



MOTOROLA
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*Cable Operator Deployment
of CableCARD/Host
Technology*



APPLICATION NOTE October 03

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DESCRIPTION

OpenCable is a project that standardizes the cable network interface and is intended to help create a retail market for digital cable products. As part of this effort, the OpenCable specifications define the following:

- A Host device (set-top box or integrated television) that provides generic cable tuning and decoding capabilities, that is portable across all cable networks. The Host is capable of decoding clear analog and clear digital content.
- A removable CableCARD module security module that separates a retail delivered set-top box (Host) from the cable operator's proprietary conditional access system and network messaging. The CableCARD module has a PCMCIA Type II form factor.
- An interface between the Host and CableCARD module, that allows for Hosts and CableCARD modules from different vendors to interoperate with each other freely.

The initiative provides portability for host devices. If for example, a consumer purchases a set-top box or an integrated TV in New York and then relocates to Los Angeles, that set-top box or integrated TV will be operable with the new regional cable provider's equipment provided they support CableCARD/Host.

In order to enable portability, the proprietary features of a set-top box, such as encryption, security, and other private network features, had to be removed from the Host and placed on a removable device. This device, the CableCARD module, is the size of a laptop computer's network interface card (NIC) or Personal Computer–Memory Card International Association (PCMCIA) card. When inserted into a Host device, the CableCARD module provides the conditional access function and decrypts encrypted digital content.

Set-top boxes developed using the OpenCable hardware specifications will allow a consumer to purchase, from the retailer of their choice, a Host set-top box, which may then be connected to their home entertainment system, much like any other piece of consumer electronics equipment. The consumer would then receive a CableCARD module, provided by the cable operator when subscribing to encrypted digital services. If the consumer moves to an area of the country served by a different cable operator, the consumer will simply return the CableCARD module to his present cable operator. The consumer will take his set-top box with him as he relocates and reconnects it upon moving to the new cable system, obtaining a new CableCARD module from the new cable provider.

Motorola was among the first to demonstrate CableCARD-Host interoperability and has been actively working with CableLabs and the leading Consumer Electronics Host vendors to facilitate the success of the OpenCable project. In July 2003, Motorola received CableCARD-compliance qualification from CableLabs.

MOTOROLA SYSTEM SUPPORT FOR CABLECARD/HOST DEPLOYMENT

New features in support of the CableCARD/Host initiatives have been progressively added to various DAC 6000 releases. In addition, a new subsystem called "Copy Protection Management System" (CPMS) will be introduced as a headend device to manage the new content copy protection and

CableCARD validation parameters that are part of the OpenCable specification for compliant CableCARD/Host units.

DAC Releases, beginning with version 2.70, support various levels of CableCARD/Host/CPMS functionality as follows:

1. DAC Release 2.70 - 2.80.8-33
 - a. CableCARDS are authorized to look like a one-way DCT2000.
 - b. CableCARD/Host has access to encrypted and clear broadcast services – no VOD.
 - c. Copy Control Information (CCI) is defaulted to “copy freely”.
 - d. No changes are required to the billing system*.
2. DAC Release 2.80.9, System Lab Support (same as #1 above, plus the following:)
 - a. CCI can be set globally (ie. All services = “copy once”)
 - b. CableCARD validation data is entered into the DAC after being transferred from a Motorola Copy Protection Management System (CPMS).
3. DAC Release 2.97 (same as #1 and #2 above, plus the following:)
 - a. CCI can be set on a service-by-service basis.
 - b. CCI and validation data is automatically synchronized between the DAC and CPMS.
 - c. Support of extended billing system commands for direct import of CableCARD data.

