related Information

Introduction

This document contains frequently asked questions (FAQs) about the Cisco WT−2750 Multipoint Broadband Wireless System. For a diagram of components of the Multipoint Broadband Wireless network, see the What are subchannels? question in this document.

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

General

Q. What are the necessary components for the Multipoint Broadband Wireless System?

A. Headend (HE):

- Cisco uBR7223/7246/7246VXR Universal Broadband router
- WT−2751 Multipoint Headend Line Card − up to four for each HE; supports up to 1024 simultaneous users
- WT−2781 Multipoint Quad Power Feed Panel − one for up to two line cards
- Power supply (−48VDC)
- HE transverter (outdoor unit (ODU)) − one or two for each line card, depending upon whether diversity is employed
- HE duplexer − one for each ODU

  Note: The orientation of the installed duplexer determines transmit (TX) high or receive (RX) high frequency in configuration.
- Antenna(s) − either omnidirectional or sectorized
- Lightning arrestors

Subscriber Unit (SU):

- Cisco 2600/3600 Series routers (2610, 2611, 2612, 2613, 2620, 2621, 3620, 3640, 3661, 3662)
- WT−2755 Multipoint Subscriber Network Module (NM)

  Note: NMs must be installed when router is powered off, except on the Cisco 3660 router.

- DC Power Injector (−48VDC for high−power ODU or +24VDC for standard power ODU) with power supply
- SU Transverter (ODU) − two needed if using diversity; available either integrated with antenna or nonintegrated, and either providing high or standard power

  Note: Diversity antenna is RX only.
- SU Directional Antenna (if not using integrated ODU)
- Lightning arrestors

Q. How are point−to−multipoint networks typically designed?

- Supercell:
  - ◊ Up to 20 miles in diameter (10 mile radius)
  - ◊ Single HE
- Minicell:
  - ◊ Four to 10 miles in diameter (two to five mile radius)
  - ◊ Can employ frequency reuse
- Microcell:
  - ◊ Up to two miles in diameter (one mile radius)
  - ◊ SUs can use lower TX power
  - ◊ Allows maximum number of SUs within given area
  - ◊ Allows for frequency reuse

Q. What are the frequency bands used for this system?

- MMDS: 2.500 − 2.690 GHz
- MDS: 2.150 − 2.162 GHz (used for upstream only)
- ETSI: 3.400 − 3.600 GHz (ODU will be available second half of 2001)
- U−NII: 5.725 − 5.825 GHz (ODU will be available first quarter of 2001)

Q. What is the modulation scheme that the Cisco WT−2750 Multipoint Broadband Wireless System uses?

A. 64QAM over Vector Orthogonal Frequency Division Multiplexing (VOFDM)

Q. What is Vector Orthogonal Frequency Division Multiplexing (VOFDM), and why is VOFDM so compelling?

A. VOFDM leverages multi−path phenomenon a key deterrent in microwave transmission into real life deployment advantages. VOFDM technology increases transmission signal strength through a combination of multiple signals at the receiving end. VOFDM increases the overall wireless system performance, link quality, and availability. VOFDM also dramatically increases the market coverage of service providers through non−line−of−sight transmission.

Q. What is the maximum coverage range?

A. You can have 3, 4, and 6−sector designs, based on different off−the−shelf antenna designs.

Q. What is non−line−of−sight transmission?

A. The coverage range of non−line−of−sight transmission depends on these parameters:

- Path loss assumption How much signal is lost along the transmission path.
- Link reliability and availability requirement How many 9s service providers must guarantee over the wireless link.
- Customer premises equipment (CPE) ODU transmission power Standard power ODU or high power ODU at the CPE end.
- Antenna gain The type of antenna used at the CPE end.
- Channelization and performance requirement What type of channelization and performance required for each sector.
- Number of receiving antennae One or two.

With a standard power ODU with high gain antenna, the WT−2750 Multipoint Broadband Wireless System can achieve six miles in non−Loss of Signal (LOS) transmission with two antennae/ODUs for each CPE, and three miles with a single antenna/ODU, when it meets 99.9% link availability requirement, and uses 6 MHz channel downstream, and 3 MHz channel upstream for each sector at normal path loss.

Q. What are the intermediate frequency (Ifs) for the Headend (HE) and Subscriber Unit (SU)?

- HE: 324 MHz TX, 420 MHz RX
- CPE: 330 MHz TX, 426 MHz RX

Q. What Cisco IOS® releases currently support the Multipoint Broadband Wireless System?

- 12.1(3)XQ1
- 12.1(3)XQ2
- 12.1(5)XM
- 12.2(1)T (available February/March 2001)
- Associated microcode

Q. What downstream frequency bandwidths are allowed? Can I change this?

A. Bandwidths of 6 MHz, 3 MHz, 1.5 MHz are allowed. The HE line card is configured to use a single channel 6 MHz wide, unless there are Radio Frequency (RF) variables that do not allow this configuration.

Q. What are the different upstream frequency bandwidths that I can configure?

A. The bandwidths are 6 MHz, 3 MHz, and 1.5 MHz. Because subchannelization is possible, you can use combinations of each of these channelization schemes. For example, if you use three upstream ports, you can have one upstream set for 3 MHz and the other two set for 1.5 MHz. You cannot exceed 6 MHz total with these combinations.

Q. What are the data throughput rates for this system?

Downstream

Bandwidth (Mhz)	Throughput (Mbps)	Multipath Robustness	Burst Length
1.5	4.2	standard	medium
1.5	3.2	standard	medium
1.5	1.6	standard	medium
3.0	10.0	standard	medium
3.0	7.6	standard	medium
3.0	5.1	standard	medium
3.0	8.6	high	medium
3.0	6.6	high	medium
3.0	4.4	high	medium
6.0	22.0	standard	medium
6.0	17.0	standard	medium
6.0	12.0	standard	medium
6.0	19.0	high	medium
6.0	14.0	high	medium
6.0	11.0	high	medium

Upstream

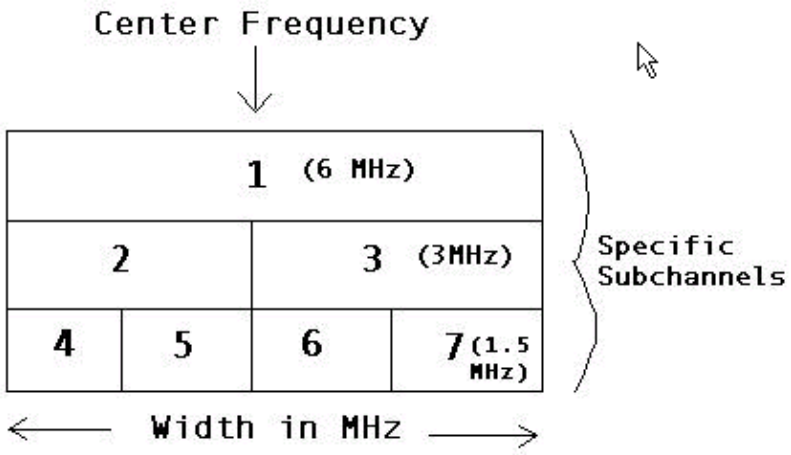
Bandwidth (Mhz)	Throughput (Mbps)	Multipath Robustness	Burst Length
1.5	4.2	standard	medium
1.5	3.2	standard	medium
1.5	1.4	standard	medium
3.0	8.1	high	medium
3.0	6.3	high	medium
3.0	4.4	high	medium
6.0	19.0	high	medium
6.0	15.0	high	medium
6.0	11.0	high	medium

Q. What are subchannels?

A. Subchannels are 6 MHz, 3 MHz, or 1.5 MHz blocks of a 6 MHz−wide channel. Subchannels allow you to use multiple upstream ports on the wireless modem card. A particular subchannel is positioned within the 6 MHz band allowable for use. The total

bandwidth that all subchannels use cannot exceed the 6 MHz for that channel. For example, if you use only subchannel 1, which is 6 MHz, you can only use one upstream port. If you want to use multiple upstream ports, subchannels 2 through 7 allow for bandwidth allocations of either 3 MHz or 1.5 MHz. Configure modulation profiles using subchannels 2 through 7.

