



Advanced DOCSIS Set-Top Gateway Implementation Design Guide for System Release 5.0

Overview

Introduction

Direct AD SG (Advanced DOCSIS®* Set-top Gateway) allows system operators to set up their Digital Network Control System (DNCS) to send the following types of broadcast DSG data directly to a host device:

- System Information (SI) (ANSI SCTE 65)
- Emergency Alert System (EAS) (ANSI SCTE 18)
- Extended Application Information Table (XAIT)

To successfully reach the host device, and therefore bypass flow to the CableCARD™ module, each data flow must include a broadcast tunnel (BT) header.

Note: Traditionally, a host device that receives broadcast out-of-band (OOB) data passes it to the CableCARD module. The CableCARD module would reformat the data and send it back to the host device. This method of flow occurs when the CableCARD Communications Mode (CCM) is defined on the DNCS as indirect AD SG.

This application guide is specific to the operation of the Digital Broadband Delivery System (DBDS) network in a direct AD SG environment for both SARA, with CableLabs® tru2way™ (formerly OCAP™), and third-party applications. It also includes guidelines for configuring the DBDS for direct AD SG with BT headers on the DNCS.

* Data-Over-Cable Service Interface Specification

Purpose

This guide provides guidelines and sample configurations for setting up your overall system and for configuring the DNCS for direct AD SG with BT headers using an OOB data path for CableCARD host devices.

Scope

The contents of this document apply to sites that are running DNCS System Release (SR) 5.0. This document provides high-level information that applies to the configuration of the DBDS network so that AD SG hosts can *directly* receive broadcast DSG data (SI, EAS, XAIT, and CDL CVT) from the DNCS. This guide provides sample configurations; however, it does not include installation or troubleshooting procedures.

Audience

This guide is written for the following personnel involved in setting up and operating a DBDS in a direct AD SG environment:

- DBDS and DNCS system administrators and operators
- Cisco® Services engineers
- Call-center personnel

Document Version

This is the first formal release of this document.

Understand Direct ADSG

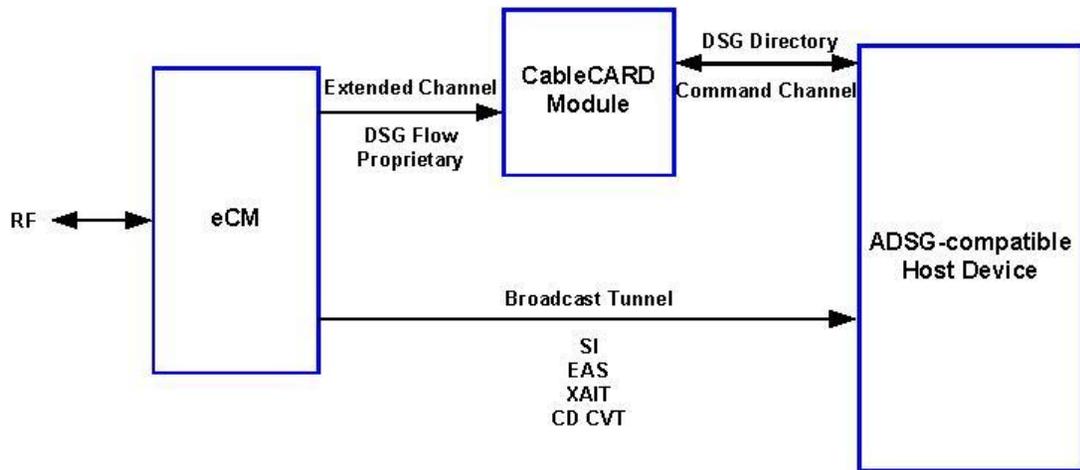
This section provides an overview of a direct ADSG environment. It includes various concepts and other information to help you understand how to provision direct ADSG and CMTS bridge definitions on the DNCS.

Broadcast Data Flow in a Direct ADSG Environment

In direct ADSG, the CableCARD module parses the downstream channel descriptor (DCD) file which results in a DSG directory. This directory defines the broadcast tunnels (IP addresses and ports) for each broadcast tunnel type. The embedded cable modem (eCM) uses these broadcast tunnels to transmit broadcast DSG messages (SI, EAS, XAIT, and CDL CVT) directly to an ADSG-compliant host device.

Note: For non-broadcast tunnel data (for example, passthru, BFS), the eCM uses the extended channel to pass the DSG flows to the CableCARD module, which then uses the command channel for delivery of the data to the host device.