	DAC Release 2.70 through 2.80.8-33	DAC Release 2.80.9	DAC Release 2.97
DAC Identification of CableCARD	Defines as Motorola DCT2000 – Oneway	Defines as Motorola DCT2000 – Oneway	Defines as CableCARD Host – Oneway
Billing System Support	Available now	Available now	CableCARD Host – Oneway Billing System upgrade required to support new CableCARD/Host pairing information
CableCARD/Host Interface Encryption	None	Default None Special Script can be executed for Lab testing purposes only	Controlled by DAC settings for each Service
DAC Interface to Copy Protection Management System	None	Manual Interface	Automatic/networked
Transmission of Validation Message	None	Manual Execution utilizing a DAC Utility	Automatic/networked

* * If the billing system software has not been designed to include fields for CableCARD ID, Host ID, and Data Field, then this information must be stored separately for subsequent transfer to the CPMS so that CableCARDS can eventually be represented in the CPMS and DAC databases. If this is not done, future system migration to distribution of copy-protected content will cause loss of video at CableCARD/Hosts that are not properly registered with the CPMS and DAC. (See “System Support For CableCARD/Host” section for a further discussion of managing CableCARD/Host data).

EARLY SYSTEM SUPPORT FOR CABLECARD/HOST

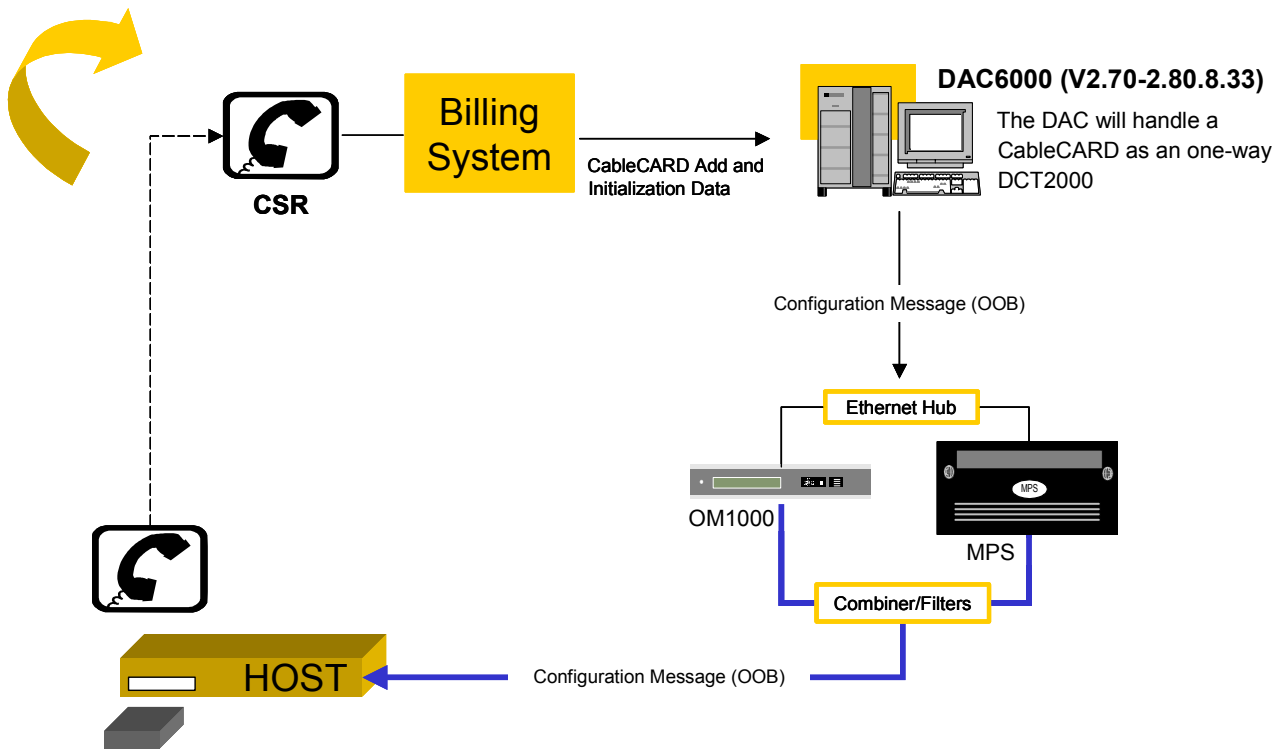
DAC versions 2.70 and 2.80.

