OpenCable™ Host Device Core Functional Requirements

OC-SP-HOST-CFR-I15-031121

ISSUED SPECIFICATION

Notice

Document Status Sheet

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Work in Progress	An incomplete document, designed to guide discussion and generate feedback which may include several alternative requirements for consideration.
Draft	A document in specification format considered largely complete, but lacking review by Members and vendors. Drafts are susceptible to substantial change during the review process.
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Closed	A static document, reviewed, tested, validated, and closed to further engineering change requests to the specification through CableLabs.

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION (Informative)

1.1 OpenCable Overview

The goal of the OpenCable specifications is to define a new generation of host devices that are interoperable across cable systems in North America. Information is presented in this document in order to help define the range of capabilities and applications to be supported by digital set-top boxes (Set-top Host Device) and integrated terminal devices (Terminal Host Device). Information on the OpenCable Project can be obtained from the OpenCable website http://www.opencable.com.

The OpenCable specifications:

1. Provide for integrated environments for broadcast services (analog and digital) and real-time interactive multimedia services, including IP data services (program synchronous and asynchronous), IP voice communications, video telephony, and on-demand interactive applications. Multiple models of OpenCable Host Devices are expected to co-exist within any given system, allowing the network operator to offer various services.
2. Require openness and interoperability. OpenCable takes advantage of "open" computing and network architectures, wherever possible, to minimize costs and maximize the ability to include new technologies as they become available and affordable. "Open" is defined as adherence to, either international standard, North American standard, or published *de facto* industry standard. In all cases, the acquisition of the necessary software, hardware, and intellectual properties will be achievable at fair and reasonable costs. All standard interfaces will be in the public domain or, if such technology standards are to be defined, they will be available for license at a fair and reasonable cost. Closed proprietary systems are to be avoided.
3. Require portability. Retail availability of cable navigation devices is required in compliance with the FCC's 1996 Telecom Reform Act. The OpenCable system permits "point-of-deployment decisions" for network, security and operator-programmed user interfaces enable the anticipated variety of retail devices.
4. Define a renewable and replaceable core encryption system (point-of-deployment (POD) module). The POD is called the CableCARD™ device, and will be referred to as CableCARD throughout this document.
5. Provide cable Multiple System Operators (MSOs) the ability to inform the navigation device (Host) of the services (video, Internet, etc.) that are offered.
6. Present a migration path from uni-directional to bi-directional networks and from broadcast to real-time interactive applications. Media servers and the related hardware (e.g., disk storage, switch fabric, modulators) will support the incremental addition of the required components to preserve any existing investment while taking advantage of more cost-effective solutions. In addition, the system software will be designed to scale efficiently as more interactive applications are added and service offerings expand. Of particular note are "authentication" and "name" services, data base services, fault tolerance, and recovery mechanisms.
7. Allow efficient application and network design by:
    - Improving quality of service and/or reducing the bit rate of a digital stream through improved compression and transmission technologies; for example, by using improved MPEG-2 encoders and higher constellation digital modulation techniques.
    - Optimizing the use of network capacity. During the broadcast applications phase, bandwidth is allocated to accommodate broadcast digital program streams. As systems migrate to real-time interactive applications, the system will make efficient use of the network resources by dynamically allocating bandwidth.

- Developing applications designed to use network resources efficiently, varying their behavior according to the network's resource availability.
- Minimizing the network resources required when the consumer "turns on" the terminal device.

8. Maximize compatibility with existing and/or newly installed operational and customer support systems. All interfaces developed specifically for this effort will be integrated into the current and/or newly installed billing support systems.
9. Co-exist with the embedded base of existing set-top devices.

1.2 OpenCable Host Overview

This document describes the all the requirements for all ten forms of OpenCable Host Devices. These devices include a Bi-directional Set top Box (BDCS); Bi-directional Terminal (BDCT); Uni-directional STB (UDCS); Uni-directional Terminal (UDCT); Bi-directional Set-top Host Device with OCAP 1.0 (OBDCS); Bi-directional Terminal with OCAP 1.0 (OBDCT); Advanced STB (ADVS); Advanced Terminal (ADVT); HD Set-top Host Device (HDS) and Advanced HD Set-top Host Device (AHDS). A graphical representation of the ten possible OpenCable Host Devices is shown below; in the diagram each type of host device must meet the requirements for the device(s) below it.

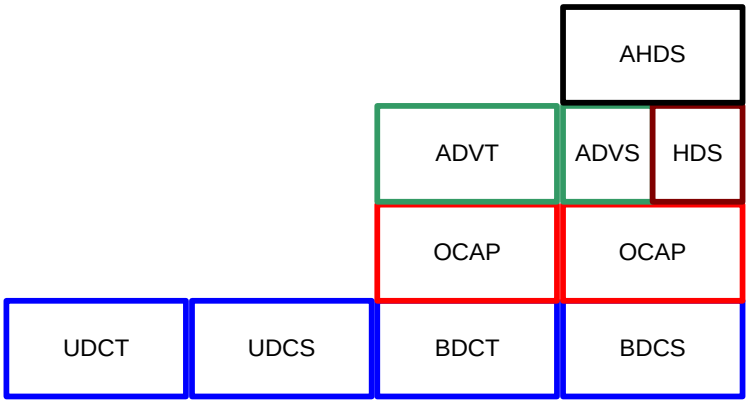


Figure 1 - OpenCable Host Device Types

The table below gives more detail on the distinct functionality of each of the ten OpenCable Host Device types.

Table 1 - Host Type Overview Matrix

Host Type / *Features*				*Two-way communi-cation?*	OOB Signaling		*Internal High Definition Decoder?*	*Digital Interfaces*		*OCAP*	
					Legacy	*DOCSIS*		*1394+5C*	*DVI+HDCP*	*"1.0"*	*"2.0"*
Set-Top Hosts	**Unidirectional Set-top**			No	One-way	No	No	Yes (source)	No	No	No
	Bidirectional Set-top boxes	**Standard Definition**	Bi-directional Set-top	Yes	Yes	No	No	Yes (source)	No	No	No
			Bi-directional Set-top with OCAP	Yes	Yes	No	No	Yes (source)	No	Yes	No
			Advanced Set-top	Yes	Yes	Yes	No	Yes (source)	Output Optional	Yes	Yes
		High Definition	High Definition Set-top	Yes	Yes	No	Yes	Yes*	Output Required	Yes	No
			Advanced High Definition Set-top	Yes	Yes	Yes	Yes	Yes*	Output Required	Yes	Yes
Integrated Hosts	**Unidirectional Terminal**			No	One-way	No	Yes	Optional	Input Required, Output Optional	No	No
	Bidirectional Terminals		Bi-directional Terminal	Yes	Yes	No	Yes	Yes (sink)	Input Required, Output Optional	No	No
			Bi-directional Terminal with OCAP	Yes	Yes	No	Yes	Yes (sink)	Input Required, Output Optional	Yes	No
			Advanced Terminal	Yes	Yes	Yes	Yes	Yes (sink)	Input Required, Output Optional	Yes	Yes

* 1394+ 5C is required at a minimum to support VCR functions as a source.