The logical flow of broadcast tunnel data in an ADSG environment is shown in the following diagram.



Environments for Direct ADSG

Direct ADSG can be provisioned in the following environments:

- **SARA:** broadcast data is sent out-of-band from the Broadcast File System (BFS) object carousel directly over a CMTS or QPSK bridge directly to host devices
- **tru2way and other Third-Party Navigators:** broadcast data is sent out-of-band from a third-party application object carousel (for example, TSBroadcaster) over a CMTS or QPSK bridge directly to host devices. For details about third-party applications, please refer to the documentation that accompanied the application.

Note: When provisioning direct ADSG with a third-party application, you must link the application to ADSG using the ADSG Application window on the DNCS Admin Console. Refer to *Defining a Third-Party Application for ADSG (Optional)* (on page 15) for details.

Format Required for Broadcast Data

To successfully reach each ADSG-compliant host device, broadcast data must be sent in a format that includes the following criteria:

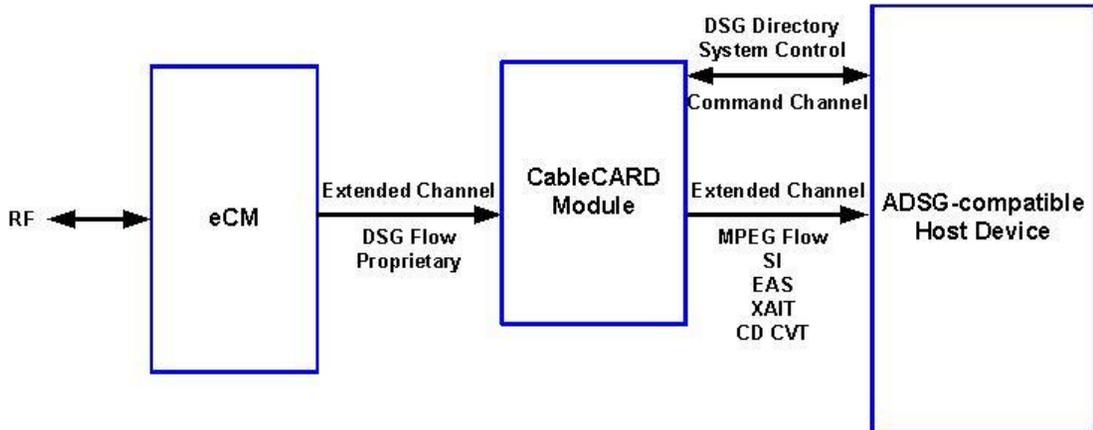
- A broadcast tunnel header
- An accurate virtual channel to source ID (derived from the CableCARD Channel Map file)
- Non video/audio sources defined as hidden

Note: For more information about hidden channels, please refer to *Configuring Hidden Channels for System Release 3.8/4.3 User Guide* (part number 4022454).

How Does Indirect ADSG Differ From Direct ADSG?

In indirect ADSG, there are no broadcast tunnels. Instead, the CableCARD module uses the extended channel and the command channel to deliver all broadcast data to the host; however, the CableCARD module processes the data *before* passing it to the host.

The logical flow for indirect ADSG is shown in the following diagram.



Unique Terminology

ADSG Tunnel MAC Address

ADSG provides the capability to implement a user-defined MAC address with a multicast IP address rather than a true multicast MAC address defined in *Host Extensions for IP Multicasting, RFC 1112*. ADSG also allows you to define a single MAC address for multiple multicast IP addresses. Therefore, you can multiplex several multicast IP addresses to a single user-defined MAC address on an ADSG-capable CMTS.

Because the DSG specification requires support for a minimum of 32 DSG tunnels per downstream channel, you can have OOB data flowing on 32 separate multicast IP addresses. Also, the eCM on the host can support a minimum of 8 DSG tunnels simultaneously.

In our ADSG environment, the non-RFC 1112 mapped MAC address should be used for tunnel addresses, and each OOB source should use a unique IP multicast address.

DSG Client Types

The DSG specification defines four types of clients. Each client is identified in the following table, along with the values used to identify each client in a particular headend configuration.