Figure 1 Subchannel Map Diagram



Configuration Headend

Q. What does a sample configuration of the HE router look like?

A. The sample configuration looks like this:

```
radio modulation-profile 1 bandwidth 6.0 throughput 22.0
 multipath-robustness standard burst-length medium
radio modulation-profile 2 bandwidth 6.0 throughput 19.0
 multipath-robustness high burst-length medium

!
!--- To view acceptable inputs for these modulation profiles, use the
!--- show radio capability modulation-profile command.
!--- Change the throughput setting from high to medium to employ more
!--- multipath-robustness, and change the throughput setting from medium
! --- to low to employ more forward error correction (FEC) coding.


interface Radio4/0 point-to-multipoint
ip address 191.20.1.1 255.255.255.0 secondary

!--- IP address network used for hosts behind SUs.

ip address 10.1.1.1 255.255.255.0

!--- IP address network used for the SUs.

no keepalive
radio alc interval 96

!--- Airline Control (ALC) ensures the TRP at the HE is maintained
!--- over time, through power measurements of all subscribers
!--- several times each second.
```

```
radio cable-loss auto

!--- Usually set to "auto."

radio transmit-power 20

!--- Acceptable range for Multichannel Multipoint Distribution Service (MMDS)
!--- is 15 to 38 dBm. For Unlicensed National Information Infrastructure
!--- (UNII), it is -5 to 15 dBm.


radio upstream frequency 2677000 width 6.0
radio upstream 0 subchannel 1 modulation-profile 2

!--- Refer to modulation-profile and sub-channel chart above.

radio upstream 0 target-receive-power -65
no radio upstream 0 shutdown
no radio upstream 1 target-receive-power
radio upstream 1 shutdown
no radio upstream 2 target-receive-power
radio upstream 2 shutdown
no radio upstream 3 target-receive-power
radio upstream 3 shutdown
radio downstream frequency 2521000 width 6.0

!--- Default width is 6 MHz.

radio downstream subchannel 1 modulation-profile 1

!--- Refer to the modulation-profile and sub-channel chart.

radio dhcp-giaddr policy
radio helper-address 10.1.1.5

!--- IP address of the DHCP server, if you do not use DHCP on HE router
!--- (see the next question).

radio su-onoff-trap interval 600
```

Q. How do you configure the HE to run TOD, TFTP, and DHCP all in one?

A. Make sure that you have the latest "T" code when you use this configuration. Do not enable the **radio helper address** command in your configuration because the DISCOVER packet does not need to be "helped" to another machine, the packet resides on the HE.

```
service udp-small-servers max-servers no-limit
!
radio time-server
!
ip dhcp pool modems-c3

!--- Modems-c3 is just a string.

!
  network 10.30.128.0 255.255.240.0
  bootfile p2mp.cm
  next-server 10.30.128.1

!--- Radio interface.

  !
  default-router 10.30.128.1
  option 7 ip 10.30.128.1
```

```
  option 4 ip 10.30.128.1
  option 2 hex 0000.0000
  !
interface Radio3/0 point-to-multipoint
ip address 10.30.128.1 255.255.240.0
!
tftp server slot0:p2mp.cm alias p2mp.cm

!--- Use this statement when .cm file is stored in "flash,"
!--- not in the TFTP server.
```

Complete these steps to put the **.cm** file in flash:

1. Copy **tftp slot:0**, and press ENTER.
2. When the parser queries for a name of a remote host, type the address of the TFTP server.
3. When the parser queries for a source filename, type the .cm filename, and press ENTER.

You can also configure a **DOCSIS** configuration file that resides on the HE instead of the TFTP server:

```
radio config-file
p2mp.cm
cpe max
4
service-class
1 priority 2
service-class
1 max-upstream 128
service-class
1 max-downstream 1000
timestamp
```

Note: You do not need the statement "tftp server slot0:p2mp.cm alias p2mp.cm" because there is no .cm file. It resides within the configuration.

Q. How do you configure Baseline Privacy?

A. Complete these steps to configure the Baseline Privacy:

1. Load K1 images on the HE and SUs.
2. Use a Configuration File Editor to open **DOCSIS** configuration file.
3. Click **Expand** in the **Class of Service Group** tab.
4. Enable a 1 under the **Class−of−Service Privacy Enable (0/1): 1** field. By default this is a 0, so change the value to 1.
5. Save the **DOCSIS** configuration file the TFTP boot file, which resides on the TFTP server connected to the Fast Ethernet (FE) port of the HE. After a reboot, the SU loads your new DOCSIS configuration file with the above parameters.
6. The SU negotiates Baseline Privacy Interface (BPI) with the HE. Use the **show radio subscriber** command to see that the SU is registered as "online(PT)" instead of as just "online". If you do not see "(PT)" check to see if you have K1 images on SU and the HE, and check to see if you have enabled "Class−of−Service Privacy" to equal 1 in the .cm file.

Q. What is the difference between a DOCSIS configuration file and an IOS configuration file?

A. A DOCSIS configuration file is a binary file, and has the parameters for radio SUs to come online in accordance to what the ISP provisions, for example, Maximum Downstream and Upstream Rates, Maximum Upstream Burst Rate, Class of Service or Baseline Privacy, MIBs and many other parameters.

A Cisco IOS configuration file is a text file that can contain specific configurations, such as access lists, passwords, and NAT configurations, that you can download within the DOCSIS configuration file.

Q. What are some helpful commands to monitor and troubleshoot the Headend?

- **show radio interface** *slot number/port number* **[{if | rf}]**
- **show radio subscribers** Shows all the radio subscribers and current states.
- **show radio flap−list** Displays the radio flap−list of a wireless modem card.
- **show interfaces radio** *slot number/port number* **hist−data** Shows signal−to−noise ratio (SNR). You must have histograms configured on the radio interface to see any output. This is the only command that shows SNR.
- **show interfaces radio** *slot number/port number* **link−metrics** Shows all codeword errors on a link over a specific period.
- **show controllers radio** *slot number/port number* **[{if | rf}]** Displays all or a subset of attributes of a particular modem card.
- **show controllers radio** *slot/downstream−port* **downstream** Displays downstream port information for a wireless modem card.
- **show controllers radio** *slot/upstream−port* **upstream** Displays upstream port information for a wireless modem card.
- **radio loopback local main if** Shows if the line card is faulty.
- **radio loopback local main rf** Shows if there is a cable problem between the card and the ODU.

Q. What does the show radio subscriber command output look like and what does each column mean?

```
Headend# show radio flap−list
    MAC Address         Upstream        Ins             Hit             Miss    CRC
    0003.6b4f.bf90      Radio4/0/U0     0               21180   148             10
```

A. This is the **show radio flap−list** command output on the HE. The flap list is an event detector, and here are the three situations which cause an event to be counted:

- Insertions
- Hits
- Misses

Note: Disregard the Power−Adjustment (P−Adj) column in this output. The P−Adj column applies only to cable networks for the **show cable flap−list** command

Insertions

First, you can see flaps along with insertions if a SU has a registration problem and repeatedly tries to quickly reregister. The P−Adj column can be low. When the time between two initial maintenance re−registrations by the SU is less than 180 seconds, you get "flaps" along with "insertions," and the flap detector counts it. You can change this default value of 180 seconds if you want:

```
Headend(config)# radio flap−list insertion−time ?
 <60−86400> Insertion time interval in seconds
```

Hits / Misses

Second, the flap detector counts a flap when you see a "miss" followed by a "hit." The event detection is counted in the Flap column only. These polls are hello packets that are sent every 30 seconds. If you get a "miss" followed by a "miss," then the polls are sent every second for 16 seconds. If you get a "hit" before the 16 seconds are up, you get a flap, but if you don't get a "hit" for 16 polls, the modem goes off−line in order to begin initial maintenance again. If the SU finally comes back online, you'll get an "insertion" because the SU inserted itself back into an active state. The flap count increments if there are six consecutive misses. This default value can be changed if desired:

```
Headend(config)# radio flap miss−threshold ?
 <1−12> missing consecutive polling messages
```

Note: Currently the P−Adj column is not used for the point−to−multipoint system.

Q. What command shows what TX and RX frequencies are configured other than the show run command? What other valuable information does this command provide?