The goals and objectives of the OpenCable Host Devices are:

- To be developer-friendly.
- To support non-scrambled analog services as well as new scrambled or in-the-clear digital services.
- To be sold through retail channels directly to the customer.
- To receive digital premium (scrambled) cable services via an interface with a CableLabs Qualified CableCARD Device.
- To optionally support interactive and two-way services through standardized OOB data channels and direct connection to the cable plant.

The unique goals and objectives of the Advanced Host are to provide a host device with an embedded DOCSIS®-compatible High Speed Cable Modem for out-of-band data transport.

Information on the OpenCable Project can be obtained from the OpenCable website at http://www.opencable.com/, and information on the DOCSIS specifications can be found at the DOCSIS web site at http://www.cablemodem.com/.

1.3 Compliance Notation

Throughout this document, the words used to provide normative statements are capitalized as shown below:

MUST / SHALL	These words or the adjective "REQUIRED" means that the item is an absolute requirement of this specification.
MUST NOT / SHALL NOT	These phrases mean that the item is an absolute prohibition of this specification.
SHOULD	This word or the adjective "RECOMMENDED" means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
SHOULD NOT	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

1.4 Glossary of Terms

This document uses the following terms:

OpenCable Host Device	A cable receiver that is compliant with any of the hardware profiles defined by this specification. These profiles include: • Bi-directional Set-top Box (BDCS); • Bi-directional Terminal (BDCT); • Uni-directional Set-top Box (UDCS); • Uni-directional Terminal (UDCT); • Bi-directional Set-top with OCAP 1.0 (OBDCS); • Bi-directional Terminal with OCAP 1.0 (OBDCT); • Advanced Set-Top (ADVS); • Advanced Terminal (ADVT); • HD Set-top Host Device (HDS); and • Advanced HD Set-top Host Device (AHDS).
Set-top Host Device	A cable receiver that has no integrated display and is compliant with the BDCS, UDCS, OBDCS, ADVS, HDS or the AHDS profiles defined by this specification.
Terminal Host Device	A cable receiver that includes an integrated display and is compliant with the BDCT, UDCT, OBDCT, or the ADVT profiles defined by this specification.

Bi-directional Host Device	An OpenCable Host Device that includes the return data channel and is compliant with the BDCS, BDCT, OBDCS, OBDCT, ADVS, ADVT, HDS or the AHDS profiles defined by this specification.
Uni-directional Host Device	A compliant OpenCable Host Device that does not include the return data channel and is compliant with the UDCS or the UDCT profiles defined by this specification.
Advanced Host Device	A Host Device that includes support for: • an OpenCable Application Platform (OCAP) implementation, running on the Host • a standardized mechanism for downloading OCAP software • a standardized Out-of-Band messaging channel implemented via an embedded cable modem
HD Set-top	An OpenCable set-top device that includes internal hardware for the decode of High Definition MPEG streams and is compliant with the HDS or AHDS profiles defined by this specification.
OpenCable-compatible Digital TV	A digital television that includes an IEEE-1394 interface which is fully compliant with ANSI/SCTE 26, [19], and EIA/CEA-849-A (US profile).
Embedded Cable Modem	A DOCSIS-compatible cable modem that is integrated into the customer premise equipment.
Network Controller	This is the computer system responsible for managing the Hosts within a cable system. It manages Hosts through control and information messages sent via a dedicated Out-Of-Band channel.
Out-Of-Band Messaging	The control and information messages sent from the Network Controller to one or more Hosts requiring a dedicated channel containing Out-Of-Band Messaging. This includes the following types of messages: • Conditional Access (CA) messages including entitlements • System Information (SI) messages • Electronic Program Guide (EPG) messages • Emergency Alert System (EAS) messages • Other generic messages
CableCARD	A CableCARD device, also referred to as “Point of Deployment” (POD) module, is a detachable device distributed by cable providers that connects to the home receiver. The interface between the CableCARD device and the receiver is specified by the OpenCable platform. CableCARD functionality includes copy protection and signal demodulation.

1.5 Abbreviations and acronyms

ADVS	**Advanced Set-Top**
ADVT	**Advanced Terminal**
AHDS	**Advanced HD Set-top Host Device**
BDCS	**Bi-directional Set-top Box**
BDCT	**Bi-directional Terminal**
CA	**Conditional Access**
CM	**Cable Modem**
CMTS	**Cable Modem Termination System**
DDWG	**Digital Display Working Group**
DOCSIS®	**Data-Over-Cable Service Interface Specifications**
DSG	**DOCSIS Set-top Gateway**
DTCP	**Digital Transmission Content Protection**
DTLA	**Digital Transmission Licensing Administrator**
DVI	**Digital Video Interface**
DVS	**Digital Video Subcommittee**
EAS	**Emergency Alert System**
EPG	**Electronic Program Guide**
FAT Channel	**Forward Application Transport Channel**
FDC	**Forward Data Channel**
HD	**High Definition**
HDCP	**High-Bandwidth Digital Content Protection**
HDS	**HD Set-Top Host Device**
HDTV	**High Definition Television**
HFC	**Hybrid Fiber/Coax**
IP	**Internet Protocol**