	Client Type	Value
1	application-id	Used for the OCAP OOB object carousel
2	broadcast	<ul style="list-style-type: none"> ■ Type 1 [SCTE 65] ■ Type 2 [SCTE 18]
3	ca-system-id	0xE00
4	network-specific or well-known MAC address	0001.a6d0.0b1e

In direct ADSSG, the broadcast client type is the client of interest. Type 1 broadcast values include SI messages delivered out-of-band; type 2 broadcast values include EAS messages delivered out-of-band. This is identified in the following table which includes various data types for the broadcast tunnel types.

Number	Description
1	Contains SCTE 65 (SI data)
2	Contains SCTE 18 (EAS data)
5	Contains XAIT and/or CVT data
6-55534	Reserved for future use
55535-65535	Reserved for system operator-specific use

A client can use any of these data types alone or combined to identify which IP addresses to filter in order to obtain its OOB information.

Traditionally, we have used both the network-specific or well-known MAC address and the CA system ID to identify the appropriate filter required for OOB data. The OOB data includes the following data types.

Type	UDP Port
Broadcast File System (BFS)	13821
Conditional Access (CA)	2000
System Information (SI)	2001
Emergency Alert System (EAS)	13820
Passthrough	13820
UNConfig	13818

Understand Direct ADSG

This data is typically sent on a single IP multicast address from the DNCS. Using the industry-standard definition of an IP flow (defined by destination IP and port), there are typically five separate flows. If CA is provided by a third party, (for example, NDS), then the CA system ID is different but may be paired with the SA MAC address ID. Third-party CA data can be placed on a unique IP multicast address or DSG tunnel, which can then be described as a “CA Tunnel.”

Important: The CA Tunnel term should not be used with systems using our conditional access because we do not implement a dedicated tunnel that carries only conditional access (CA) data.

CA Tunnel Address

The CA tunnel term implies that CA data is sent via a dedicated multicast address defined by the DCD. This is not the case with our DBDS. We cannot place CA data (entitlement management messages [EMMs]) on a dedicated multicast IP address. Instead, the DBDS relies on the transport layer (layer 4 of the OSI model) to differentiate OOB data and assign a unique port to various components, one of which is CA data.

Understanding the ADSG Portion of the DNCS CMTS Configuration

The ADSG portion of the CMTS is responsible for the following two roles:

- **Generate the DOCSIS MAC management message known as the DCD**

The DCD message is sent out once per second on the cable downstream interface to a well-known MAC address (01:e0:2f:00:00:01). The DCD is a rules-based file used by the digital home communications terminal (DHCT) to determine which multicast MAC addresses to filter for OOB data. This determination is made by examining the client types assigned to each rule. A tunnel defined on the CMTS is simply a rule in the DCD file.

Note: There is no reference to the term "rule" when configuring the Cisco CMTS, which could cause confusion when provisioning it.
- **Define the MAC address used to forward OOB multicast IP data**

Note: The ADSG tunnel address is really just the destination MAC address. The CMTS will examine and modify the destination MAC address of every outbound packet that belongs to a multicast IP address associated to an ADSG tunnel. If desired, multiple multicast IP addresses can be mapped to a single multicast MAC address.

Note: The ADSG portion of the CMTS configuration does not address the forwarding of multicast data, as this is handled by the multicast routing portion. Each packet that is sent to any static Internet Group Management Protocol (IGMP) group address and is configured on the cable interface will be forwarded by the CMTS. The ADSG portion of the CMTS does not selectively filter based on ports, nor does it rate-limit the multicast data. These functions, if implemented, are handled by normal Access Control Lists (ACLs) and Quality of Service (QoS) settings typically found on any layer 3 network device.

DNCS CMTS Bridge Definitions

Note: Broadcast tunnel data includes OOB SI and EAS data in reference to the SCTE 65 and SCTE 18 specifications, respectively.

Traditionally, the DNCS has included the following two types of CMTS bridge definitions:

- **Advanced DSG:** supports indirect ADSG and legacy ADSG host devices as Cisco tunnel traffic generates broadcast DSG data
- **Basic DSG:** supports basic DSG clients that utilize the bridge resolution file (BRF) which maps hub assignments to multicast MAC addresses when setting up a CMTS bridge

The CMTS bridge can now accommodate the CableCARD host's capability to directly accept broadcast tunnel data using the DSG broadcast client ID type. A CableCARD host implementing this capability is referred to as being in direct ADSG mode. This allows the CableCARD host to use broadcast tunnels to transmit data directly to host devices.