A. The **show controller r4/0 rf** command shows what TX and RX frequencies are configured. The following is a sample output and some of the important things to look at in this output:

```
Headend# show controller r4/0 rf
RF ODU# 1 Hardware Identification Info:
 PIC code version: 0.15

 !−−− This shows the point in call (PIC) code version that is
 !−−− currently on the ODU.
 !−−− This is important if you encounter problems with the ODU.

 NVS checksum   0x69
 NVS version:   0.0
 Card type:     0x10
 Vendor name:   cisco
 Part number:   800−05805−03
 Board number:  73−4352−03
 HW rev code:   03
 Serial number: JAB041904BZ
 Date code:     05112000

RF ODU# 1 Hardware Capability Info:
 Capability flag1: 0x9F
 Capability flag2: 0x2C
 RF Diversity Head: Tx/Rx
 Tx Blanking Capable: Yes
```

```
 RF Power Level Mode Capable: Yes
 RF Power Gain Mode Capable: Yes
 RF Loopback Capable: Yes
 Tx Predistortor Capable: No
 Antenna Alignment Capable: No
 PA Temp Sensor Capable: Yes
 Tx Spectral Inversion: No
 Rx Spectral Inversion: No
 Rx Blanking Capable: Yes
 Rx Gain Cal. Capable: Yes
 Variable Gain Info Available: No
 Duplexor Field Replaceble: Yes
 Max chan. BW: 6 Mhz
 Tx frequency bands: 1, step: 600 Khz
  min: 2500000 Khz, max: 2686000 Khz

!--- These TX and RX values show the ODU bandpass.
 !--- With this information, you will know what center
 !--- frequencies are available for use.

 Rx frequency bands: 2, step: 600 Khz
  min1: 2150000 Khz, max1: 2162000 Khz
  min2: 2500000 Khz, max2: 2686000 Khz
 IF Tx freq: 330000 Khz

!--- These are the IF, TX, and RX frequencies that you can measure
 !--- for verification purposes from the front of the board out of
 !--- the monitor port.

 IF Rx freq: 426000 Khz
 Freq reference: 24 Mhz
 Tx power range min: 15 dbm, max: 41 dbm, step: 1 dbm
 Tx fixed gain min: 0 db, max: 0 db, step: 0 db
 Rx fixed gain min: 0 db, max: 0 db, step: 0 db
 Tx var gain min: 48 db, max: 56 db, step: 1 * 0.125 db
 Rx var gain min: 30 db, max: 36 db, step: 1 * 0.125 db
 Temp. threshold low: 95 deg. C, high: 98 deg. C
 BW adjusted max tx pwr: full:0 dbm     half:0 dbm      quarter:0 dbm

RF ODU# 1 Status:
  TX Frequency: 2521000 Khz

!--- These are the TX and RX frequencies that are actually
  !--- configured on the HE.

  RX Frequency: 2677000 Khz
  TX Output Power: 20 dbm

  !--- As well as the output power that is configured on the HE.

  TX Cable Loss: 15 db
```

Q. How do you configure histograms and get the data output from them?

A. Histograms are configured on the Radio Interface. There are several different types of histograms to configure; the most commonly used ones are the ones for signal−to−interference plus noise ratio (SINR) and RF RX Power. A few of the available histograms are listed below:

```
radio histogram sinr−ant1 0 bin−range 10 50 duration 5 tone average
 update 5 sum false width coarse
    radio histogram timing−offset 0 bin−range −10 10 duration 5
 update 5 sum false width coarse
    radio histogram rf−rx−power−ant1 0 bin−range −100 0 duration
```

```
 5 update 5 sum false width coarse
    radio histogram chan-delay-spread-ant1 0 bin-range 0 22 duration
 5 update 5 sum false width coarse
    radio histogram power-amb 0 bin-range -101 -21 duration
 5 update 5 sum false width coarse
```

When the histogram is configured on the radio interface, you can view the data from it with the **show interface** *slot number/port number* **hist-data** <*particular histogram*> global command. See the next question for an example.

Q. What does the show `interface radio slot number/port number hist-data` command output typically look like on the HE?

Note: When you look at histogram outputs, pay close attention to the minimum, average, and maximum values.

```
Headend# show interface r4/0 hist-data sinr-ant1 0
% Radio4/0 Histogram captured at 17:42:58 UTC Mon Jan 3 2000
% radio histogram sinr-ant1 0
% bin 10 50 dur 5 tone ave up 5 sum f width c
% min=29.250 avg=30.000 max=30.500

!--- This is the SNR value for the wireless modem card.

% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<10    |
% 0             10<=x<14                |
% 0             14<=x<18                |
% 0             18<=x<22                |
% 0             22<=x<26                |
% 2             26<=x<30                |*
% 3             30<=x<34                |*
% 0             34<=x<38                |
% 0             38<=x<42                |
% 0             42<=x<46                |
% 0             46<=x<50                |
% 0             50<=x<MAXINT    |

Headend# show interface r4/0 hist-data chan 0
% Radio4/0 Histogram captured at 17:58:21 UTC Mon Jan 3 2000
% radio histogram chan-delay-spread-ant1 0
% bin 0 22 dur 5 up 5 sum f width c
% min=2.500 avg=2.500 max=2.500

!--- You want channel delay spread to be minimal.

% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<0             |
% 5             0<=x<4                  |*
% 0             4<=x<8                  |
% 0             8<=x<12                 |
% 0             12<=x<16                |
% 0             16<=x<20                |
% 0             20<=x<24                |
% 0             24<=x<28                |
% 0             28<=x<32                |
% 0             32<=x<36                |
% 0             36<=x<40                |
% 0             40<=x<MAXINT    |

Headend# show interface r4/0 hist-data power-amb 0
% Radio4/0 Histogram captured at 17:59:16 UTC Mon Jan 3 2000
% radio histogram power-amb 0
```

```
% bin −101 −21 dur 5 up 5 sum f width c
% min=−96.000 avg=−96.000 max=−96.000
% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<−101  |
% 1             −101<=x<−93             |*
% 0             −93<=x<−85              |
% 0             −85<=x<−77              |
% 0             −77<=x<−69              |
% 0             −69<=x<−61              |
% 0             −61<=x<−53              |
% 0             −53<=x<−45              |
% 0             −45<=x<−37              |
% 0             −37<=x<−29              |
% 0             −29<=x<−21              |
% 0             −21<=x<MAXINT   |

Headend# show interface r4/0 hist−data rf−rx−power−ant1 0
% Radio4/0 Histogram captured at 17:58:37 UTC Mon Jan 3 2000
% radio histogram rf−rx−power−ant1 0
% bin −100 0 dur 5 up 5 sum f width c
% min=−65.000 avg=−65.000 max=−65.000

!−−− These are good values.

% [1*=100 events] captured 0 seconds remain
% 0             MININT<=x<−100  |
% 0             −100<=x<−84             |
% 0             −84<=x<−68              |
% 5             −68<=x<−52              |*
% 0             −52<=x<−36              |
% 0             −36<=x<−20              |
% 0             −20<=x<−4               |
% 0              −4<=x<12               |
% 0             12<=x<28                |
% 0             28<=x<44                |
% 0             44<=x<60                |
% 0             60<=x<MAXINT    |

Headend# show interfaces r4/0 hist−data timing−offset 0
% Radio4/0 Histogram captured at 17:58:48 UTC Mon Jan 3 2000
% radio histogram timing−offset 0
% bin −10 10 dur 5 up 5 sum f width c
% min=−1 avg=0 max=0
% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<−10   |
% 0             −10<=x<−8               |
% 0             −8<=x<−6                |
% 0             −6<=x<−4                |
% 0             −4<=x<−2                |
% 4             −2<=x<0                 |*
% 1             0<=x<2                  |*
% 0             2<=x<4                  |
% 0             4<=x<6                  |
% 0             6<=x<8                  |
% 0             8<=x<10                 |
% 0             10<=x<MAXINT    |
```

Q. What debug is available on the HE to troubleshoot the wireless portion of the link?

A. debug radio p2mp phy cwrlog radio Use this command to view the digital signal processing (DSP) synchronization for a subscriber−unit modem card.

Subscriber Unit (SU)

Q. What does a sample configuration of the SU router look like?

```
interface Radio1/0 point-to-multipoint
ip address docsis
docsis boot admin 2
docsis boot oper 5
docsis mac-timer t2 40000
radio cable-loss 1 2 1
radio downstream saved channel 2521000 subchannel 0

!--- This is an optional parameter that can be added to save
!--- the SU time from scanning the digital signal DS upon initialization.
```

Q. What are some helpful commands to monitor and troubleshoot the Subscriber Unit?

- **show interfaces radio** *slot number/port number* **link-metrics** Displays all codeword errors on link over a specific period of time.
- **show interfaces radio** *slot number/port number* **hist-data** You must have histograms configured on interface to see output.
- **show controllers radio** *slot number/port number* Displays all or a subset of attributes of a particular modem card.
- **show controllers radio** *slot number/port number* **if** Displays the IF hardware information for the specified radio interface.
- **radio loopback local main if** Displays if the NM is faulty.
- **radio loopback local main rf** Displays if there is a cable problem between the card and the ODU.

Note: To run this command, it is necessary to have daughterboard.