For Cable Operators systems in North America currently running DAC version 2.70 and DAC version 2.80, here are the steps necessary to support a CableCARD/Host:

1. CableCARD module is installed into a Host
2. CableCARD/Host Pairing Information is displayed on TV
3. Customer or Installer calls Cable Operator CSR with CableCARD module unit address, serial number, and CableCARD /Host pairing information. The CableCARD module unit address and serial number are on the CableCARD module label.
4. CSR adds, initializes and authorizes CableCARD module as DCT2000 – Oneway
5. CSR may record CableCARD/Host pairing information for future use if these parameters cannot be currently stored in the billing system database.

DAC version 2.70 and DAC version 2.80 were released at a time when CableCARD modules and Hosts were not deployed. They do not have specific support for those devices (i.e. no CableCARD terminal type, no interface to Billing System for CableCARD/Host pairing information, no interface to the CPMS to retrieve and send the CableCARD/Host validation message). Since these DAC versions do not have a capability to store and maintain the CableCARD-Host pairing information, a situation exists where the Cable Operator would be advised to “capture and hold” the CableCARD/Host pairing information during the initial installations. It is recommended that the installer inform the Cable Operator Customer Service Representative (CSR) of the CableCARD/Host pairing information during installation. The CSR may record this information in a separate database for retrieval at a later date. This action may alleviate a potential surge of calls to a CSR if/when the default copy control information values are changed.

Figure 1 below is a representation of how a system can support CableCARD/Host in DAC 2.70 through 2.80.8-33 deployments.



CableCARD

- Customer installs Host & CableCARD
- Customer or Installer calls MSO CSR with CableCARD unit address, serial number and CableCARD/Host mating information

CABLECARD/HOST PAIRING INFORMATION SCREEN - Man Machine Interface (MMI)

The OpenCable™ specifications defined an interface between the Host and CableCARD module, that allows for Hosts and CableCARD modules from different vendors to interoperate with each other freely. The (MMI) Man Machine Interface is an important first component of identifying and pairing new cards with set-top hosts. Both the business and conditional access systems utilize this information.

A MMI pairing screen is typically displayed when a CableCARD module is initially installed into a Host device. The MMI screen will contain the CableCARD module ID, Host ID, Data Field and the CableCARD module Unit Address, as shown below.

In order to start cable service
for this device, please contact
your cable provider

CableCARD(tm): 000-385-880-105-4

Host: 071-848-735-181-5

Data: 245-312-199-64

UnitAddress: 000-03858-80105-238

- Cable Card ID = AAA-BBB-CCC-DDD-c
 - AAA = the manufacturer ID, Motorola was assigned 000
 - BBB-CCC-DDD = the 9 least significant digits of the unit address (when in decimal format)
 - c = the Luhn digit, which is a checksum defined by the OpenCable Copy protection specification
- Host ID = EEE-FFF-GGG-HHH-c
 - EEE = This is the manufacturer ID
 - FFF-GGG-HHH = A unique value assigned to a Host device
 - c = the Luhn digit, which is a checksum defined by the OpenCable Copy protection specification
- Data Field
 - Unique randomly generated value created during the CableCARD/Host pairing process. This value is a private security data authenticator utilized by the Motorola Conditional Access System in performance of the functions specified in the CableCARD Copy Protection System specification.
- Unit Address = III-JJJJJ-KKKKK-LLL
 - Unique, 16 character, decimal value representing the unit address of the CableCARD module with the LLL representing the checksum

COPY CONTROL INFORMATION (CCI)

In the OpenCable standards, Copy Control Information (CCI) is used to indicate the copying rules associated with content, and to indicate when “high value” content must be encrypted across a digital interface, whether it is the CableCARD/Host physical interface, or a digital output on a Host. Any content marked with CCI indicating that it cannot be copied, must be encrypted on digital interfaces.