This is accomplished by defining the CMTS bridge (on the DNCS) as **Advanced DSG with BT headers**. When the DNCS generates OOB data with BT headers, the following types of data are sent to and from the CableCARD host using this bridge:

- **SI messages**
- **EAS messages**

When a DNCS OOB bridge is provisioned for ADSG with BT headers, SI and/or EAS are the only types of data present. None of the other required OOB data types for either the host or CableCARD module are present on the bridge. Therefore, in addition to the advanced DSG with BT headers bridge, you must also configure the following OOB bridges for hosts that are provisioned for direct ADSG:

- **Advanced DSG OOB bridge**
 - Bridge without BT headers
 - Bridge with BT headers
- **QPSK bridge** - defines the CableCARD Communications Mode (CCCM)

The advanced DSG OOB bridge for direct ADSG now includes the CableCARD host's capability to directly accept SCTE-formatted data messages using the DSG-broadcast client ID type shown in *DSG Client Types* (on page 6). A CableCARD host implementing this capability is referred to as being in "Direct Mode" and relies on the CableCARD module to pass the data in the correct format.

The DSG broadcast client ID merely identifies the data as conforming to specific industry standards, in this case SCTE with Broadcast Tunnel (BT) headers. It does not identify all the broadcast type data required by the Cisco host.

Understand Direct AD SG

Only the following two types of DNCS-generated OOB data can be configured with BT headers:

- SI
- EAS

When a DNCS OOB bridge is configured for Direct Mode, SI and/or EAS will be the only types of data present. None of the other required OOB data for either the host or CableCARD module will be present on the bridge.

Relationships between the data types for each bridge and the port associated with the data types are shown in the following two tables.

Advanced DSG OOB Bridge

Type	UDP Port
BFS	13821
CA	2000
SI	2001
EAS	2001
Passthrough	13820
UNConfig	13818

Advanced DSG with BT Headers OOB Bridge

Type	UDP Port
SI	User-defined
EAS	User-defined

DHCT and CableCARD Module Communication Modes

The CableCARD host learns its OOB data path from one of the following two fields in the UNConfig message:

Note: These fields are configurable options in the DNCS Admin Console when provisioning a QPSK modulator and a CMTS bridge.

- **DHCT Communication Mode (DCM):** defines the communications path for the host device

Important: It is required that you set this value to DOCSIS.

- **CCCM:** defines the CableCARD communication path as either Direct ADSG, Direct ADSG with Socket, Indirect ADSG, or Indirect ADSG with Socket

The CableCARD host receives its communication mode over the Digital Audio /Video Council (DAVIC) path via a QPSK modulator. Consequently, the DCM and CCCM must be correctly defined on the QPSK OOB bridge. This is why both are present on the Set Up QPSK Modulator GUI.

Notes:

- Legacy hosts with embedded security ignore the CCCM.
- Any host device (for example, a host device set up as DAVIC only) ignores a DCM mode that it does not support.
- Direct ADSG with Socket means the CableCARD module and the host share the same IP address.
- Direct ADSG without Socket means the CableCARD module independently issues a UNConfig request and is the only entity in the DNCS database marked as two-way.

IP Flow Schemes

When configuring the CMTS bridge on the DNCS, the following three IP flow schemes are available:

Important: We recommend that you select single flow multicast (SFM) as it is an optimal choice when implementing an OOB bridge.

- **Unicast**
- **SFM** - recommended scheme for an OOB bridge
- **Multiflow, Multicast (MFM)**

Configure Direct AD SG

This section provides guidelines to help you configure the DBDS network to support AD SG in an environment where the DNCS is enabled for direct AD SG.

Important: In this environment, a CMTS OOB bridge must be defined to support direct AD SG.

Prior to configuring direct AD SG, please note the following definitions within this document concerning a logical CMTS bridge and a physical CMTS device.

- A logical CMTS bridge refers to the "logical" model of the CMTS bridge as configured and maintained on the DNCS Admin Console.
- A physical CMTS device refers to the physical CMTS hardware that resides in the headend or hub of a given cable system.
- The relationship between the DNCS-configured logical CMTS bridge and the actual physical CMTS device is such that the logical CMTS bridge may represent one or many physical CMTS devices.