Q. What does the `show interfaces radio slot number/port number link-metrics` command output look like?

```
 ------------------ show interface radio 1/0 link-metrics ------------------

Radio link metrics.            Collected from: 00:12:00 - Fri Dec 1 2000
                                                  to: 00:12:00 - Fri Dec 1 200
Availability of the physical link:
        Available seconds       (EFS+ES-SES):           00:00:00:       0.000999%
        Unavailable seconds (SES+SLS):   00:00:00: 99.99900%
        Total                :            00:00:00: 100.0000%
Error characteristics of the physical link:
        Error free seconds              (EFS):       00:00:00:  0.00000%
        Errored seconds (CWerr>=1)    (ES):        00:00:00:    0.00000%
        Degraded seconds  (5.00000>CWerr>=  1.00000%)(DS):       00:00:00:      0.00
        Severely errored seconds (CWerr>=  5.00000%)(SES):  00:00:00:   0.00000%
    Sync Loss seconds           SLS):      00:00:00:    0.00000%

Synchronization event counters:
        Initial Synchronization seconds         :    00:00:19
        Time since last successful synchronization :    00:00:00
        Time since last synchronization failure :    00:00:00
        Synchronization attempts - Successful   : 1 : Unsuccessful : 0
        Recovery attempts       - Medium effort   : 0 :  High effort : 0
```

```
Physical link data rates:
        Effective data rate (PHY payload bits/sec) :    0
        Efficiency (PHY payload bits/total bits)       :   0.00000%
```

Q. What does the show interfaces radio slot number/port number hist−data command output typically look like on the SU?

Note: When you look at histogram outputs, pay close attention to the minimum, average, and maximum values.

```
Subscriber# show interfaces r1/0 hist−spec data sinr−ant1
% Radio1/0 Histogram captured at 02:01:59 UTC Mon Mar 1 1993
% radio histogram sinr−ant1
% bin 10 50 dur 5 tone ave up 5 sum f width c

% min=28.750 avg=29.875 max=30.875
% [1*=1100events]  captured 0 seconds remain
% 0             MININT<=x<10    |
% 0             10<=x<14                |
% 0             14<=x<18                |
% 0             18<=x<22                |
% 0             22<=x<26                |
% 22632         26<=x<30        |********************
% 31717         30<=x<34        |****************************
% 0             34<=x<38                |
% 0             38<=x<42                |
% 0             42<=x<46                |
% 0             46<=x<50                |
% 0             50<=x<MAXINT    |

Subscriber# sh int r1/0 hist−data timing−offset
% Radio1/0 Histogram captured at 02:01:59 UTC Mon Mar 1 1993
% radio histogram timing−offset
% bin −10 10 dur 5 up 5 sum f width c
% min=−1 avg=0 max=1
% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<−10   |
% 0             −10<=x<−8               |
% 0             −8<=x<−6                |
% 0             −6<=x<−4                |
% 0             −4<=x<−2                |
% 287   −2<=x<0                 |***
% 1223  0<=x<2                  |*************
% 0             2<=x<4                  |
% 0             4<=x<6                  |
% 0             6<=x<8                  |
% 0             8<=x<10                 |
% 0             10<=x<MAXINT    |

Subscriber# sh int r1/0 hist−data rf−rx−power−ant1
% Radio1/0 Histogram captured at 02:01:59 UTC Mon Mar 1 1993
% radio histogram rf−rx−power−ant1
% bin −100 0 dur 5 up 5 sum f width c
% min=−44.625 avg=−42.000 max=−39.125
% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<−100  |
% 0             −100<=x<−84             |
% 0             −84<=x<−68              |
% 0             −68<=x<−52              |
% 4529  −52<=x<−36              |*******************************************
% 0             −36<=x<−20              |
% 0             −20<=x<−4               |
% 0             −4<=x<12                |
```

```
% 0             12<=x<28                |
% 0             28<=x<44                |
% 0             44<=x<60                |
% 0             60<=x<MAXINT    |

Subscriber# sh int r1/0 hist-data chan-delay-spread-ant1
% Radio1/0 Histogram captured at 02:01:59 UTC Mon Mar 1 1993
% radio histogram chan-delay-spread-ant1
% bin 0 22 dur 5 up 5 sum f width c
% min=2.500 avg=2.500 max=2.500
% [1*=100 events]  captured 0 seconds remain
% 0             MININT<=x<0             |
% 4529  0<=x<4                  |*****************************************
% 0             4<=x<8                  |
% 0             8<=x<12                 |
% 0             12<=x<16                |
% 0             16<=x<20                |
% 0             20<=x<24                |
% 0             24<=x<28                |
% 0             28<=x<32                |
% 0             32<=x<36                |
% 0             36<=x<40                |
% 0             40<=x<MAXINT    |
```

Q. What debugs are available on the SU to troubleshoot the wireless link?

- **debug radio p2mp phy cwrlog radio** Use this command to view the digital signal processing (DSP) synchronization for a subscriber−unit modem card.
- **debug docsis mac [log]** Displays debug messages generated by the DOCSIS MAC realtime log.