MAC	**Media Access Control**
MMI	**Man Machine Interface**
MPEG	**Motion Picture Expert Group**
MTA	**Media Terminal Adaptor**
OBDCS	**Bi-directional Set-top with OCAP 1.0**
OBDCT	**Bi-directional Terminal with OCAP 1.0**
OCAP	**OpenCable Application Platform**
OC Host	**OpenCable Host Device**
OOB	**Out-Of-Band**
POD Module	**Point Of Deployment Module (now known as CableCARD Device)**
RDC	**Reverse Data Channel**
SCTE	**Society of Cable Telecommunications Engineers**
SD	**Standard Definition**
SI	**System Information**
TCP	**Transmission Control Protocol**
UDP	**User Datagram Protocol**
UDCS	**Uni-directional Set-top Box**
UDCT	**Uni-directional Terminal**

1.6 List of Requirements Applied to Each Hardware Profile

	Set-top Host Devices		Terminal Host Devices	
REQUIREMENT	**Bi-directional (BDCS) see Note[1]**	**Uni-directional (UDCS)**	**Uni-directional (UDCT)**	**Bi-directional (BDCT) see Note[2]**
● = Required ◉ = Conditional Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable				
STT-BDI-C-1	●	●	●	●
STT-BDI-C-2	●	●	●	●
STT-BDI-C-3	●	n/a	n/a	●
STT-BDI-C-3a	n/a	●	●	n/a
STT-BDI-C-3b	●	n/a	n/a	n/a
STT-BDI-C-3c	n/a	●	n/a	n/a
STT-BDI-C-4	●	●	●	●
STT-BDI-C-5	●	●	n/a	n/a
STT-BDI-C-5a	n/a	n/a	◉	◉
STT-BDI-C-6	●	●	n/a	n/a
STT-BDI-C-6a	n/a	n/a	◉	◉
STT-BDI-C-7	●	●	n/a	n/a
STT-BDI-C-7a	n/a	n/a	◉	◉
STT-BDI-C-8	●	●	●	●
STT-BDI-C-115	●	●	●	●
STT-BDI-C-116	◉	n/a	n/a	◉
STT-BDI-C-9	●	●	●	●
STT-BDI-C-10	●	●	●	●
STT-BDI-C-11	●	●	●	●
STT-BDI-C-12	●	●	●	●
STT-BDI-C-13	●	●	●	●
STT-BDI-C-14	●	●	●	●
STT-BDI-C-15	●	●	●	●
STT-BDI-C-16	●	●	●	●
STT-BDI-C-17	●	●	●	●
STT-BDI-C-18	●	⊘	⊘	●
STT-BDI-C-19	●	⊘	⊘	●
STT-BDI-C-20	●	⊘	⊘	●
STT-BDI-C-84	⊘	●	●	⊘
STT-BDI-C-100	●	●	●	●
STT-BDI-C-21	●	●	●	●
STT-BDI-C-22	●	●	●	●
STT-BDI-C-85	n/a	●	●	n/a
STT-BDI-C-23	●	●	●	●
STT-BDI-C-66	●	●	●	●
STT-BDI-C-67	●	●	●	●
STT-BDI-C-86	n/a	●	●	n/a
STT-BDI-C-87	●	⊘	⊘	●
STT-BDI-C-92	●	●	●	●
STT-BDI-C-93	●	●	●	●

[1] These also apply to OBDCS, ADVS, HDS & AHDS
[2] These also apply to OBDCT, ADVT

	Set-top Host Devices		Terminal Host Devices	
REQUIREMENT	**Bi-directional (BDCS) see Note[1]**	**Uni-directional (UDCS)**	**Uni-directional (UDCT)**	**Bi-directional (BDCT) see Note[2]**
● = Required ◉ = Conditional Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable				
STT-BDI-C-94	●	●	●	●
STT-BDI-C-94a	●	●	●	●
STT-BDI-C-96	●	●	●	●
STT-BDI-C-68	●	●	●	●
STT-BDI-C-69	●	●	●	●
STT-BDI-C-24	●	●	n/a	n/a
STT-BDI-C-24a	n/a	n/a	◉	◉
STT-BDI-C-25	●	●	n/a	n/a
STT-BDI-C-25a	n/a	n/a	◉	◉
STT-BDI-C-26	●	●	n/a	n/a
STT-BDI-C-27	●	●	n/a	n/a
STT-BDI-C-27a	n/a	n/a	◉	◉
STT-BDI-C-28	●	●	n/a	n/a
STT-BDI-C-28a	n/a	n/a	◉	◉
STT-BDI-C-29	●	●	n/a	n/a
STT-BDI-C-29a	n/a	n/a	◉	◉
STT-BDI-C-30	●	●	n/a	n/a
STT-BDI-C-30a	n/a	n/a	◉	◉
STT-BDI-C-31	●	●	n/a	n/a
STT-BDI-C-32	●	●	n/a	n/a
STT-BDI-C-32a	n/a	n/a	◉	◉
STT-BDI-C-33	●	●	n/a	n/a
STT-BDI-C-34	●	●	n/a	n/a
STT-BDI-C-35	●	●	n/a	n/a
STT-BDI-C-35a	n/a	n/a	◉	◉
STT-BDI-C-36	●	●	n/a	n/a
STT-BDI-C-37	●	●	n/a	n/a
STT-BDI-C-37a	n/a	n/a	◉	◉
STT-BDI-C-88	n/a	n/a	◉	◉
STT-BDI-C-88a	n/a	n/a	◉	◉
STT-BDI-C-88b	◉	◉	n/a	n/a
STT-BDI-C-112	n/a	n/a	●	●
STT-BDI-C-113	n/a	n/a	●	●
STT-BDI-C-114	n/a	n/a	●	●
STT-BDI-C-38	●	●	●	●
STT-BDI-C-39	●	●	●	●
STT-BDI-C-40	●	●	●	●
STT-BDI-C-41	●	●	●	●
STT-BDI-C-42	●	●	●	●
STT-BDI-C-43	●	●	●	●
STT-BDI-C-44	●	●	●	●
STT-BDI-C-45	●	●	●	●
STT-BDI-C-46	●	●	●	●
STT-BDI-C-46a	⊘	⊘	●	●
STT-BDI-C-47	●	●	●	●
STT-BDI-C-47a	⊘	⊘	●	●

