

# Cable Modem Basic Install with Cisco Network Registrar

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## Introduction

The purpose of this tech note is to provide a complete setup guide for a cable modem (CM) network in a lab environment. This setup can be used as a first step before deployment to a customer network. It is important to note that a trouble-free setup in the lab does not necessarily mean a trouble-free setup in a customer's network. In a controlled lab environment, noise may not be an issue; while in real life, it can be quite the opposite. However, this procedure can be used to rule out issues that arise from the Cisco IOS® Software Release, the configuration, the hardware, and Radio Frequency (RF).

## Prerequisites

### Requirements

There are no specific requirements for this document.

### Components Used

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.

## Conventions

For more information on document conventions, refer to the [Cisco Technical Tips Conventions](#).

## Lab Topology

### Figure 1 – Lab Network Setup

In this diagram, there is a Cable Modem Termination System (CMTS) that consists of these components:

- uBR7246 that runs Cisco IOS Software Release 12.1(2)T with MC16C Modem Cards
- CM uBR904 that runs Cisco IOS Software Release version 12.0(7)T
- Upconverter
- Diplex Filter to separate high frequency from low frequencies
- Cisco Network Registrar (CNR) version 3.5(3)
- Three-way Splitter
- Customer Premises Equipment (CPE) which, in this case, is a laptop

**Note:** The RF setup in that diagram can be used as a starting reference point; however, this might change once you deploy it at a customer site. RF measurements are beyond the scope of this document; refer to [Connecting the Cisco uBR7200 Series Router to the Cable Headend](#) for proper RF setup and measurements.

## Assumptions

- The upconverter is already installed and configured properly. Refer to the vendor's documentation for setup. Remember that if you are using a GI upconverter, it should be set at 1.75 MHz lower than the center frequency of the NTSC channel in question. (See [Obtain Power Measurements of a DOCSIS Downstream Signal Using a Spectrum Analyzer](#).)
- There is a properly configured CPE that sits behind the CM, specifically to obtain an IP address via the DHCP server.
- The CNR is used as the DHCP and TFTP servers, with the same IP address: 172.17.110.136.
- The Time of Day (ToD) server software is running on the same NT server as CNR.

The sections in this document explain the steps that are needed to configure these components:

- Cisco Network Registrar (CNR)
- Data-over-Cable Service Interface Specification (DOCSIS) configuration file
- Cable Modem Termination System (CMTS)
- Cable Modem (CM)

## Network Diagram

Figure 2 – Network Diagram with the IP Addresses and Names Used in this Tech Note

## Cisco Network Registrar Configuration

Follow this procedure to configure the CNR:

1. Launch CNR from the Start menu.
2. On the menu bar, click the **Add** tab to add a new cluster. Enter the cluster name. In this case, an IP address is used as the name. Check the **Connect to this cluster once added** checkbox. Click **OK**. **Figure 3 – Cluster Name or IP Address Window in CNR**
3. When you are prompted for the Username and Password, use `admin` and `changeme`. **Figure 4 – Username and Password Window in CNR**
4. Click **OK**. A window appears that is similar to [Figure 5](#), which contains the names or IP addresses of the configured clusters. **Figure 5 – Server Manager Window in CNR**
5. Double-click **DHCP@172.17.110.136**, to bring up the DHCP@172.17.110.136 Properties window.
6. Click the **Policies** tab and then click **New**, to create a new policy. **Figure 6 – Adding a Policy Called “Cable Modems” and Copying the Attributes from the “default” Policy**
7. Type in the name of the policy. In this example, the name is **Cable Modems**.
8. If this is a new policy, set the Copy from field to **default**.
9. Click **OK**.
10. Click **Edit options**, to specify DHCP options. For the policy called **Cable Modems**, add the following options (see [Figure 7](#)): **dhcp-lease-time** is active by default and set to **604800** seconds, which is the number of seconds in one week. **routers** is the IP address of the CMTS cable interface, in this case **10.1.1.10**. See [Configuring the Headend \(CMTS\)](#). **time-offset** of the CM from Universal Coordinated Time (UTC); this is used by the CM to calculate the local time, in order to time-stamp error logs. See [How to Calculate the Hexadecimal Value for DHCP Option 2 \(time offset\)](#). **time-servers** IP address for the ToD server, which is **172.17.110.136**. **packet-siaddr** is the IP address of TFTP server, which is **172.17.110.136**. **packet-file-name** is the DOCSIS configuration file configured with the [DOCSIS CPE Configurator](#). This file should reside in the `tftpboot` directory of the TFTP server. **Figure 7 – Edit Options Window with the Attributes Given to the Cable Modem Policy** **Note:** Ensure that you check the **Send to BOOTP clients** checkbox, if you have BOOTP clients. It is also highly recommended that you check the **Always send to DHCP clients** checkbox.
11. Create another policy associated with the CPEs behind the CM, like laptops, and so forth. In this example, the name of the policy is **Cable Modem Clients**. Follow the same procedure as was used for the Cable Modems policy except, this time, set the Copy from field to the **Cable Modems** policy instead of to the **default** policy. **Figure 8 – Adding a Policy Called “Cable Modem Clients” and Copying the Attributes from the Existing Policy Named “Cable Modems”**
12. Click **OK**.
13. Click the **Edit option** button, to select the active options.
14. For the CPE policy, remove all options from the Active list except the **dhcp-lease-time** and the **routers** options. To do so, select the property to delete in the Active list and click the **Remove** button.
15. Change the IP address for the **routers** option to **192.168.1.1**, which is the secondary IP address configured on the CMTS router. See [Configuring the Headend \(CMTS\)](#). **Figure 9 – Adding the IP Address for the routers Attribute, which is the Secondary IP Address Configured in the Cable Interface to which this Policy Applies in the CMTS** **Note:** This example uses a private IP address as the secondary address on the CMTS and in the Cable Modems Client policy. In a production environment, CPE devices should use a public

IP address, to be able to access the Internet (unless Network Address Translation [NAT] is used).

16. Create scopes to associate with the Cable Modems and Cable Modem Clients policies. To make a new scope, click on **DHCP@172.17.110.136** in the main menu, and then click the **Add** tab. This will allow you to add a new scope. Enter the name of the new scope and then select the appropriate policy. In this example, the scope for the Cable Modems is set to use the IP addresses range from 10.1.1.20 to 10.1.1.30. **Figure 10 – Scope for the Cable Modems called “Cable Modems”** Repeat Steps 16a and 16b for the **Cable Modem Clients** scope. In this case, the private IP address range from 192.168.1.20 to 192.168.1.30 is used. **Figure 11 – Scope for CPE Equipment Behind the Cable Modems called “Cable Modem Clients”** The scope used for the CPE devices requires additional configuration. Once you have created the **Cable Modem Clients** scope, you need to double-click the scope to open the dialog box that is shown in [Figure 12](#). **Figure 12 – Cable Modem Clients Scope Window** Click the **Advanced** tab, in order to relate the secondary scope to the primary scope. Check the **Make this scope a secondary** checkbox. Once the drop-down list shows a blank value, select the appropriate primary scope. In this example, the **Cable Modems** scope is selected. **Figure 13 – Making the “Cable Modem Clients” Scope Secondary and Relating It to the Primary Scope**
17. Finally, you need to restart your DHCP server so that your changes can take place. In the main menu, select **DHCP@172.17.110.136** and click the **Control** tab at the top, to get the dialog box shown in [Figure 14](#). This dialog box allows you to reload the DHCP server. **Figure 14 – Reload Window to Commit Changes in CNR**

## DOCSIS Configuration File

The next step that is required to setup a Cable Network is to compose the configuration file. For a cable modem to come online, it needs to download its configuration file via TFTP from a DHCP server. In this document's example, CNR is used to provide both TFTP and DHCP servers. Refer to [DHCP and the DOCSIS Configuration File for Cable Modems \(DOCSIS 1.0\)](#) for more information on the minimum requirements to setup the configuration file. The file is set up with the [DOCSIS CPE Configurator](#). In the [On the CM \(uBR904\)](#) section of this document, the DOCSIS configuration file that is used is called platinum.cm.