Q. What does the output of the `debug radio p2mp phy cwrlog radio` command look like under normal initialization?

```
Subscriber Unit#
01:48:27: SU RFSM: STATE CHANGE standby_state
 ====> if_hw_reset_state
01:48:27: SU RFSM: Debug PIC Timeouts occurred=0
01:48:27: SU RFSM: Debug PIC NAKs occurred=0
01:48:28: SU RFSM: Resetting IF HW
01:48:28: SU RFSM: STATE CHANGE if_hw_reset_state
 ====> if_hw_read_version_state
01:48:28: SU RFSM: Default IF Unsolicited Msg Processing
01:48:28: IFHW: PIC unsolicited msg received − IDU PIC Reset Event
01:48:28: IFHW: PIC boot loader version=1, vendor ID=0
01:48:28: IFHW: IF PIC code version=0.10, eeprom version=0
01:48:28: IFHW: IF EEPROM Checksum=0x87
01:48:28 : SU RFSM: STATE CHANGE if_hw_read_version_state
 ====> if_hw_read_eeprom_state
01:48:28: SU RFSM: Reading IF HW EEPROM
01:48:28: SU RFSM: IF Hardware Cached EEPROM okay
01:48:28: SU RFSM: STATE CHANGE if_hw_read_eeprom_state
 ====> rf_hw_reset_state
01:48:28: SU RFSM: Default RF Resp. Processing
01:48:28: SU RFSM: Default DSP Resp Processing
01:48:28: SU RFSM: Default DSP Ind Processing
01:48:28: SU RFSM: Default DSP Ind Processing
01:48:28: SU RFSM: Resetting RF/ODU1
01:48:28: %LINK−3−UPDOWN: Interface Radio1/0, changed state to up

!−−− The line above is out of place.  This line often appears here.
```

```
!--- You can ignore this line. You can get stuck in this state
!--- if for some reason the SU cannot communicate with the ODU.

01:48:29: SU RFSM: STATE CHANGE if_hw_reset_state
 ====> if_hw_read_version_state
01:48:29: IFHW: IF PIC code version=0.11, NVS major version=0
01:48:29: IFHW: PIC boot loader version=1, vendor ID=0
01:48:29: IFHW: IF NVS Checksum=0x9D
01:48:29: SU RFSM: STATE CHANGE if_hw_read_version_state
 ====> if_hw_read_eeprom_state
01:48:29: SU RFSM: Re-using cached IF NVS data
01:48:29: SU RFSM: STATE CHANGE if_hw_read_eeprom_state
 ====> rf_hw_reset_state
01:48:29: RFHW: Unsolicited PIC msg - ODU PIC Reset Event (opcode=0x1A state=0x0)
01:48:29: SU RFSM: STATE CHANGE rf_hw_reset_state
 ====> rf_hw_read_version_state
01:48:29: RFHW: RF/ODU1 PIC code version=0.30, NVS major version=0
01:48:29: RFHW: RF/ODU1 PIC boot loader version=255, vendor ID=0
01:48:29: RFHW: RF/ODU1 NVS Checksum=0x48
01:48:29: SU RFSM: STATE CHANGE rf_hw_read_version_state
 ====> rf_hw_read_eeprom_state
01:48:30: SU RFSM: Re-using cached RF/ODU1 NVS data
01:48:30: SU RFSM: STATE CHANGE rf_hw_read_eeprom_state
 ====> rf_hw_reset_state
01:48:35: SU RFSM: RF/ODU2 not detected/operational
01:48:35: SU RFSM: STATE CHANGE rf_hw_reset_state
 ====> if_hw_cable_comp_state
01:48:35: IFHW: Rx1 cable loss=1 db compensation=12 db
01:48:35: SU RFSM: STATE CHANGE if_hw_cable_comp_state
 ====> rf_hw_cable_comp_state
01:48:35: RFHW: Tx cable loss=2 db compensation=11 db
01:48:35: SU RFSM: STATE CHANGE rf_hw_cable_comp_state
 ====> if_hw_config_state
01:48:35: IFHW: IF Tx Gain=16 db
01:48:35: SU RFSM: STATE CHANGE if_hw_config_state
 ====> rf_hw_config_state
01:48:35: RFHW: RF/ODU1 Rx Fixed Gain=0 db, Rx Var Gain=15 db
01:48:35: RFHW: RF/ODU1 Tx Fixed Gain=0 db, Tx Var Gain=20 db
01:48:35: RFHW: RF/ODU1 Auto updating cached NVS (Max Tx Pwr)
 for Standard Power ODU
01:48:35: SU RFSM: STATE CHANGE rf_hw_config_state
 ====> loopback_state
01:48:35: SU RFSM: STATE CHANGE loopback_state
 ====> ds_candidate_selection_state
01:48:35: SU RFSM: STATE CHANGE ds_candidate_selection_state
 ====> ds_hardware_init_state
01:48:35: SU RFSM: STATE CHANGE ds_hardware_init_state
 ====> dspinit_powerup_state
01:48:35: SU RFSM: STATE CHANGE dspinit_powerup_state
 ====> dspinit_ping_state
01:48:35: SU RFSM: STATE CHANGE dspinit_ping_state
 ====> dspinit_config_state
01:48:35: SU RFSM: STATE CHANGE dspinit_config_state
 ====> dspinit_agc_config_state
01:48:35: SU RFSM: STATE CHANGE dspinit_agc_config_state
 ====> dspinit_ifrf_config_state
01:48:35: SU RFSM: STATE CHANGE dspinit_ifrf_config_state
 ====> dspinit_down_sync_config_state
01:48:35: SU RFSM: DS RF Freq = 2521000  Down sync carrier for DSP = 50420
01:48:35: SU RFSM: DS RF Freq = 2521000  Down sync carrier for DSP = 50420
01:48:35: SU RFSM: STATE CHANGE dspinit_down_sync_config_state
 ====> dspinit_down_sync_state_config_state
01:48:35: SU RFSM: STATE CHANGE dspinit_down_sync_state_config_state
 ====> dsp_sync_state
01:48:36: SU RFSM: Received DSP SYNC IND (0)
01:48:36: SU RFSM: Received DSP SYNC IND (2)
```

```
01:48:36: SU RFSM: Received DSP SYNC IND (4)
01:48:36: SU RFSM: Received DSP SYNC IND (5)
01:48:36: SU RFSM: Received DSP SYNC IND (7)
01:48:37: SU RFSM: Received DSP SYNC IND (4)
01:48:37: SU RFSM: Received DSP SYNC IND (5)
01:48:37: SU RFSM: Received DSP SYNC IND (8)
01:48:37: SU RFSM: DSP SYNC PASSED
01:48:37: SU RFSM: STATE CHANGE dsp_sync_state ====> fec_sync_state

!--- You have found a valid downstream signal at this state.

01:48:37: SU RFSM: SYNC Timer
01:48:37: SU RFSM: FEC Sync State, Viterbi Sync SUCCESS

!--- If you get stuck here, try a shut command and then a no shut command
!--- on the SU first. Sometimes this state has intermittent failures.
!--- Try again if you receive a failure response.

01:48:37: SU RFSM: STATE CHANGE fec_sync_state ====> trc_sync_state
01:48:38: SU RFSM: TRC Sync State, Successful TRC LOCK
01:48:38: SU RFSM: STATE CHANGE trc_sync_state ====> maintenance_state

!--- This is where the SU MAC chip starts to communicate with the HE MAC chip.

01:48:38: SU RFSM: Received Advance DS Channel Msg
01:48:43: SU RFSM: Default RF Resp. Processing
01:48:43: SU RFSM: UCD US bw is Full, adjusted max RF tx gain is 37
01:48:43: SU RFSM: Default RF Resp. Processing
01:48:43: SU RFSM: Default RF Resp. Processing
01:48:43: SU RFSM: DSPMSG_TX_POWER_ADJ [-128 db], IF[-4 db], RF[-13 db]
01:48:45: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[-1 db], RF[-13 db]

!--- Lines like the one above appear often in the debug messages.
!--- This line says that the transmit power is being adjusted up 3 dB,
!---  and after the adjustment, the IF gain is -1 dB, and the RF gain
!--- is -13 dB.

01:48:48: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[02 db], RF[-13 db]
01:48:49: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[05 db], RF[-13 db]
01:48:50: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[-11 db]
01:48:51: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[-8 db]
01:48:52: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[-5 db]
01:48:53: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[-2 db]
01:48:54: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[01 db]
01:48:55: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[04 db]
01:48:56: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[07 db]
01:48:57: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[10 db]
01:48:58: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[13 db]
01:48:59: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[16 db]
01:49:00: SU RFSM: DSPMSG_TX_POWER_ADJ [3 db], IF[06 db], RF[19 db]
01:49:01: SU RFSM: DSPMSG_TX_POWER_ADJ [2 db], IF[06 db], RF[21 db]
01:49:02: SU RFSM: Set ALC State Resp: alcState 1, IFloopMode 0,
 RFloopMode 1, Tmin_IF 35
01:49:16: %LINEPROTO-5-UPDOWN: Line protocol on Interface Radio1/0,
 changed state to up
```