	Set-top Host Devices		Terminal Host Devices	
REQUIREMENT	**Bi-directional (BDCS) see Note[1]**	**Uni-directional (UDCS)**	**Uni-directional (UDCT)**	**Bi-directional (BDCT) see Note[2]**
● = Required ◉ = Conditional Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable				
STT-BDI-C-48	●	●	●	●
STT-BDI-C-48a	⊘	⊘	●	●
STT-BDI-C-49	●	●	●	●
STT-BDI-C-49a	⊘	⊘	●	●
STT-BDI-C-50	●	●	●	●
STT-BDI-C-90	●	●	●	●
STT-BDI-C-91	●	●	●	●
STT-BDI-C-51	●	●	n/a	n/a
STT-BDI-C-51a	n/a	n/a	●	●
STT-BDI-C-51b	◉	◉	n/a	n/a
STT-BDI-C-51c	n/a	n/a	●	●
STT-BDI-C-52	●	●	●	●
STT-BDI-C-52a	◉	◉	◉	◉
STT-BDI-C-53	●	●	●	●
STT-BDI-C-54	◉	◉	n/a	n/a
STT-BDI-C-54a	n/a	n/a	◉	◉
STT-BDI-C-54b	○	○	○	○
STT-BDI-C-54c	◉	◉	n/a	n/a
STT-BDI-C-54d	n/a	n/a	◉	◉
STT-BDI-C-54e	◉	◉	n/a	n/a
STT-BDI-C-54f	n/a	n/a	◉	◉
STT-BDI-C-54g	◉	◉	◉	◉
STT-BDI-C-97	●	●	●	●
STT-BDI-C-98	●	●	●	●
STT-BDI-C-55	●	●	●	●
STT-BDI-C-56	●	●	n/a	n/a
STT-BDI-C-57	●	●	n/a	n/a
STT-BDI-C-70	●	●	n/a	n/a
STT-BDI-C-99	●	●	n/a	n/a
STT-BDI-C-101	●	●	n/a	n/a
STT-BDI-C-102	●	●	n/a	n/a
STT-BDI-C-58	●	●	●	●
STT-BDI-C-59	●	●	n/a	n/a
STT-BDI-C-59a	n/a	n/a	◉	◉
STT-BDI-C-59b	●	●	n/a	n/a
STT-BDI-C-59c	n/a	n/a	◉	◉
STT-BDI-C-60	●	●	●	●
STT-BDI-C-71	●	●	●	●
STT-BDI-C-61	●	●	n/a	n/a
STT-BDI-C-62	●	●	●	●
STT-BDI-C-63	●	●	●	●
STT-BDI-C-64	●	n/a	n/a	●
STT-BDI-C-73	●	●	●	●
STT-BDI-C-74	●	●	●	●
STT-BDI-C-75	●	●	●	●
STT-BDI-C-76	●	●	●	●

	Set-top Host Devices		Terminal Host Devices	
REQUIREMENT	**Bi-directional (BDCS) see Note[1]**	**Uni-directional (UDCS)**	**Uni-directional (UDCT)**	**Bi-directional (BDCT) see Note[2]**
● = Required ◉ = Conditional Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable				
STT-BDI-C-77	●	●	●	●
STT-BDI-C-78	●	●	●	●
STT-BDI-C-79	●	●	●	●
STT-BDI-C-80	●	⊘	⊘	●
STT-BDI-C-81	◉	⊘	⊘	◉
STT-BDI-C-82	●	●	●	●
STT-BDI-C-83	●	●	◉	◉
STT-BDI-C-65	●	●	●	●
STT-BDI-C-72	●	●	●	●

1.6.1 List of Requirements Applied to Each Hardware Profile for OCAP 1.0 Implementation

OpenCable Host Devices that implement OCAP 1.0 shall comply with all of the bi-directional requirements of Section 1.6 and in addition shall support the following requirements:

REQUIREMENT	Bi-directional Set-top Host Devices with OCAP 1.0 (ODBCS)	Bi-directional Terminal Host Devices with OCAP 1.0 (OBDCT)
● = Required ◉ = Conditiona1 Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable		
STT-BDI-C-103	●	●
STT-BDI-C-104	●	●
STT-BDI-C-105	●	●
STT-BDI-C-106	●	●
STT-BDI-C-107	●	●
STT-BDI-C-108	●	●
STT-BDI-C-109	●	●
STT-BDI-C-110	●	●
STT-BDI-C-111	●	●

1.6.2 List of Requirements Applied to Each Hardware Profile for Advanced Host Implementations

OpenCable Advanced Host Devices shall comply with all of the bi-directional requirements of Section 1.6 and all of the OCAP 1.0 requirements in section 1.6.1. Additionally, an OpenCable Advanced Host Device shall support the following requirements:

REQUIREMENT	Advanced Set-top Host Devices	Advanced Terminal Host Devices
● = Required ◉ = Conditiona1 Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable		
ADV-BDI-001	●	●
ADV-BDI-002	●	●
ADV-BDI-003	●	●
ADV-BDI-004	●	●
ADV-BDI-005	●	●
ADV-BDI-006	●	●
ADV-BDI-007	●	●
ADV-BDI-008	●	●
ADV-BDI-009	●	●
ADV-BDI-010	●	●
ADV-BDI-011	●	●
ADV-BDI-012	●	●
ADV-BDI-013	●	●

1.6.3 List of Requirements Applied to OpenCable High Definition Set-top Host Hardware Profile

OpenCable High Definition Set-top Devices and Advanced High Definition Set-top Host Devices shall comply with all of the bi-directional requirements of Section 1.6 with the following exceptions:

- STT-BDI-C-51b is **Mandatory** for the OpenCable High Definition Set-top Device.
- STT-BDI-C-57 is **Optional** for the OpenCable High Definition Set-top Device.
- STT-BDI-C-70 is **Optional** for the OpenCable High Definition Set-top Device.
- STT-BDI-C-99 is **Optional** for the OpenCable High Definition Set-top Device.

An OpenCable High Definition Set-top Host Device shall also comply with all of the OCAP 1.0 requirements in section 1.6.1 and the High Definition requirements listed below.

An Advanced High Definition Set-top shall also comply with all of the OCAP 1.0 requirements in section 1.6.1, all of the Advanced Set-top requirements in section 1.6.2, and the High Definition requirements listed below.