CCI is information that describes the duplication rules for an item of digital content. It is intended to reduce illegal duplication and subsequent distribution of video and audio content subject to copyright restrictions. Content providers indicate illegal duplication and distribution of entertainment content as a leading cause of revenue loss. Although copying of content by analog equipment such as VHS VCRs would still be possible and has been ongoing for many years, the content copied to such devices is stored at a reduced quality level because of the nature of that equipment and the storage medium. Digital storage devices would have no inherent qualities such that the copied content would be reduced in quality. In fact, such equipment would be capable of “perfect” storage of the original digital content. This “perfect” storage capability is a primary motivation for the requirement to include CCI information in all “high value” content.

In the case of the CableCARD/Host interface, a specification exists that describes how content that has been decrypted by the CableCARD module must be re-encrypted on the CableCARD-Host interface if the CCI value for the content indicates that it is “high value”. Hosts that receive content from the CableCARD module that is marked with “high value” CCI must also protect that content on any of its digital outputs, such as a 1394 output.

Inclusion of CCI support in the CableCARD module and Host as well as the system infrastructure is required to protect high value content. Newer set-top-boxes (STBs) with embedded security will also include digital outputs requiring system infrastructure support to protect high value content.

CCI will be carried along with digital content steams from the headend and can be set on a service-by-service basis with the installation of DAC release 2.97. The four possible values that CCI may take on and their meaning are indicated in the table below:

CCI Information

CCI Text	Description
Copy Freely	Any number of copies may be produced.
Copy No More	A copy of the content has already occurred and no more copies are permitted.
Copy Once	Only one copy of the content is permitted.
Copy Never	Copying of the content is never permitted.

COPY PROTECTION MANAGEMENT SYSTEM (CPMS)

The CPMS is a new PC based Motorola headend device to support requests for the creation of Copy Protection validation messages intended for CableCARD modules within a system. The CPMS controls the secure aspects of the CableCARD validation message. These messages contain authenticated fields protected with secure encryption. Authentication must be done to prevent someone from validating a CableCARD module or Host independently of the cable headend control system and circumventing the copy protection system. The CPMS is physically secured and separated from the other controller functions, thus designed to prevent the theft of security system information. The

connection between the CPMS and the Access Control System is established via the local area network.

Another element of the CPMS is the Certificate Revocation List (CRL) used to determine if a “good” or “bad” validation message should be sent to a CableCARD module. If any of the identified CableCARD module or Host ID’s exist on the Certificate Revocation List, (maintained and updated by CableLabs, the CableCARD module will be sent a bad validation message and the CableCARD module will request that the Host display an Authorization Failure Screen. The CableCARD module will not decrypt CA encrypted video until a “good” validation message is received. If the CableCARD module or Host does not appear on the CRL a “good” validation message is sent to the CableCARD/Host allowing the CableCARD module to decrypt “high value” video services.