Q. What does the output of the debug `docsis mac log` command look like under normal circumstances of initialization?

```
Subscriber Unit#
01:24:34:   5074.432 CMAC_LOG_LINK_DOWN
01:24:34:   5074.432 CMAC_LOG_LINK_UP
01:24:34:   5074.432 CMAC_LOG_STATE_CHANGE
ds_channel_scanning_state
01:24:35: %LINEPROTO-5-UPDOWN: Line protocol on Interface Radio1/0,
```

```
 changed state to down
01:24:42:   5082.264 CMAC_LOG_DS_TUNER_KEEPALIVE
01:24:45:   5085.392 CMAC_LOG_UCD_MSG_RCVD                1
01:24:45:   5085.664 CMAC_LOG_DS_CHANNEL_SCAN_COMPLETED
01:24:45:   5085.664 CMAC_LOG_STATE_CHANGE
wait_ucd_state

!--- This is where the SU mac chip starts to communicate with the HE MAC chip.

01:24:47:   5087.392 CMAC_LOG_UCD_MSG_RCVD                1
01:24:49:   5089.392 CMAC_LOG_UCD_MSG_RCVD                1
01:24:49:   5089.392 CMAC_LOG_ALL_UCDS_FOUND
01:24:49:   5089.396 CMAC_LOG_STATE_CHANGE
wait_map_state
01:24:49:   5089.396 CMAC_LOG_FOUND_US_CHANNEL            1
01:24:51:   5091.392 CMAC_LOG_UCD_MSG_RCVD                1
01:24:51:   5091.592 CMAC_LOG_UCD_NEW_US_FREQUENCY        2677000
01:24:51:   5091.592 CMAC_LOG_SLOT_SIZE_CHANGED           8
01:24:51:   5091.604 CMAC_LOG_UCD_UPDATED
01:24:51:   5091.632 CMAC_LOG_MAP_MSG_RCVD
01:24:51:   5091.632 CMAC_LOG_INITIAL_RANGING_MINISLOTS   18
01:24:51:   5091.636 CMAC_LOG_STATE_CHANGE
ranging_1_state

!--- In ranging 1 state, the SU sends a message to the HE, and then waits
!--- for a response.  If it doesn't get a response, it tries again a little
!--- louder (3 dB more transmit power each attempt).  This continues until
!--- there is a response, or until the SU has used up its tries.

01:24:51:   5091.636 CMAC_LOG_RANGING_OFFSET_SET_TO       21368
01:24:52:   5092.836 CMAC_LOG_POWER_LEVEL_IS              0.0 dBmV(commanded)
01:24:52:   5092.836 CMAC_LOG_STARTING_RANGING
01:24:52:   5092.836 CMAC_LOG_RANGING_BACKOFF_SET          0
01:24:52:   5092.936 CMAC_LOG_RNG_REQ_QUEUED               0
01:24:52:   5092.956 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:53:   5093.156 CMAC_LOG_T3_TIMER

!--- The T3 timer sets how long the SU waits before it decides that the HE
!--- didn't hear the last message.  The line above indicates that this timer
!--- has expired, and now the SU will try retransmitting.  The T3 timer can be set t
!--- very large value, so if you want the SU to receive downstream but never transmi
!--- use the docsis mac-timer t3 3600000 command.

01:24:53:   5093.156 CMAC_LOG_POWER_LEVEL_IS              0.25 dBmV(commanded)
01:24:53:   5093.156 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:53:   5093.256 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:53:   5093.316 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:53:   5093.516 CMAC_LOG_T3_TIMER
01:24:53:   5093.516 CMAC_LOG_POWER_LEVEL_IS              0.50 dBmV(commanded)
01:24:53:   5093.516 CMAC_LOG_RANGING_BACKOFF_SET         2
01:24:53:   5093.616 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:53:   5093.796 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:53:   5093.996 CMAC_LOG_T3_TIMER
01:24:53:   5093.996 CMAC_LOG_POWER_LEVEL_IS              0.75 dBmV(commanded)
01:24:53:   5093.996 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:54:   5094.096 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:54:   5094.156 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:54:   5094.356 CMAC_LOG_T3_TIMER
01:24:54:   5094.356 CMAC_LOG_POWER_LEVEL_IS              1.0  dBmV(commanded)
01:24:54:   5094.356 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:54:   5094.456 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:54:   5094.516 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:54:   5094.716 CMAC_LOG_T3_TIMER
01:24:54:   5094.716 CMAC_LOG_POWER_LEVEL_IS              1.25 dBmV(commanded)
01:24:54:   5094.716 CMAC_LOG_RANGING_BACKOFF_SET         3
01:24:54:   5094.816 CMAC_LOG_RNG_REQ_QUEUED              0
```

```
01:24:55:   5095.056 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:55:   5095.260 CMAC_LOG_T3_TIMER
01:24:55:   5095.260 CMAC_LOG_POWER_LEVEL_IS              1.50 dBmV(commanded)
01:24:55:   5095.260 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:55:   5095.360 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:55:   5095.416 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:55:   5095.620 CMAC_LOG_T3_TIMER
01:24:55:   5095.620 CMAC_LOG_POWER_LEVEL_IS              1.75 dBmV(commanded)
01:24:55:   5095.620 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:55:   5095.720 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:55:   5095.776 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:55:   5095.980 CMAC_LOG_T3_TIMER
01:24:55:   5095.980 CMAC_LOG_POWER_LEVEL_IS              2.0  dBmV(commanded)
01:24:55:   5095.980 CMAC_LOG_RANGING_BACKOFF_SET         0
01:24:56:   5096.080 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:56:   5096.136 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:56:   5096.340 CMAC_LOG_T3_TIMER
01:24:56:   5096.340 CMAC_LOG_POWER_LEVEL_IS              2.25 dBmV(commanded)
01:24:56:   5096.340 CMAC_LOG_RANGING_BACKOFF_SET         7
01:24:56:   5096.440 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:56:   5096.916 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:57:   5097.116 CMAC_LOG_T3_TIMER
01:24:57:   5097.116 CMAC_LOG_POWER_LEVEL_IS              2.50 dBmV(commanded)
01:24:57:   5097.116 CMAC_LOG_RANGING_BACKOFF_SET         1
01:24:57:   5097.216 CMAC_LOG_RNG_REQ_QUEUED              0
01:24:57:   5097.336 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:57:   5097.340 CMAC_LOG_RNG_RSP_MSG_RCVD
01:24:57:   5097.344 CMAC_LOG_RNG_RSP_SID_ASSIGNED        138
01:24:57:   5097.344 CMAC_LOG_ADJUST_RANGING_OFFSET       61
01:24:57:   5097.344 CMAC_LOG_RANGING_OFFSET_SET_TO       21429
01:24:57:   5097.344 CMAC_LOG_ADJUST_TX_POWER             20
01:24:57:   5097.344 CMAC_LOG_STATE_CHANGE
ranging_2_state

!--- The HE got the ranging message from the SU, and sent a response.
!--- Now the SU enters the ranging 2 state. In this state, it sends
!--- messages to the HE, and the HE sends back messages
!--- that instruct the SU on how to adjust its transmit power.
!--- The distance between the HE and SU is also measured, and the
!--- SU is given a ranging offset to account for propagation delay.

01:24:57:   5097.448 CMAC_LOG_RNG_REQ_QUEUED              138
01:24:58:   5098.348 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:58:   5098.352 CMAC_LOG_RNG_RSP_MSG_RCVD
01:24:58:   5098.356 CMAC_LOG_ADJUST_TX_POWER             20
01:24:58:   5098.356 CMAC_LOG_RANGING_CONTINUE
01:24:59:   5099.364 CMAC_LOG_RNG_REQ_TRANSMITTED
01:24:59:   5099.368 CMAC_LOG_RNG_RSP_MSG_RCVD
01:24:59:   5099.368 CMAC_LOG_ADJUST_TX_POWER             20
01:24:59:   5099.368 CMAC_LOG_RANGING_CONTINUE
01:25:00:   5100.376 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:00:   5100.380 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:00:   5100.380 CMAC_LOG_ADJUST_TX_POWER             20
01:25:00:   5100.384 CMAC_LOG_RANGING_CONTINUE
01:25:01:   5101.388 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:01:   5101.396 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:01:   5101.396 CMAC_LOG_ADJUST_TX_POWER             16
01:25:01:   5101.396 CMAC_LOG_RANGING_CONTINUE
01:25:02:   5102.404 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:02:   5102.408 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:02:   5102.408 CMAC_LOG_RANGING_SUCCESS
01:25:02:   5102.408 CMAC_LOG_STATE_CHANGE
dhcp_state

!--- In this example, the SU was told to increase its power in the
!--- ranging 2 state. In total, the SU increased its gain by 20 dB
```

```
!--- during this state. This is an indication that the channel is
!--- very clean - the HE was able to demodulate the signal from the SU,
!--- even when it was 20 dB below the optimal signal level. If the
!--- opposite occurs, and the SU is told to decrease the power in this
!--- state, then that is an indication that the upstream
!--- channel is not very clean. At this point, the state machine has
!--- reached the dhcp_state. The SU sends an IP broadcast request
!--- looking for a DHCP server.

01:25:02:   5102.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:02:   5102.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:03:   5103.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:03:   5103.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:04:   5104.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:04:   5104.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:05:   5105.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:05:   5105.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:06:   5106.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:06:   5106.424 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:07:   5107.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:07:   5107.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:08:   5108.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:08:   5108.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:09:   5109.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:09:   5109.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:10:   5110.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:10:   5110.424 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:11:   5111.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:11:   5111.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:12:   5112.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:12:   5112.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:13:   5113.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:13:   5113.424 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:14:   5114.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:14:   5114.424 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:15:   5115.292 CMAC_LOG_DHCP_ASSIGNED_IP_ADDRESS           10.1.1.3
01:25:15:   5115.292 CMAC_LOG_DHCP_TFTP_SERVER_ADDRESS           10.1.1.1
01:25:15:   5115.292 CMAC_LOG_DHCP_ERROR_ACQUIRING_TOD_ADDRESS
01:25:15:   5115.292 CMAC_LOG_DHCP_SET_GATEWAY_ADDRESS
01:25:15:   5115.292 CMAC_LOG_DHCP_TZ_OFFSET                    0
01:25:15:   5115.296 CMAC_LOG_DHCP_CONFIG_FILE_NAME             p2mp.cm
01:25:15:   5115.296 CMAC_LOG_DHCP_ERROR_ACQUIRING_SEC_SVR_ADDR
01:25:15:   5115.296 CMAC_LOG_DHCP_ERROR_ACQUIRING_LOG_ADDRESS
01:25:15:   5115.300 CMAC_LOG_DHCP_COMPLETE

!--- Other parameters that are required by the SU are the TFTP server
!--- address, the Time of Day (TOD) server address, the Time Zone (TX)
!--- offset value and DHCP config file name (also known as the DOCSIS
!--- config file). These parameters must all be present
!--- in the DHCP response from the DHCP server.

01:25:15:   5115.312 CMAC_LOG_STATE_CHANGE
establish_tod_state
01:25:15:   5115.316 CMAC_LOG_TOD_NOT_REQUESTED_NO_TIME_ADDR
01:25:15:   5115.316 CMAC_LOG_STATE_CHANGE
security_association_state
01:25:15:   5115.316 CMAC_LOG_SECURITY_BYPASSED
01:25:15:   5115.316 CMAC_LOG_STATE_CHANGE
configuration_file_state
01:25:15:   5115.316 CMAC_LOG_LOADING_CONFIG_FILE               p2mp.cm

!--- The establish_tod_state is the point in which the SU tries to retrieve
!--- the time of day from the TOD server. This is used to synchronize clocks
!--- for alarms and logs, among other reasons. The security_association_state
!--- is a placeholder for a state yet to be defined. In the future,
!--- a security association with a security server would provide
```

```
!--- IPsec-like security for the SUs. This is NOT the baseline privacy state.
!--- The configuration_file_state is the main configuration and
!--- administration interface to the SU DOCSIS subsystem.
!--- The name of this file and the TFTP server address in which
!--- this could be downloaded was originally provided in the DHCP state.
!--- This configuration file contains downstream channel and upstream
!--- channel identification, characteristics, Class of Service settings,
!--- Baseline Privacy settings, and general operational settings.

01:25:15:   5115.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:15:   5115.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:16: %LINEPROTO-5-UPDOWN: Line protocol on Interface Radio1/0,
 changed state to up
01:25:16:   5116.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:16:   5116.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:17:   5117.420 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:17:   5117.424 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:18:   5118.424 CMAC_LOG_RNG_REQ_TRANSMITTED
01:25:18:   5118.428 CMAC_LOG_RNG_RSP_MSG_RCVD
01:25:19:   5119.352 CMAC_LOG_CONFIG_FILE_PROCESS_COMPLETE
01:25:19:   5119.352 CMAC_LOG_STATE_CHANGE
registration_state
01:25:19:   5119.352 CMAC_LOG_REG_REQ_MSG_QUEUED
01:25:19:   5119.356 CMAC_LOG_REG_REQ_TRANSMITTED
01:25:19:   5119.368 CMAC_LOG_REG_RSP_MSG_RCVD

!--- The link is now up.
!--- The link comes up and then the SU tries to register with the HE
!--- through the registration_state. After configuration, the modem sends
!--- a registration request (REG-REQ) with a required subset
!--- of the configuration settings received in the DOCSIS config file.

01:25:19:   5119.368 CMAC_LOG_COS_ASSIGNED_SID                  1/138
01:25:19:   5119.372 CMAC_LOG_COS_ASSIGNED_SID                  2/139
01:25:19:   5119.472 CMAC_LOG_RNG_REQ_QUEUED                    138
01:25:19:   5119.472 CMAC_LOG_REGISTRATION_OK
01:25:19:   5119.472 CMAC_LOG_STATE_CHANGE
establish_privacy_state
01:25:19:   5119.472 CMAC_LOG_PRIVACY_NOT_CONFIGURED
01:25:19:   5119.476 CMAC_LOG_STATE_CHANGE
maintenance_state

!--- At this point, the service identifier (SID), which designates the
!--- MAP grants on which the SU is allowed to speak,
!--- is assigned. The establish_privacy_state only comes into effect
!--- if baseline privacy is turned on.  At the current time,
!--- this is not supported, but it will be in the future.
```