REQUIREMENT	High Definition Set-top Host Devices and Advanced High Definition Set-top Host Devices
● = Required ◉ = Conditiona1 Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable	
HD-BDI-001	●
HD-BDI-002	●
HD-BDI-003	●
HD-BDI-004	●
HD-BDI-005	●

REQUIREMENT	High Definition Set-top Host Devices and Advanced High Definition Set-top Host Devices
● = Required ◉ = Conditiona1 Mandatory ○ = Optional ⊘ = Not Permitted n/a = Not Applicable	
HD-BDI-006	○
HD-BDI-007	●
HD-BDI-008	●
HD-BDI-009	●
HD-BDI-010	●
HD-BDI-011	●
HD-BDI-012	◉
HD-BDI-013	◉
HD-BDI-013a	◉
HD-BDI-014	●
HD-BDI-014a	●
HD-BDI-015	◉
HD-BDI-016	◉
HD-BDI-017	◉
HD-BDI-018	●
HD-BDI-019	●
HD-BDI-020	●
HD-BDI-021	●
HD-BDI-022	●
HD-BDI-023	○
HD-BDI-024	●
HD-BDI-025	●
HD-BDI-025a	●
HD-BDI-026	●
HD-BDI-027	●
HD-BDI-028	●
HD-BDI-029	●
HD-BDI-030	●

2 OVERVIEW OF CORE SERVICES AND FUNCTIONALITIES

2.1 OpenCable Host Device components

This section describes the core services that OpenCable Host Devices MUST support as well as the core functions required to implement those services. A block diagram of the OpenCable Bi-directional Set-top Host Device components is shown in Figure 2.

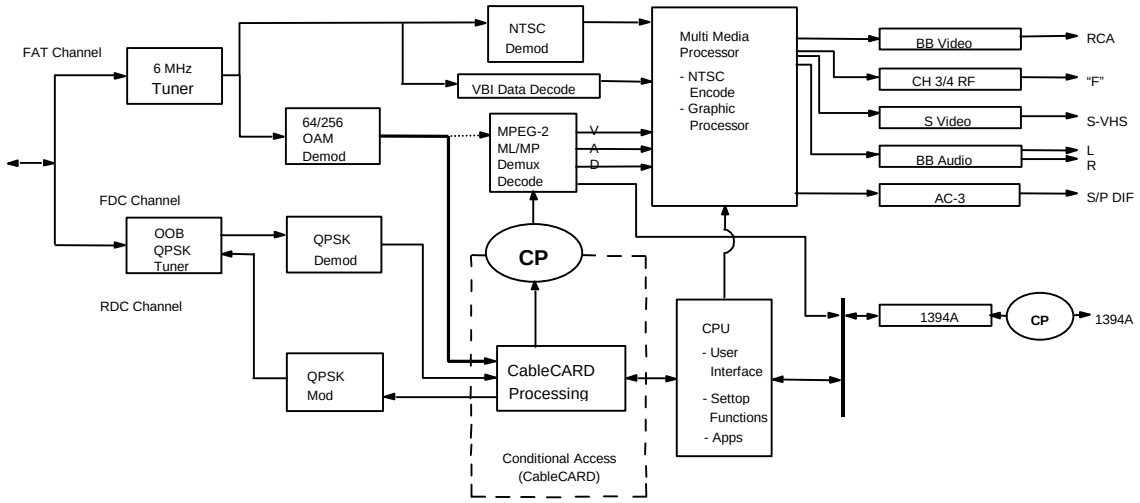


Figure 2 - Block Diagram of the OpenCable Bi-directional Set-top Host Device (Informative)

The OpenCable Host Device receives multimedia information by tuning to one of many 6 MHz input channels available via a bi-directional or uni-directional cable connection. When the input channel is an analog channel, the signal is processed via the NTSC decoder and the VBI data decoder. When the input channel is a digital channel, it is processed via the QAM demodulator and then passed to the CableCARD Device where secure and scrambled information are processed. Non-scrambled information is passed through the CableCARD Device to the MPEG-2 Transport Demultiplexer. When the CableCARD Device is not inserted, the output of the QAM demodulator is routed directly to the MPEG-2 Transport Demultiplexer. The multi-media processor handles the synchronization and display of audio-visual material.

The OpenCable Host Device also receives control information and other data by tuning to an out-of-band (OOB) Forward Data Channel (FDC) channel. The terminal will remain tuned to the OOB forward data channel to continuously receive information. This information is passed to the CableCARD Device for processing, and relevant information is passed back to the OpenCable Host Device.

The bi-directional OpenCable Host Device transmits information via an out-of-band (OOB) Reverse Data Channel (RDC).

2.1.1 Core Services (Informative)

The following services can be provided by the Core Requirements for OpenCable Host Devices:

- Analog NTSC audio-visual programming: (clear, non-scrambled).
- Digital standard definition audio-visual programming utilizing MPEG-2 main profile @ main level video and Dolby AC-3 audio: broadcast (clear), subscription-based (scrambled), music channels, call-ahead Pay-Per-View (PPV) (scrambled) for all OpenCable Host Devices and additionally, Impulse Pay-Per-View (scrambled) for Bi-directional Host Devices.
- Call-ahead Pay-Per-View is a paid service in which the viewer pre-subscribes selected programming via telephone.
- Impulse Pay-Per-View is a paid service in which the viewer subscribes for selected programming via the user-interface of the terminal.
- Support of digital high definition audio-visual programming by pass through or full decoding, dependent on OpenCable Host Device type, as defined in requirements below.

2.1.2 Core Functions and Features (Informative)

The features and functions of the OpenCable Host Device necessary to support the core services include the following, depending on OpenCable Host Device type:

- 864 MHz, analog and digital (64/256 QAM) tuning and demodulation
- Closed Caption pass-through for analog video (line 21, fields 1 and 2) output when input is analog video
- Closed Caption reinsertion into the VBI of reconstructed analog video output when input is digital video
- Copy protection on analog and digital outputs
- Emergency Alert System (compliant with SCTE 18 2001 (formerly DVS 208): Emergency Alert Message for Cable, [20])
- QPSK out-of-band receiver (compliant with ANSI/SCTE 55-2 2002 (formerly DVS 167): March 10, 2002, Digital Broadband Delivery System: Out-of-Band Transport – Mode B, [17], and ANSI/SCTE 55-1 2002 (formerly DVS 178): February 25, 2002, Digital Broadband Delivery System: Out-of-Band Transport Part 1: Mode A, [18])
- QPSK out-of-band transmitter (compliant with [17] and [18])
- Standard I/Os: analog NTSC RF Channel 3/4 output
- Support for RF bypass
- Baseband Video output
- L&R Baseband Audio outputs
- SP/DIF Digital Audio output
- High speed IEEE-1394 digital interface (see ANSI/SCTE 26 2001 (formerly DVS 194): Home Digital Network Interface Specification with Copy Protection, [19])
- CableCARD digital interface with copy protection (see OpenCable CableCARD Interface Specification, [10] and OpenCable CableCARD Copy Protection System Specification [11])
- Optional processing of interactive services
- DOCSIS out-of-band channel DOCSIS Set-top Gateway (DSG) Interface Specification, SP-DSG-I01-020228, [33]