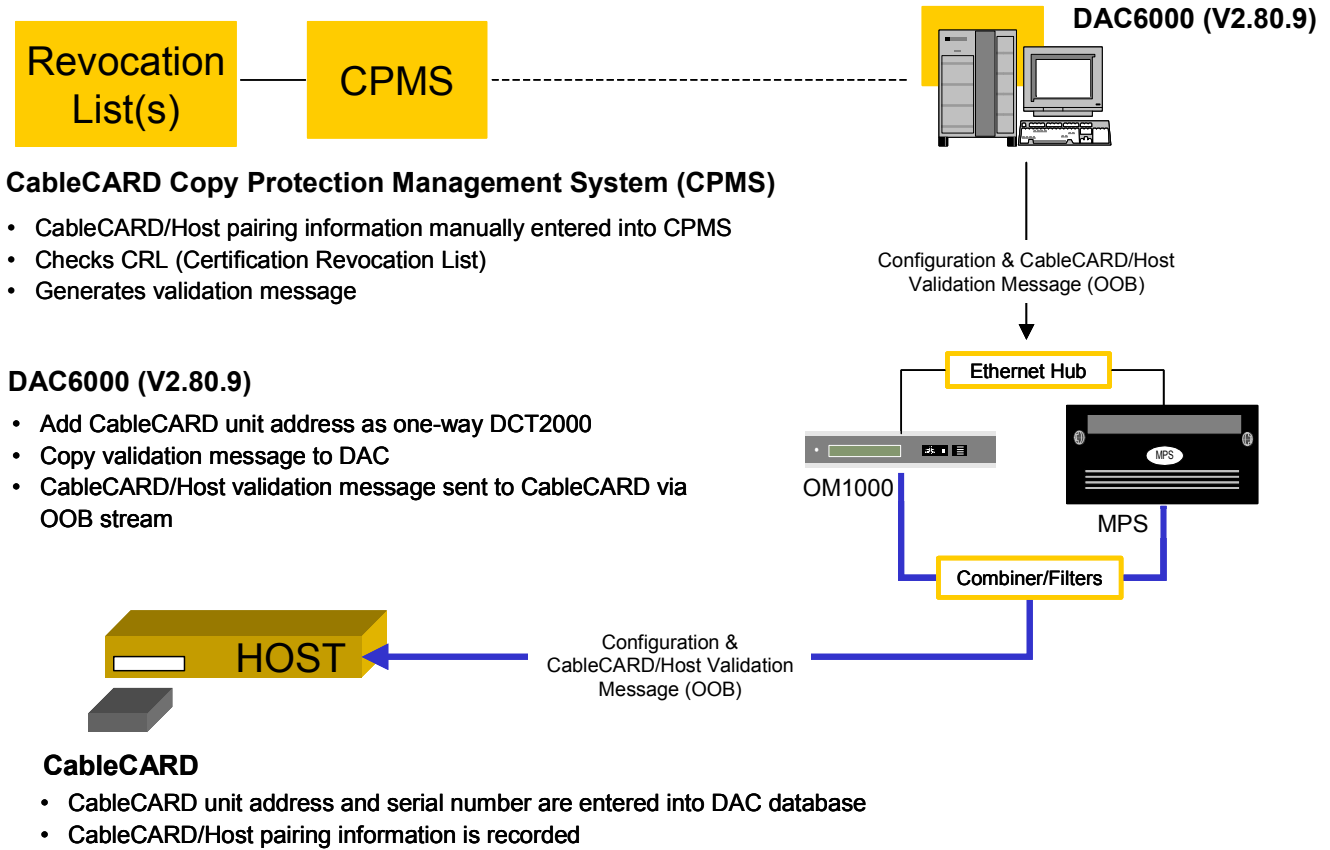
SYSTEM LAB SUPPORT FOR CABLECARD/HOST

In order for Motorola to allow the consumer electronics vendor and cable operator qualification labs to continue to make progress on OpenCable product development, two features have been implemented in the DAC 2.80.9 system release. The first feature allows CCI to be modified on a global basis; the second feature enables the DAC to manually insert the validation message into the OOB stream for delivery to the appropriate set-top Host.

Below are the steps necessary for supporting CableCARD/Host and CCI in a DAC 2.80.9 lab system:

1. CableCARD module is installed into a Host
2. CableCARD/Host Pairing Information is displayed on TV and recorded
3. Lab personnel adds, initializes and authorizes CableCARD module as DCT2000 – One way in DAC
4. CableCARD/Host pairing information is entered into CPMS, validation message is generated
5. Validation message is manually transferred to DAC (via FTP, disk, etc)
6. Utilizing a DAC script, the validation message is sent to the appropriate settop via the OOB

Figure 2 is a representation of how a lab system can support CableCARD/Host in a DAC 2.80.9 deployment. In this release of DAC code, the interface between the CPMS and the DAC is a manual process and in most instances the CPMS will be located at a Motorola Engineering facility. Dial-in access to the CPMS is available 24/7.