Q. What if the SU cannot get passed the downstram_channel_scanning_state?

A. This probably means that the microcode never loaded. If the microcode download fails, this message appears:

```
00:00:38: %CWRMP-3-UCODEFAIL: Radio 1/0: Loading slot1:/cod.001 failed
```

This message appears right after you boot, so you can easily miss this message. You can also see the problem through a **no shut** command:

```
SU1(config-if)# no shut
SU1(config-if)#
00:02:26:    146.628 CMAC_LOG_LINK_DOWN
```

```
00:02:26:    146.628 CMAC_LOG_LINK_UP
00:02:26:    146.628 CMAC_LOG_STATE_CHANGE        ds_channel_scanning_state
00:02:27:    147.628 CMAC_LOG_RESET_CANT_START_DS_TUNER_PRCESS
00:02:27:    147.628 CMAC_LOG_STATE_CHANGE    reset_interface_state
00:02:27: SU RFSM: MAC FSM Stop Cmd
00:02:27:    147.628 CMAC_LOG_STATE_CHANGE        reset_hardware_state
00:02:27:    147.628 CMAC_LOG_STATE_CHANGE    wait_for_link_up_state
00:02:27:    147.628 CMAC_LOG_LINK_DOWN
```

In order to fix the problem type:

```
end
conf t
microcode cwrsu [path to microcode]
microcode reload
```

The path to microcode is typically slot1: so the command looks like this:

```
microcode cwrsu slot1:
```

You receive this message when the code successfully loads:

```
00:06:06: %CWRMP-5-UCODE: Radio 1/0: Loaded slot1:
```

If this still does not work, check to make sure that the flash card is inserted properly into slot 1. From the exec prompt (type end to get to the exec prompt), you can look at the directory of what is on the card in slot 0 or 1 or in the flash. Type:

```
dir flash:
dir slot0:
dir slot1:
```

Q. What if the SU cannot get beyond the rf_hw_reset_state?

A. Here are the possible causes for this problem:

- The ODU is not turned on. This is easy to overlook, as the ODU has its own power supply, which you must turn on separately from the router.
- The ODU is not correctly connected to the wireless line card. Make sure that the cables are all connected and screwed on tightly. See the installation guide for a wiring diagram.
- The PIC, a processor inside the ODU, has locked up. In order to fix this issue, turn off the ODU, wait a few seconds, and turn the ODU back on.
- The router is configured for two ODUs, but only one is connected.

If the SU cannot get beyond the rf_hw_reset_state, the log shows that the software tries to reset a second ODU:

```
10:26:43: SU RFSM: STATE CHANGE if_hw_read_eeprom_state
 ====> rf_hw_reset_state
10:26:43: SU RFSM: Resetting RF/ODU1
10:26:44: %LINK-3-UPDOWN: Interface Radio1/0, changed state to up
10:26:48: SU RFSM: STATE CHANGE rf_hw_reset_state
 ====> rf_hw_read_version_state
10:26:48: RFHW: RF/ODU1 PIC boot loader version=255, vendor ID=0
10:26:48: RFHW: RF/ODU1 PIC code version=0.5, eeprom version=0
10:26:48: RFHW: Error: RF/ODU1 EEPROM Checksum failed!
10:26:48: RFHW: RF/ODU1 EEPROM Checksum=0x61
10:26:48: SU RFSM: STATE CHANGE rf_hw_read_version_state
 ====> rf_hw_read_eeprom_state
```

```
10:26:48: SU RFSM: Reading RF HW EEPROM
10:26:48: SU RFSM: Loading RF/ODU1 HW EEPROM data...
10:26:52: SU RFSM: Re-using RF/ODU1 HW EEPROM cached data
10:26:52: SU RFSM: RF/ODU1 HW EEPROM load complete
10:26:52: SU RFSM: STATE CHANGE rf_hw_read_eeprom_state
 ====> rf_hw_reset_state
10:26:52: SU RFSM: Resetting RF/ODU2
10:27:00: SU RFSM: PIC RESP Timeout
10:27:00: SU RFSM: Error: PIC msg timeout during SU RFSM rf_hw_reset_state
10:27:00: %CWRMP-4-RF_IF_COMM: Radio1/0, IF-to-RF/ODU2 comm error
 (ODU Controller Reset cmd)
10:27:00: SU RFSM: STATE CHANGE rf_hw_reset_state
 ====> standby_state
```

In order to fix this problem, either connect a second ODU, or configure the system to use only one. In order to configure for one ODU, type the **radio receive-antennas 1** command from the radio interface prompt.

Q. What if the SU cannot get beyond the dsp_sync_state?

A. In this state, the DSP attempts to find a valid downstream signal, lock to the frequency of that signal, and begin demodulating the signal. If there is anything wrong with the downstream signal that arrives, then the problem is likely to show up here. In order to help you troubleshoot, the DSP sends messages as it progresses through the synchronization process. If everything works, then these messages are sent:

```
09:55:54: SU RFSM: STATE CHANGE dspinit_down_sync_state_config_state
 ====> dsp_sync_state
09:55:54: SU RFSM: Received DSP SYNC IND (0)
09:55:54: SU RFSM: Received DSP SYNC IND (2)
09:55:54: SU RFSM: Received DSP SYNC IND (4)
09:55:54: SU RFSM: Received DSP SYNC IND (5)
09:55:54: SU RFSM: Received DSP SYNC IND (8)
09:55:54: SU RFSM: DSP SYNC PASSED
```

or

```
09:55:54: SU RFSM: STATE CHANGE dspinit_down_sync_state_config_state
 ====> dsp_sync_state
09:55:54: SU RFSM: Received DSP SYNC IND (0)
09:55:54: SU RFSM: Received DSP SYNC IND (2)
09:55:54: SU RFSM: Received DSP SYNC IND (4)
09:55:54: SU RFSM: Received DSP SYNC IND (5)
09:55:54: SU RFSM: Received DSP SYNC IND (7)
09:55:54: SU RFSM: Received DSP SYNC IND (4)
09:55:54: SU RFSM: Received DSP SYNC IND (5)
09:55:54: SU RFSM: Received DSP SYNC IND (8)
09:55:54: SU RFSM: DSP SYNC PASSED
```

The possible DSP sync indicators are:

- 0 AGC_PASS The DSP sees some power in the received signal.
- 1 AGC_FAIL The DSP does not see power in the received signal. This indicator is hard to get. Make sure the downstream frequency is set correctly.
- 2 BURST_SIZE_PASS The DSP assumes the presence of a valid downstream signal. If this is the last DSP indicator you receive, the DSP cannot lock to the frequency of the downstream. Power cycle everything and try again. If that does not work, replace the SU IF card.
- 3 BURST_SIZE_FAIL The DSP is unable to find a valid downstream signal. This problem can occur due to either too weak or too strong a signal. Make sure the HE is

turned on and transmits properly, the antenna points in the right direction, and the downstream frequency is set correctly. Problems with any of these settings means there is no signal, or a very weak signal, to receive. The other possibility is that there is too much signal. If this is the case, the amplifiers in the ODU can saturate. Use a spectrum analyzer and a splitter to look at the signal between the ODU and the line card. The downstream signal must be between 423 and 429 MHz, and the signal power must be between 64 and 15 dBm. If the signal looks too strong, check for saturation. Consider an antenna with lower gain. Another possibility is that the cable−comp is set incorrectly.