- An embedded DOCSIS-compatible cable modem compliant with Data-Over-Cable Service Interface Specifications, Radio Frequency Interface Specification, [30]
- High-definition analog (CEA/EIA-770.3B component analog video specification)
- Digital Visual Interface (DVI digital video specification) interfaces
- OpenCable Application Platform (OCAP) Middleware

2.2 OpenCable Advanced Host Device Profiles

The Advanced Host Device Profiles are derived from existing OpenCable and DOCSIS specifications. In particular, the Advanced Host Device Profiles are derived from the Bi-directional OpenCable Host Device Profiles as specified in this document. The Advanced Host Device Profiles differ from the Bi-directional OpenCable Host Device Profiles in the following two ways:

- It incorporates an embedded DOCSIS-compatible cable modem, as specified in the Data-Over-Cable Service Interface Specifications [30].
- It details how the reverse transmitter is allocated to either the Reverse Data Channel (RDC) physical communication paths detailed in the CableCARD Interface [10] or the DOCSIS-compatible upstream channel detailed in [30].

The transport of out-of-band messaging that is provided by the FDC/RDC in the Bi-directional OpenCable host has been expanded to include the additional capability of DOCSIS transport in accordance with the DOCSIS Set-top Gateway (DSG) Interface Specification [33]. The Advanced Host Profile operates either in a mode that is compatible with the Bi-directional OpenCable Host FDC/RDC or in a mode that is compatible with the DSG. Once the CableCARD Device determines which mode to use, only that mode of operation is used for the remainder of the session. Because the Host can not assume which mode is supported on the network, both modes must be available within the Host.

2.3 OpenCable Advanced Host Device Components

This section details the deviations of the Advanced Host from the Bi-directional OpenCable Host. Figure 3 shows the applicable diagram of the Advanced Host.

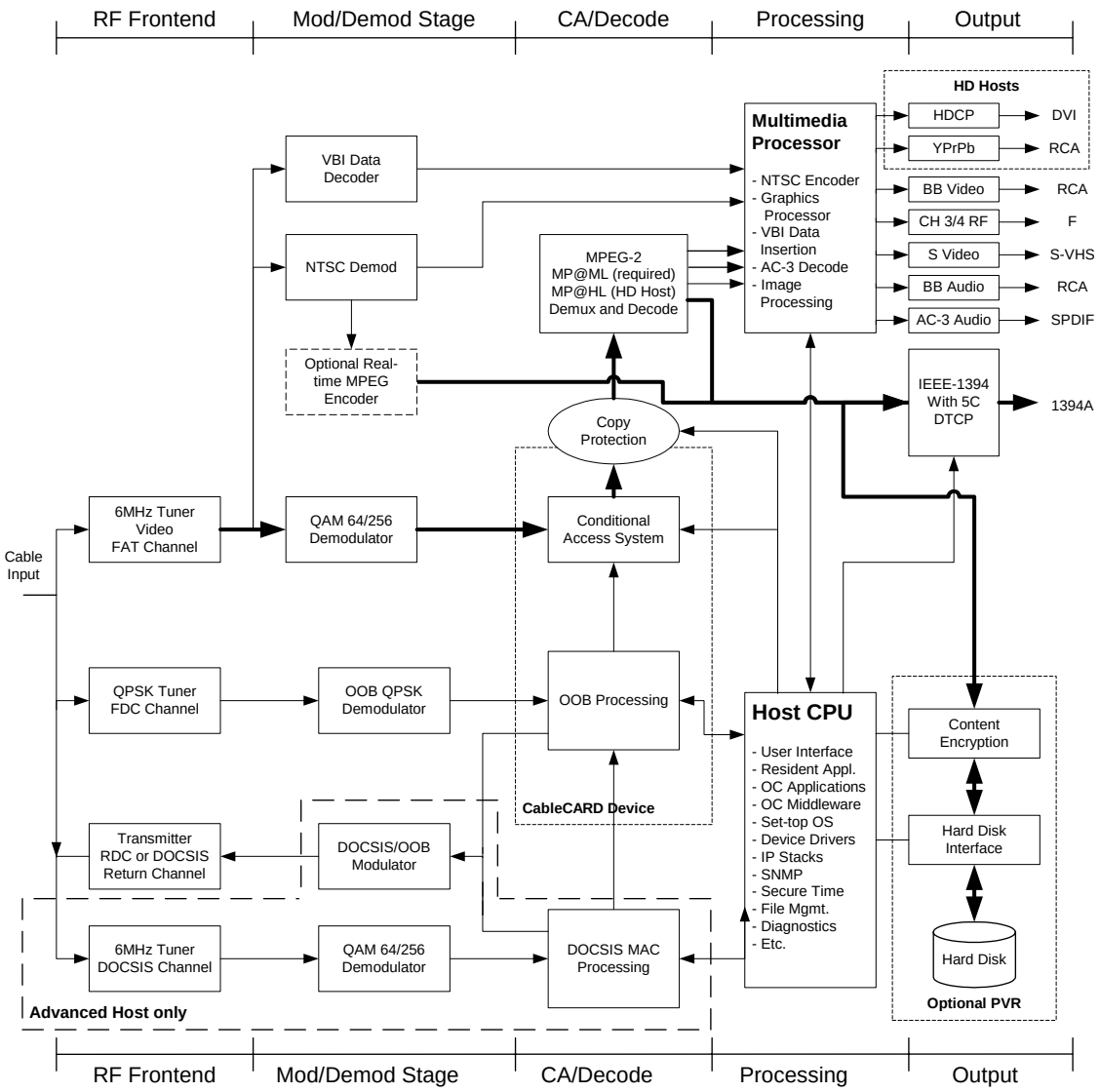


Figure 3 - Block Diagram of the OpenCable Advanced Host (Informative)

Based on the network configuration, the Advanced Host may receive control information and other data by either tuning to an out-of-band (OOB) Forward Data Channel (FDC) channel or via the embedded DOCSIS-compatible cable modem. Which of these two alternatives is used by the network is communicated by the CableCARD Device to the Host via the CableCARD Interface [10]. The transport of the OOB messaging received over this channel is detailed in the DOCSIS Set-top Gateway (DSG) Interface Specification [33].