SYSTEM SUPPORT FOR CABLECARD/HOST

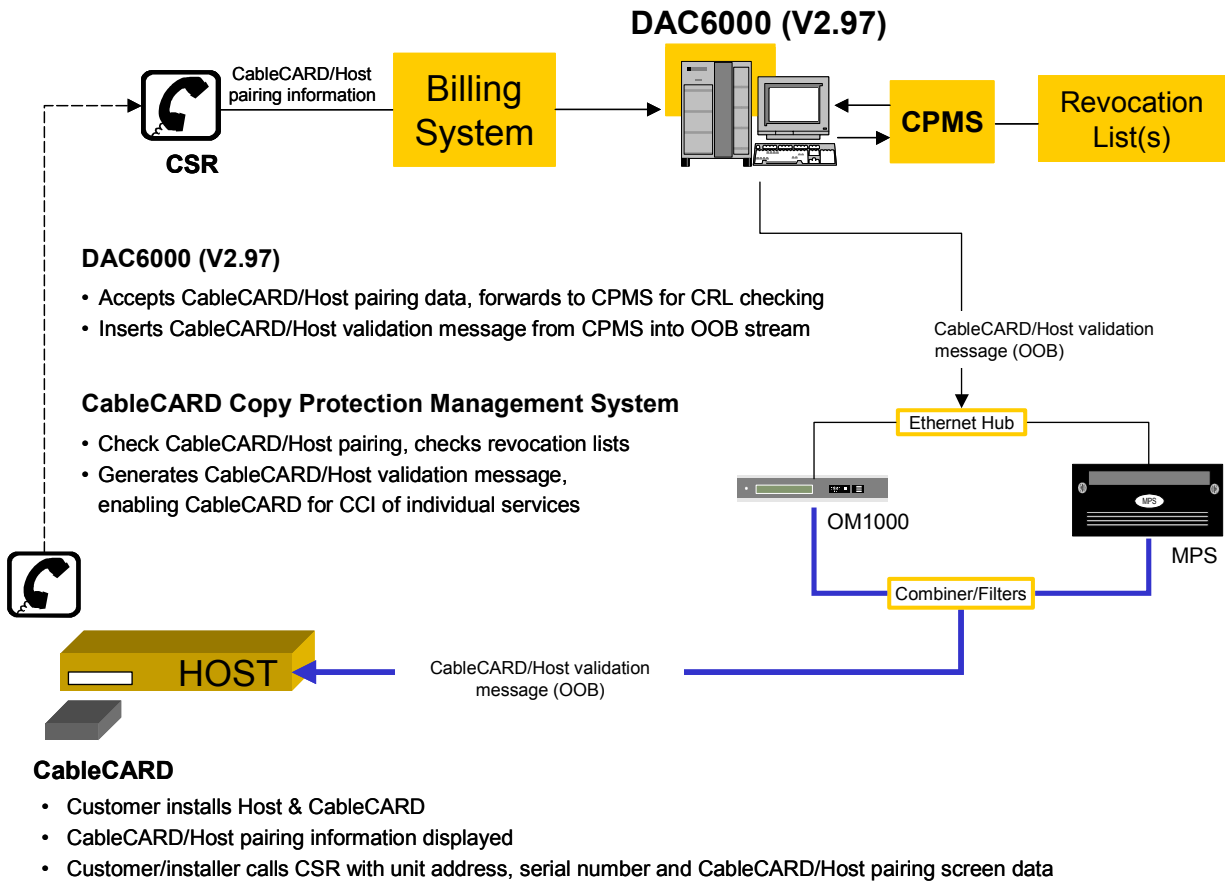
The DAC version 2.97 release will support automatic authentication and validation of CableCARD modules and Hosts as well as the ability to set CCI values on a service-by-service basis. Version 2.97 will also support the new Business System commands specified in Business System Correspondence 14 and soon Correspondence 15. These changes include additional CableCARD module and Host equipment types along with changes to several of the 700 series commands needed to support the CableCARD module and Host. MSOs must ensure that Business Systems vendors implement the required changes by the time CableCARD modules and Hosts are deployed. Prior to Business System support of these changes, this new information can be entered directly into the DAC database via the DAC GUI.