- 4 TIME_D_PASS The DSP has synchronized to the timing of the received signal.
- 5 COARSE_FREQ_PASS This indicator always follows the indicator number 4. It is essentially meaningless.
- 6 This number is unused.
- 7 OSC_ADJ_PASS The DSP needed to make a large frequency adjustment. After a large frequency adjustment, the DSP returns to the TIME_D state, so the only message that can follow this one is indicator number 4. If you see this message many times, it is likely that the IF module is miscalibrated. Replace the IF card.
- 8 DEMOD_TT_PASS The DSP has found all the modulation parameters of the downstream signal, and is ready to begin data demodulation.

If you get into the dsp_sync_state, but do not see any of the indicator messages from the DSP, the microcode probably did not download correctly. Type these commands:

```
shut
end
configure terminal
microcode reload
```

Q. What if the SU cannot get beyond the fec_sync_state?

A. This problem usually occurs due to a low SNR. The DSP can sync on a much lower SNR signal than it can be demodulated. In order to fix this problem, you need to get a cleaner signal into the subscriber. Make sure that the cable−comp values are set correctly, and that all the cables are connected tightly. Redirect the antenna.

Note: This state sometimes fails for no apparent reason. Before you look for the error, try again and see if it works the second time.

Q. What if the SU cannot get beyond the trc_sync_state?

A. This problem often indicates a problem with the HE, rather than with the subscriber. Power cycle the subscriber and try again, just to be sure. If you encounter the same problem, check whether any other subscribers are successfully connected to this HE card. If not, try a **shut/no shut** command on the HE. If that does not work, power cycle the HE. The problem is that sometimes the HE appears to have no shut, but in fact the MAC chip never got started. Thus, there is a downstream signal being transmitted, but there is not data on the signal.

Q. What if the SU cannot get beyond the wait_ucd_state?

A. There are two possibilities here. The first is that the DOCSIS initial−ranging−offset is set incorrectly. This is present in the running configuration, which you can view from the exec prompt with the **show run** command. In order to fix this issue, go into the interface prompt and type **docsis initial−ranging−offset 27000**. The second possibility is the HE has a problem. See the "What if the SU cannot get beyond the trc_sync_state?" question for more information.

Q. What if the SU cannot get beyond the ranging_1_state?

A. The initial−ranging−offset can be set incorrectly. See the above question and answer. The other possibility is that something is wrong with the upstream signal. Check that the upstream frequency is set correctly. Make sure that ALC is turned on. This is the default mode, but you can also set the transmit gain manually, which disables ALC. In general, you must not disable the ALC. In order to insure that ALC is turned on, type the **no radio diag transmit−gain** command from the interface prompt.

Q. What if the SU cannot get beyond the ranging_2_state?

A. This probably means that the HE sees either too much or too little power from the SU, or that the signal from the subscriber is too poor to demodulate consistently. There are messages that tell you to what the transmit gain is being set. Here is a command, which means that the SU was told to reduce the gain by 3 dB [−3 db], and so the SU set the IF gain to −4 dB and the RF gain to 0 dB:

```
10:54:26: SU RFSM: DSPMSG_TX_POWER_ADJ [−3 db], IF[−4 db], RF[00 db]
```

In order to see the legal range of transmit gain settings, type these commands from the exec prompt:

```
show cont r1/0 rf

show cont r1/0 if
```

These commands show a lot of information about the IF and RF cards, and one of the fields they display is the range of the Time Zone (TX) variable gain. If the subscriber only uses gains near the bottom of the range, probably the HE receives too much power. Switch to a lower power ODU, align the antenna differently, or put an attenuator between the ODU and the antenna.

On the other hand, if the SU is set to full gain and the HE continues to instruct the SU to increase the power, this is an indication that the HE does not receive enough power. Check to what value the RF receive power of the HE is set, and check the alignment of the antenna. A higher gain antenna can help. Alternatively, move the antenna around, or mount it higher.

Q. What if the SU gets to the dhcp_state but never gets an IP address?

A. If you see the dhcp_state message and never see an IP address get assigned to the SU, this generally points to incorrect configuration of the DHCP server, or the lack of an IP path to the DHCP server. Verify the configuration of the DHCP server and if you run an external DHCP server, verify that the correct **radio helper−address** command is configured under the radio interface through the **show running** command.

Q. What if the SU gets to dhcp_state, receives an IP address but fails on other parameters?

A. Other parameters that the SU requires are the TFTP server address, the Time of Day (TOD) server address, the Time Zone (TX) offset value, and the DHCP config file name (also called the **DOCSIS** config file). These parameters must all be present in the DHCP response from the DHCP server.

Note: You can configure the HE to play the part of the DHCP/TFTP server. If the HE is not configured to be the DHCP/TFTP server, make sure that there is a **radio helper−address** command configured under the HE radio interface. This ensures that DHCP broadcasts are forwarded to the correct server. If you use an external DHCP/TFTP server, the server must also contain a route or default gateway that instructs how to send packets back to the SU network.

These error messages point to the absence of optional parameters in the DHCP response:

```
DHCP_ERROR_ACQUIRING_SEC_SVR_ADDR
DHCP_ERROR_ACQUIRING_LOG_ADDRESS
```

Configure the secondary server and log server address on the DHCP server to eliminate these errors.

Q. What if the SU gets to the establish_tod_state but never gets to TOD_REPLY_RECEIVED?

A. A common reason for failure at this state is that a TOD server is not present either externally or on the HE. You can configure the HE to act as the TOD server. Issue the **radio time−server** command from the global configuration mode. Once again, to use an external TOD server, a route must be present for the TOD server to send the response back to the SU.

Q. What if the SU fails on the configuration_file_state?

A. The configuration_file_state is the main configuration and administration interface to the SU DOCSIS subsystem. The name of this file and the TFTP server address in which this can be downloaded were originally provided in the DHCP state. This configuration file contains:

- Downstream channel and upstream channel identification
- Characteristics
- Class of Service settings
- Baseline Privacy settings
- General operational settings

Common reasons for failure at this state are missing files, wrong file permissions, an unreachable TFTP server, files in the wrong format, files with missing required options, incorrectly configured required options, or incorrect options (unknown or invalid Type−Length−Values (TLVs)).

Q. What if the SU fails at the registration_state?

A. Problems with the registration state almost always point to a configuration file error. Make sure the SU and the HE both support the settings in the configuration file. Make sure the HE allows the creation of class of service profiles or use a profile that the HE creates. Check the authentication strings in the HE radio interface configuration and in the **DOCSIS** configuration file.

Q. What if the SU fails at the establish_privacy_state?

A. This situation probably means that the HE or the SU tries to establish Baseline Privacy (BPI) and the other one is not. Verify whether the **DOCSIS** config file has BPI turned on. On the HE, verify whether the QoS profile also shows BPI turned on. Use the **show radio qos profile** command. Also, make sure both the HE and SU use K images.

Q. What if the SU gets to the maintenance_state, but does not ping?

A. Check that the SU radio line card has a valid IP address. If you have to try a few times to get beyond the ranging_2_state, this is a sign that something else is wrong. This means that somehow the SNR is too low. If the unicast retry counter in the SU is set to non−zero, this is an indication of low SNR. In order to see the SNR value, use the **show controller r1/0 mac** command.

Related Information

- **Cisco Aironet Wireless LAN Client Adapters**
- **Multipoint Wireless Support for the Cisco uBR7200 Series Universal Broadband Router**
- **Technical Support & Documentation − Cisco Systems**

Updated: Dec 14, 2005 Document ID: 14240