Based on the network configuration, the Advanced Host transmits information either via an out-of-band (OOB) Reverse Data Channel (RDC) or over IP via the DOCSIS return channel. Again, which of these two alternatives is supported by the network configuration is communicated by the CableCARD Device to the Host via the CableCARD Interface [10].

2.4 General Compliance (Normative)

Any features of an OpenCable Host Device mandated by law or FCC regulation (e.g., Emergency Alert System, V-Chip) SHALL be supported in the Core Requirements for all OpenCable Host Devices.

STT-BDI-C-1-:	The OpenCable Host Device manufacturer SHALL confirm compliance with all applicable FCC rules and regulations.
STT-BDI-C-2:	The OpenCable Host Device manufacturer SHALL confirm compliance with all applicable UL rules and regulations.
STT-BDI-C-3:	The Bi-directional Host Device SHALL comply with the specifications described in: Table 2 - Analog and FAT Channel: RF Performance Parameters, Table 3 - FDC Channel: RF Performance Parameters, Table 4 - Adjacent Channel Characteristics, Table 6 - Reverse Data Channel RF & Modulation Performance Parameters, Table 8 - Composite Analog Video Output Performance Parameters, Table 9 - Analog Video Output Performance, Table 10 - Compression Format Constraints for OpenCable Host Device Processing Table 11 - Compression Format Constraints for HD Decoding & Pass Through, Table 13 - Baseband Audio Output when a Digital Service is Selected, Table 14 - Baseband Audio Output with Analog Service*, and Table 15 - Environmental / Mechanical Requirements below.
STT-BDI-C-3a:	The Uni-directional Host Device SHALL comply with the specifications described in Table 2 - Analog and FAT Channel: RF Performance Parameters, Table 3 - FDC Channel: RF Performance Parameters Table 4 - Adjacent Channel Characteristics, Table 8 - Composite Analog Video Output Performance Parameters, Table 9 - Analog Video Output Performance, Table 10 - Compression Format Constraints for OpenCable Host Device Processing, Table 11 - Compression Format Constraints for HD Decoding & Pass Through, Table 13 - Baseband Audio Output when a Digital Service is Selected Table 14 - Baseband Audio Output with Analog Service*, and Table 15 - Environmental / Mechanical Requirements below.
STT-BDI-C-3b:	The Bi-directional Set-Top Host Device SHALL comply with STT-BDI-C-3 and the specifications described in: Table 7 - Channel 3/4 RF Output Performance Parameters (0° - 40° C), Table 12 - RF Output
STT-BDI-C-3c:	The Uni-directional Set-Top Host Device SHALL comply with STT-BDI-C-3a and the specifications described in Table 7 - Channel 3/4 RF Output Performance Parameters (0° - 40° C), Table 12 - RF Output

3 SECURITY

This section describes requirements for copy protection of video programs, security of video streams, conditional access to video streams, and security of transmitted data.

3.1 Conditional Access

STT-BDI-C-4:	The OpenCable Host Device SHALL utilize the CableCARD Device to perform the following Conditional Access functions as defined in EIA-679-B (Part B): National Renewable Security Standard, March 2000 [15]: decryption, authorization, entitlement, and key generation. These functions SHALL be implemented in the CableCARD Device [10] and not in the OpenCable Host Device. If conditional access functionality is present in the OpenCable Host Device, it MUST be disabled under all circumstances, including the absence of a CableCARD Device.

3.2 Analog Program Copy Protection

STT-BDI-C-5:	The Set-top Host Device SHALL be capable of adding analog copy protection to NTSC outputs from digital programs, in accordance with the [Macrovision] standard. The control of Macrovision is handled in the APS bits as defined in the OpenCable Copy Protection Specification [11].
STT-BDI-C-5a:	If the Terminal Host Device includes analog video outputs, it SHALL be capable of adding analog copy protection to NTSC outputs from digital programs in accordance with the [Macrovision] standard. The control of Macrovision is handled in the APS bits as defined in the OpenCable Copy Protection Specification, [11].
STT-BDI-C-6:	The Set-top Host Device SHALL include analog program copy protection, which is software controllable on a per-program basis.
STT-BDI-C-6a:	If the Terminal Host Device includes analog video outputs, it SHALL include analog program copy protection, which is software controllable on a per-program basis.

3.3 Digital Program Copy Protection

STT-BDI-C-7:	The Set-top Host Device SHALL support the copy protection requirements as defined by the 5C Digital Transmission Content Protection Specification. (Use of the technology defined in this specification is subject to licensing by Digital Transmission Licensing Administrator, dtla@dtcp.com.).
STT-BDI-C-7a:	If the Terminal Host Device includes an IEEE-1394 [9] digital interface, it SHALL support the copy protection requirements as defined by the 5C Digital Transmission Content Protection Specification. (Use of the technology defined in this specification is subject to licensing by Digital Transmission Licensing Administrator, dtla@dtcp.com.).
STT-BDI-C-8:	The OpenCable Host Device SHALL implement the OpenCable Copy Protection Specification, [11].
STT-BDI-C-115:	The OpenCable Host Device SHALL only change its CCI value when a channel change occurs or a new CCI value is received from the CableCARD Device or the OCAP Monitor Application.
STT-BDI-C-116:	In the event the Host receives conflicting CCI messages from the CableCARD Device and the OCAP Monitor Application, the OpenCable Host Device SHALL only respond to the CCI value received from the CableCARD Device.

3.4 HD Copy Control

The following describe the requirements on the HD Set-top to ensure protection of HD content when required.

Control of copy control mechanisms on high-definition outputs is determined by the OCAP Monitor Application and/or the status of CCI bits. The cable operator determines the control policy through agreements between the operator and the content provider, and asserts that policy with the Monitor Application and the CCI bits.