If a system has CableCARD modules installed prior to an upgrade to DAC 2.97 (i.e. 2.70, 2.80), a validation message must be sent to the CableCARD module after transitioning to the 2.97 release and prior to changing any of the service level CCI values from the default of Copy Freely. If the CableCARD module does not receive a “good” validation message and the CCI value is changed from the default, the CableCARD module will not decrypt the “high value” content encrypted by the CA System and the Host will be incapable of displaying that service. The Host will display the CableCARD/Host pairing

information when the user tunes to that service until a Host validation message is received. This could result in many customers phoning into the Cable Operator customer service center for assistance.

As discussed in the Early System Support of CableCARD/Host section, one way to circumvent this situation is to “capture and hold” the CableCARD/Host pairing information as part of the installation process. When the Billing System supports the CableCARD/Host pairing information interface to the DAC, the stored pairing information can be read into the Billing System (BS) and transmitted to the DAC, with subsequent transmission to the CPMS with a request for a validation message. The CPMS will respond to the request for the validation message and the DAC then transmits the validation message to the CableCARD module in the background. Once this procedure is performed for all installed CableCARD modules, the CCI value used may be changed from Copy Freely without interruption of service to customers.

Figure 3 is a representation of a typical system and the support of CableCARD/Host in a DAC 2.97 deployment.



In this release, the interface between the CPMS and the DAC is automated. The CPMS could be co-located with each DAC, or 1 CPMS can be used to service many DACs. The steps outlined below are utilized in the support of CableCARD/Host in a DAC 2.97 system:

1. CableCARD module is installed into a Host

2. CableCARD/Host Pairing Information is displayed on TV and recorded
3. Customer or Installer calls Cable Operator CSR with CableCARD module Unit Address, Serial Number, and CableCARD/Host Pairing Information

CSR adds, initializes and authorizes CableCARD module in Business System

4. CableCARD module information sent and added to DAC via Wirelink
5. DAC to forward CableCARD/Host pairing information to CPMS
6. CPMS to check CableCARD/Host pairing against revocation list
7. If OK, validation message is generated and sent to DAC
8. DAC inserts validation message into OOB

CPMS and CableCARD Availability

Lab Qualification		Production
CPMS	Dial-in access to Motorola CPMS, available now 24/7	September 2003
CableCARD module	Prototype CableCARD moduleS available for development and test	September 2003, 6 months order lead time

SOURCE NAME INFORMATION

The Source Name Table is a DAC-based file that allows the association of a text name for each service. This information is transmitted out-of-band according to the OpenCable specification and may be used by a host or TV receiver to display the program name associated with each virtual channel. In this context, a *source* is one specific source of video, text, data, or audio programming. The source name can be defined in such a way that every programming source (service) offered in the system can be uniquely identified. For example, HBO/E can be identified differently than either HBO-2 or HBO-3.

ACRONYMS

BCS	Broadband Communications Sector
BS	Business System
CA	Conditional Access
CCI	Copy Control Information
CE	Consumer Electronics
CPMS	Copy Protection Management System
CRL	Certification Revocation List
CSR	Customer Service Representative
DAC 6000	Digital Addressable Controller 6000
DCT	Digital Consumer Terminal
DTV	Digital Television
MMI	Man Machine Interface
MPS	Modular Processing System
NIC	Network Interface Card
OM	Out of Band Modulator
OOB	Out-of-Band
PC	Personal Computer
PCMCIA	Personal Computer Memory Card International Association
POD	Point of Deployment Module
RPD	Return Path Demodulator
SCTE	Society of Cable and Telecommunications Engineers
STB	Set Top Box
TV	Television
VCR	Video Cassette Recorder