**Note:** Once the configuration file is created, ensure that it is copied to the TFTP server. In the case of CNR's TFTP server, you also must ensure that the TFTP server is started:

1. Select **TFTP@172.17.110.136** and then click the **Control** tab. This brings up the TFTP@172.17.110.136 Control dialog box, where the server can be started.
2. The TFTP server functionality is **off** by default. To make the TFTP server start automatically at bootup, start NRCMD (the [command line interface for CNR](#)) and issue these commands:

```
server tftp set start-on-reboot=enabled
```

```
save
```

## Configuring the Headend (CMTS)

This is a basic configuration for the CMTS (the uBR7246):

Current configuration:

```
!  
version 12.1  
service timestamps debug uptime  
service timestamps log uptime  
no service password-encryption  
!  
hostname Sydney  
!  
boot system flash ubr7200-ik1s-mz_121-2_T.bin  
no logging buffered  
enable password <deleted>  
!  
no cable qos permission create  
!--- Default. no cable qos permission update !--- Default. cable qos permission  
modems !--- Default. !!! ip subnet-zero no ip domain-lookup !! interface  
FastEthernet0/0 no ip address shutdown half-duplex ! interface Ethernet1/0 ip address  
172.17.110.139 255.255.255.224  
!--- The IP address of the interface in the same LAN segment as CNR. ! interface  
Ethernet1/1 no ip address shutdown ! interface Ethernet1/2 no ip address shutdown !  
interface Ethernet1/3 no ip address shutdown ! interface Ethernet1/4 no ip address  
shutdown ! interface Ethernet1/5 no ip address shutdown ! interface Ethernet1/6 no ip  
address shutdown ! interface Ethernet1/7 no ip address shutdown ! interface Cable2/0  
ip address 192.168.1.1 255.255.255.0 secondary  
!--- The secondary IP address is used for the CPE's scope in CNR. ip address  
10.1.1.10 255.255.255.0  
!--- The primary IP address is used for the CM's scope in CNR. no keepalive cable  
downstream annex B !--- Default for DOCSIS-compliant cable plants. For EuroDOCSIS,  
use annex A. cable downstream modulation 64qam !--- Default. cable downstream  
interleave-depth 32 !--- Default. cable downstream frequency 451250000  
451250000  
!--- Cosmetic except for the uBR7100. This line has no effect !--- on Upconverter  
Frequency. Used as a reminder of the frequency !--- that is used in the Unconverter.  
cable upstream 0 frequency 28000000  
!--- Upstream Frequency configuration. This is chosen after a careful !--- analysis  
on the noise levels of the return path. cable upstream 0 power-level 0 no cable  
upstream 0 shutdown  
!--- Enables the upstream 0 port. cable upstream 1 shutdown cable upstream 2 shutdown  
cable upstream 3 shutdown cable upstream 4 shutdown cable upstream 5 shutdown cable  
dhcp-giaddr policy  
!--- Modifies the GIADDR field of DHCPDISCOVER and DHCPREQUEST packets. cable helper-  
address 172.17.110.136  
!--- Specifies a destination IP address for UDP-broadcast DHCP packets. ! interface  
Cable3/0 no ip address no keepalive shutdown cable downstream annex B cable  
downstream modulation 64qam cable downstream interleave-depth 32 cable upstream 0  
shutdown cable upstream 1 shutdown cable upstream 2 shutdown cable upstream 3  
shutdown cable upstream 4 shutdown cable upstream 5 shutdown ! ip classless ip route  
0.0.0.0 0.0.0.0 172.17.110.129  
no ip http server  
!  
line con 0  
  exec-timeout 0 0  
  transport input none  
line aux 0  
line vty 0  
  exec-timeout 0 0  
  transport input none  
line aux 0  
line vty 0  
  exec-timeout 0 0  
  password cisco  
  login  
line vty 1 4
```

```
password cisco
login
!
end
```