Assumptions About Your System

- A CMTS bridge definition only modifies the output format and does not modify the generation of data.
- There is at least one QPSK per hub.
- Each hub is set up for only one time zone and cannot span more than one time zone.
- Quadrature Amplitude Modulation modulators (QAMs) feeding into one or more hubs use the same time zone.
- Synchronization is maintained between the CMTS-generated DCD file and the DNCS bridge definitions.
- Bridges are defined to support either indirect AD SG (legacy out-of-band support using a QPSK or a well-known MAC address) or as direct AD SG.
- The DNCS receives a correct CableCARD channel map from third-party vendors.
- All servers, including the DNCS, are connected to the headend router through Ethernet.
- The network supports multicasting.
- The CMTS software supports AD SG.
- The DNCS release supports multicast and is streaming multicast traffic to the CMTS while it continues to unicast traffic to the existing QPSK modulators, provided that each CMTS and QPSK modulator is defined as an OOB bridge. Only a CMTS is interested in the multicast traffic streamed by the DNCS.

- The Dynamic Host Configuration Protocol (DHCP) servers must implement the specifications as provided in *Dynamic Host Control Protocol, RFC 2131, March 1997*.
- The term DHCT CPE (customer premise equipment) is equivalent to eSTB (embedded set-top box). All current and planned ADSG-capable software images for Cisco-based platforms (eSTB) will only operate in ADSG mode; therefore, ADSG-capable software images will not fall back to DAVIC.

Enabling a Second DNCS IP Interface for DSG (Optional)

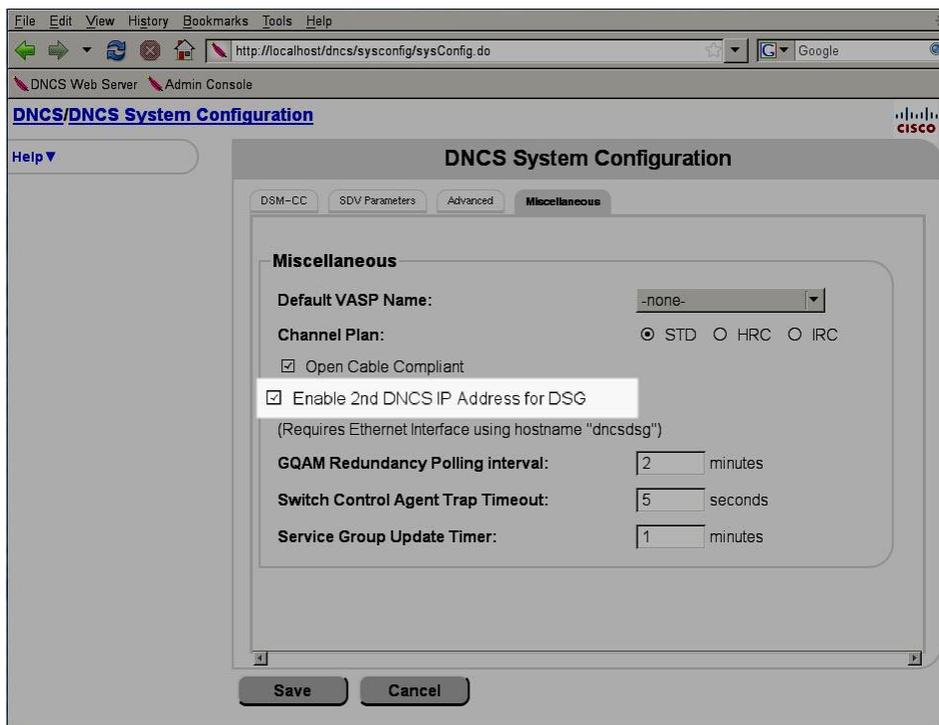
Traditionally, there has been a single IP address defined on the DNCS that all the Cisco SPVTG headend components and set-tops recognize for provisioning. This IP address is defined by the hostname entry “dncsatm” in the DNCS /etc/hosts file and is based on legacy network attachment. The hostname “dncsatm” is still used because of its omnipresent existence in both the DNCS database and application software code. This interface is linked to a number of processes and intrinsically defined in multiple database tables on the DNCS. Using the “dncsatm” interface for ADSG requires a coupling between the cable modem high speed data networks (HSDN) and DBDS networks. SR 5.0 provides the ability to provision a second DNCS IP address to obviate the need to couple the HSDN and DBDS networks. This second interface is defined by the hostname entry “dncsdsg” in the DNCS /etc/hosts file. Once configured, all CMTS bridges will automatically advertise this second IP address via UNConfigIndication messages directed to each set-top.