## Configuring the CM

Typically, a cable modem does not require any user configuration for it to come online (aside from factory defaults). This applies only if the CM is to be used as a bridge. This is an example of a uBR cable modem configuration that is being obtained automatically, after the CM comes online:

```
version 12.0
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
clock timezone - 0
ip subnet-zero
no ip routing
!
!
interface Ethernet0
ip address 10.1.1.25 255.255.255.0
no ip directed-broadcast
no ip route-cache
bridge-group 59
bridge-group 59 spanning-disabled
!
interface cable-modem0
ip address negotiated
no ip directed-broadcast
no ip route-cache
cable-modem downstream saved channel 453000000 20 1
cable-modem mac-timer t2 40000
bridge-group 59
bridge-group 59 spanning-disabled
!
ip default-gateway 10.1.1.10
ip classless
no ip http server
!
!
line con 0
transport input none
line vty 0 4
!
end
```

## Verification and Troubleshooting

This section describes commands that can be used to verify correct operation of the Cable Network.

### On the CMTS (uBR7246)

Ensure that the cable modems are online:

```
Sydney# show cable modem
```

Interface	Prim	Online	Timing	Rec	QoS	CPE	IP address	MAC address
	Sid	State	Offset	Power				
Cable2/0/U0	2	<b>online</b>	2290	-0.25	6	<b>1</b>	<b>10.1.1.25</b>	<b>0050.7366.2223</b>

If the cable modems are stuck in `init(d)` state, then there is no connectivity between the CMTS cable's interface and the DHCP Server.

Ensure that you can issue an extended ping from the cable interface of the CMTS:

```
Sydney# ping ip
```

```
Target IP address: 172.17.110.136
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 10.1.1.10
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.110.136, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/24 ms
```

If the ping is not successful, check the IP routing. Also, ensure that the NT server that is running CNR has the correct default gateway or route back to the CMTS. You can also issue a ping from CNR.

Another command that can be used on the CMTS to verify cable modem and CPE connectivity is **show interface cable 2/0 modem 0**:

```
Sydney# show interfaces cable 2/0 modem 0
```

SID	Priv bits	Type	State	IP address	method	MAC address
<b>2</b>	<b>00</b>	<b>host</b>	<b>unknown</b>	<b>192.168.1.20</b>	<b>dhcp</b>	<b>0010.a4e6.d04d</b>
<i>!--- A laptop that is obtaining an IP address. 2</i>						
<b>10.1.1.25</b>		<b>dhcp</b>	<b>0050.7366.2223</b>		<b>modem</b>	<b>up</b>
<i>!--- The cable modem.</i>						

## On the CM (uBR904)

You can also check connectivity on the cable modem side. Issue the **show ip interface brief** command and check that the interfaces are `up/up`:

```
Router# show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
<b>Ethernet0</b>	<b>10.1.1.25</b>	YES	unset	<b>up</b>	<b>up</b>
<b>cable-modem0</b>	<b>10.1.1.25</b>	YES	unset	<b>up</b>	<b>up</b>

Router# **show controllers cable-modem 0**

```

BCM Cable interface 0:
CM unit 0, idb 0x2010AC, ds 0x86213E0, regaddr = 0x800000, reset_mask 0x80
station address 0050.7366.2223 default station address 0050.7366.2223
PLD VERSION: 32
MAC State is maintenance_state, Prev States = 15
MAC mcfilter 01E02F00 data mcfilter 01000000
MAC extended header ON
DS: BCM 3116 Receiver: Chip id = 2
US: BCM 3037 Transmitter: Chip id = 30AC
Tuner: status=0x00
Rx: tuner_freq 453000000, symbol_rate 5055880, local_freq 11520000
    snr_estimate 35210, ber_estimate 0, lock_threshold 26000
    QAM in lock, FEC in lock, qam_mode QAM_64
Tx: TX_freq 27984000, power_level 0x30 (24.0 dBmV), symbol_rate 8
    (1280000 sym/sec)
DHCP: TFTP server = 172.17.110.136, TOD server = 172.17.110.136
    Security server = 0.0.0.0, Timezone Offest = 0
    Config filename = platinum.cm
buffer size 1600

RX data PDU ring with 32 entries at 0x202130
    rx_head = 0x202168 (7), rx_p = 0x8621418 (7)

RX MAC message ring with 8 entries at 0x202270
    rx_head_mac = 0x2022A0 (6), rx_p_Mac = 0x86214BC (6)

TX BD ring with 8 entries at 0x2023A8, TX_count = 0
    TX_head = 0x2023C8 (4), head_txp = 0x8621548 (4)
    TX_tail = 0x2023C8 (4), tail_txp = 0x8621548 (4)

TX PD ring with 8 entries at 0x202428, TX_count = 0
    TX_head_pd = 0x202C28 (4)
    TX_tail_pd = 0x202C28 (4)

Global control and status:
    global_ctrl_status=0x00
interrupts:
    irq_pend=0x0008, irq_mask=0x00F7

```

You can also test IP connectivity. Ping the DHCP server from the CM:

Router# **ping 172.17.110.136**

```

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.110.136, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/12/24 ms

```

## uBR7246

Sydney# **show version**

Cisco Internetwork Operating System Software



```
IOS (tm) 7200 Software (UBR7200-IK1S-M),
  Version 12.1(2)T, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2000 by cisco Systems, Inc.
Compiled Tue 16-May-00 13:36 by ccai
Image text-base: 0x60008900, data-base: 0x613E8000
ROM: System Bootstrap,
  Version 11.1(10) [dschwart 10], RELEASE SOFTWARE (fc1)
BOOTFLASH: 7200 Software (UBR7200-BOOT-M),
  Version 12.0(10)SC, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)
Sydney uptime is 4 days, 40 minutes
System returned to ROM by reload
System image file is "slot0:ubr7200-ik1s-mz_121-2_T.bin"
cisco uBR7223 (NPE150) processor (revision B) with 57344K/8192K bytes of memory.
Processor board ID SAB0249006T
R4700 CPU at 150Mhz, Implementation 33, Rev 1.0, 512KB L2 Cache
3 slot midplane, Version 1.0
Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
8 Ethernet/IEEE 802.3 interface(s)
1 FastEthernet/IEEE 802.3 interface(s)
2 Cable Modem network interface(s)
125K bytes of non-volatile configuration memory.
1024K bytes of packet SRAM memory.
20480K bytes of Flash PCMCIA card at slot 0 (Sector size 128K).
4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
```

## uBR904

```
Router# show version
```

```
Cisco Internetwork Operating System Software
IOS (TM) 900 Software (UBR900-K1OY556I-M),
  Version 12.0(7)T, RELEASE SOFTWARE (fc2)
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Tue 07-Dec-99 02:01 by phanguye
Image text-base: 0x08004000, database: 0x0852E888

ROM: System Bootstrap,
  Version 11.2(19980518:195057), RELEASED SOFTWARE
ROM: 900 Software (UBR900-RBOOT-M),
  Version 11.3(7)NA, EARLY DEPLOYMENT RELEASE SOFTWARE (fc1)

Router uptime is 1 hour, 6 minutes
System returned to ROM by reload at 11:20:43 - Thu Oct 12 2001
System restarted at 11:21:53 - Thu Oct 12 2001
System image file is "flash:ubr900-k1oy556i-mz.120-7.T.bin"

cisco uBR900 CM (68360) processor (revision D) with 8192K bytes of memory.
Processor board ID FAA0315Q07M
Bridging software.
1 Ethernet/IEEE 802.3 interface(s)
1 Cable Modem network interface(s)
4096K bytes of processor board System flash (Read/Write)
2048K bytes of processor board Boot flash (Read/Write)

Configuration register is 0x2102
```

## Related Information

- [Connecting the Cisco uBR7200 Series Router to the Cable Headend](#)
- [How to Calculate the Hexadecimal Value for DHCP Option 2 \(time offset\)](#)
- [Broadband Cable Technology Support](#)
- [Technical Support & Documentation - Cisco Systems](#)