To enable this communication, complete the following steps:

- 1 From the DNCS Administrative Console, click the **DNCS** tab and then click **System Provisioning**.
- 2 From the System Management area, click **Sys Config**. The DNCS System Configuration window opens.

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- 3 Click the **Miscellaneous** tab.



- 4 Click the box next to **Enable 2nd DNCS IP Address for DSG**. When enabled, a check mark appears in the box.
- 5 Click **Save**.

Using the Existing DNCS Interface for SFM

Using the DNCS GUI, a system operator will setup a CMTS and a CMTS bridge to provision an SFM IP address for a set of out-of-band data that is destined to a specific bridge. The system operator must provide the following information on the DNCS Admin Console:

- A hub to associate with the bridge
- A bridge name
- An IP flow scheme defined as SFM
- The name and IP address of the CMTS hosting the bridge (the presence of this field is dependent upon the DNCS software version)
- A multicast IP address
- A DCM defined as DOCSIS for set-tops that are using DSG; a DCM setting of DAVIC for set-tops that are not using DSG

After the DNCS is configured, it starts sending out each out-of-band message type using a multicast destination IP address that was provided by the system operator. If a group of CMTSs share the same out-of-band traffic, the system operator must provision only one multicast IP address on the DNCS Admin Console.

Defining a Third-Party Application for AD SG (Optional)

Important: This section pertains to systems that are using a third-party application to receive an application tunnel over DSG.

If you are using a third-party application (for example, TSBroadcaster, MediaCast server) to set up an object carousel for the transfer of files, you will need to set up the application for AD SG. This will enable the application ID to correctly associate only to a source ID.

Complete the following steps to provision a third-party application for AD SG.

- 1 From the DNCS Administrative Console, click the **System Provisioning** tab and then click **AD SG**. The AD SG Applications window opens.
- 2 Click **Add**. The window updates and includes a new row that enables you to define the values for the AD SG application.
- 3 In the Name field, enter a name that describes the application.
- 4 In the ID field, enter a number to identify the AD SG application.
- 5 Click **Save**. The AD SG Application window is updated to include the new application.
- 6 Click **Exit** to close this window.

Setting Up a QPSK OOB Bridge for the Direct ADSG CableCARD Communication Mode

Complete the following steps to provision a QPSK OOB bridge for direct ADSG.

- 1 From the DNCS Administrative Console, click the **Network Element Provisioning** tab.
- 2 Click **QPSK**. The QPSK List window opens.
- 3 Click **Add**. The Set Up QPSK Modulator window opens, similar to the following example.

Note: The CableCard Communications Mode option is highlighted in the following example.

- 4 Complete the fields in the Basic Parameters window by referring to your DNCS online help; however, go to step 5 for information about defining the appropriate CCCM value.
- 5 From the ADSG Options area, select one of the following CableCard Comm Mode types to set up direct ADSG:
 - **Direct ADSG:** the CableCARD module has its own IP address
 - **Direct ADSG with Socket:** the CableCARD module uses the IP address of the host
- 6 Click **Save**. The system saves the parameters for this QPSK bridge in the DNCS database. The QPSK List window updates to include the new QPSK bridge.

Setting Up a CMTS for Direct AD SG With BT Headers

When provisioning your system to use direct AD SG with BT headers, you need to configure the following two OOB bridges (CMTSs):

- **Advanced DSG OOB bridge:** sends all Cisco OOB data across the defined list of bridges
- **Advanced DSG with BT Headers OOB bridge:** sends only SI and/or EAS data with BT headers

Although SI and/or EAS data can be carried over both bridges, the direct mode CableCARD host only receives the data from the Advanced DSG with BT Headers bridge if the CCCM is set properly (Direct AD SG mode) on the Advanced DSG bridge for the QPSK. Note that the host and the CableCARD module have separate CCCM modes, both of which are present in the UNConfig data on the Advanced DSG bridge.

Setting Up the Advanced DSG OOB Bridge

- 1 From the DNCS Administrative Console, click the **Network Element Provisioning** tab.
- 2 Click **CMTS**. The CMTS List window opens.
- 3 Click **Add**. The Add CMTS Bridge window opens, similar to the following example:

Note: Your Add CMTS Bridge window may look different depending on the features that you have enabled.

The screenshot shows the 'Add CMTS Bridge' configuration window. The fields are as follows:

- Hub Name: EmulHub001
- CMTS Name: (empty)
- IP Flow Scheme: Unicast SFM MFM
- Comment: (empty)
- IP Address: (empty)
- DHCT Comm Mode: DAVIC
- CableCard Comm Mode: DAVIC
- Stack Configuration: IPv4
- SRM IPv4 Address: (empty)
- SRM IPv6 Address: (empty)
- SRM Port: 0
- Disable EMM Generation
- BRF/DCD Generation
- Note: BRF/DCD Generator required for Cisco SPVTG Basic DSG Clients
- Advanced DSG with BT Headers

Buttons at the bottom: Save, Cancel, Multiflow Multicast...

Configure Direct AD SG

- 4 From the **Hub Name** field, click the arrow and select the hub to which the CMTS bridge is connected.
- 5 In the **CMTS Name** field, enter a name to describe the bridge.
- 6 From the **IP Flow Scheme** field, we recommend that you select **SFM**.
- 7 In the **IP Address** field, enter an IP address for this bridge that is unique and is within the range of IP addresses reserved for multicasting (225.0.0.0 – 239.255.255.255).
- 8 From the **DHCT Comm Mode** field, select **DOCSIS**.
- 9 From the **CableCard Comm Mode** field, select either **Direct AD SG** or **Direct AD SG with Socket**.
Note: This value determines the CCCM going out from UNConfig.
- 10 Click **Save**. The Add CMTS Bridge window closes and the CMTS List window updates to include the new DNCS OOB Bridge.

Setting Up the Advanced DSG With BT Headers OOB Bridge

- 1 From the DNCS Administrative Console, click the **Network Element Provisioning** tab.
- 2 Click **CMTS**. The CMTS List window opens.
- 3 Click **Add**. The Add CMTS Bridge window opens, similar to the following example.

Note: Your Add CMTS Bridge window may look different depending on the features that you have enabled

The screenshot shows the 'Add CMTS Bridge' configuration window in the DNCS Administrative Console. The window is titled 'Add CMTS Bridge' and contains various fields for configuration. The 'Hub Name' is set to 'EmulHub001'. The 'CMTS Name' field is empty. The 'IP Flow Scheme' is set to 'SFM'. The 'Comment' field is empty. The 'IP Address' field is empty. The 'DHCT Comm Mode' is set to 'DAVIC'. The 'CableCard Comm Mode' is set to 'DAVIC'. The 'Stack Configuration' is set to 'IPv4'. The 'SRM IPv4 Address' field is empty. The 'SRM IPv6 Address' field is empty. The 'SRM Port' is set to '0'. There are checkboxes for 'Disable EMM Generation' and 'BRF/DCD Generation', both of which are unchecked. A note at the bottom states: 'Note: BRF/DCD Generator required for Cisco SPVTG Basic DSG Clients'. At the bottom of the window, there is a checkbox for 'Advanced DSG with BT Headers' which is unchecked. The window has 'Save', 'Cancel', and 'Multiflow Multicast...' buttons at the bottom.

- 4 From the **Hub Name** field, click the arrow and select the hub to which the CMTS bridge is connected.
- 5 From the **IP Flow Scheme** field, we recommend that you select **SFM**.
- 6 In the **IP Address** field, enter an IP address for this bridge that is unique and is within the range of IP addresses reserved for multicasting (225.0.0.0 – 239.255.255.255).
- 7 Check the **Advanced DSG with BT Headers** box. A check mark appears in the box and additional fields appear in the window, similar to the following example.

- 8 From the **UDP Port** field, enter the appropriate port that is associated with AD SG.

Important: The port you enter must match the port on the DCD list for the CMTS. Check with your network administrator for the correct port.
- 9 To define which data types to send on this bridge, click one of the following options:
 - **Send SI**
 - **Send EAS**

Note: If you do not enable an option, this data will not be sent out on this bridge. If applicable, that data can be provided by a third-party application.
- 10 Do you want to assign additional channel maps to the CMTS bridge?
 - If **yes**, go to step 11.
 - If **no**, go to step 12.
- 11 Select a hub from the **Available Hubs** list and click **Add**. The hub is moved to the Selected Hubs list.

Note: You may add as many hubs to the Selected Hub list as you want.
- 12 Click **Save**. The Add CMTS Bridge window closes and the CMTS List window updates to include the new DNCS OOB Bridge.

For Information

For Information

If You Have Questions

If you have technical questions, call Cisco Services for assistance. Follow the menu options to speak with a service engineer.



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