HD-BDI-025:	HD Set-tops that comply with this specification MUST provide output control and resolution reduction for controlled content on all outputs in accordance with specific instructions provide by the Monitor Application as defined in Section 20 of OCAP 1.0 [26].
HD-BDI-025a:	HD Set-tops MUST have the functionality to give the Monitor Application the ability to turn off (disable, produce only a black screen, or display an error message) the outputs listed in [26] as requiring control.
HD-BDI-026:	High Definition outputs that comply with this specification MUST provide a "Constrained Image" when requested by the Monitor Application software. A Constrained Image MUST have the visual equivalent of not more than 520,000 pixels per frame (e.g. equivalent to an image with a resolution of 960 vertical lines by 540 horizontal lines for a 16x9 aspect ratio).
HD-BDI-027:	If a Constrained Image is created, it must be sent across the high definition interface with one of the scanning formats described in CEA-861B [35] for the DVI output or Table-1 of EIA/770.3-C [34] for the component video output. This may require up-converting the constrained image via interpolation or line doubling in order to match one of the output scanning formats.
HD-BDI-028:	HD Set-tops that comply with this specification MUST provide a way for the software running on the set-top, in particular the OCAP Monitor Application, to determine the status of copy control mechanisms on digital output ports. This includes the DTCP status of the 1394 port, and the HDCP status of the DVI port.

4 BI-DIRECTIONAL PHYSICAL LAYER CHARACTERISTICS

4.1 RF Interface

The mechanical and electrical interface between the cable TV system and the OpenCable Host Device SHALL be as defined in EIA-23 Section 3, with the additional requirements specified in the remainder of this document.

4.1.1 Maximum Individual Carrier Amplitude

The OpenCable Host Device SHALL be capable of meeting the FAT and FDC channel performance requirements in the presence of interfering signals where the maximum rms value of any individual interfering signal SHALL NOT exceed the following limits (measured across 75 Ω):

0.5 Mhz to 42 MHz	+42 dBmV
42 Mhz to 52 Mhz	0 dBmV
52 Mhz to 54 MHz	-17 dBmV

The maximum rms value of any individual signal whose frequency exceeds 54 MHz is less than +20 dBmV across a 75 ohm terminating impedance measured at the input to the Host Device.

4.2 Communication Channels

The OpenCable Host Device SHALL have the following communication channels:

1. Forward Application Transport (FAT) channel, which carries MPEG-2 Programs.
2. Analog channels with Vertical Blanking Interval (VBI) signals for closed captioning, as may be required.
3. Forward Data Channel (FDC).

In addition to the above communication channels, bi-directional, HD set-top and Advanced Host Device Profiles SHALL also support the Reverse Data Channel (RDC).

Advanced Host Device Profiles SHALL also support an embedded two-way DOCSIS-compatible cable modem [30].

The FDC and RDC are referred to as out-of-band (OOB) channels.

Frequency bands for each channel SHALL be 54 to 864 MHz (FAT channel) and 70 to 130 MHz (OOB FDC channel) and 5 to 42 MHz (OOB RDC channel).

4.2.1 Forward Application Transport (FAT) Channel

The forward application transport channel is a 64 or 256 [14] Quadrature Amplitude Modulation (QAM) channel that transports 27 or 39 megabits/second, respectively. The OpenCable Host Device is instructed to tune to a particular FAT channel when a subscriber requests a service that requires transport on a FAT channel. FAT channels can be present and will adhere to the standard, HRC or IRC frequency plans of EIA/CEA-542-A: Cable Television Channel Identification Plan, [4], and can be located anywhere in the 54 to 864 MHz range.

STT-BDI-C-9:	The OpenCable Host Device SHALL be capable of receiving and demodulating a Forward Application Transport channel with either 64 or 256 QAM modulation.
STT-BDI-C-10:	The OpenCable Host Device SHALL be compliant with ANSI/SCTE 07 [14] for the transmission physical layer modulation, coding, synchronization, and Error Correction.
STT-BDI-C-11:	The OpenCable Host Device SHALL decode the Forward Application Transport channel over the range of input levels for the Forward Application Transport channel as defined in Table 2 "FAT Channel RF & Modulation Performance" included herein.
STT-BDI-C-12:	The Forward Application Transport tuner SHALL have agility over the frequency range of 54 to 864 MHz.

4.2.2 NTSC Analog Channels

The OpenCable Host Device SHALL receive analog channels that are NTSC RF AM-VSB modulated signals in accordance with current cable-system practice and applicable FCC rules. NTSC Analog channels will adhere to the standard, HRC or IRC frequency plans of [4] and can be located anywhere in the 54 to 864 MHz range.

4.2.2.1 Vertical Blanking Interval

The Vertical Blanking Interval (VBI) contains data on line 21 of an analog television signal. During this period, the headend can insert VBI data signals on VBI line 21 for closed captioning. VBI data can be inserted within field 1, field 2, or both, on any analog channel operating in the 54 to 864 MHz range.

STT-BDI-C-13:	The OpenCable Host Device SHALL include circuitry required to pass through closed captions, text mode data services, and extended data services data that is on the VBI line 21 (field 1 and 2) of NTSC programming, to all NTSC analog video outputs. The format of this data is defined in FCC 47 CFR Chapter 1 (10-1-98 Edition), Part 15, [7], and EIA 708B, [6].

4.2.3 Out-Of-Band Signaling

4.2.3.1 OOB-FDC and OOB-RDC

The RF front end provides the generic QPSK physical layer common to the OpenCable choices. These have the following characteristics:

Forward receiver:	1.544/3.088 Mbps and 2.048 Mbps
Reverse transmitter:	1.544/3.088 Mbps and 256 Kbps

Based on the network configuration the Out-of-Band Messaging for the Advanced Host is implemented either over the OOB-FDC and OOB-RDC communication channels or over the DOCSIS communication channel. Which of these two OOB Messaging alternatives is to be used by the Host is communicated by the CableCARD Device to the Host via the CableCARD Interface.

STT-BDI-C-14:	The OpenCable Host Device SHALL be capable of receiving and demodulating an Out-of-Band Forward Data channel with QPSK modulation.
STT-BDI-C-15:	The OpenCable Host Device SHALL be compliant with [17] and [18] for the OOB FDC and OOB RDC transmission physical layer modulation, coding, synchronization, and Error Correction.
STT-BDI-C-16:	The OpenCable Host Device SHALL decode the Out-of–Band Forward Data channel over the range of input levels as defined in Table 3 - FDC Channel: RF Performance Parameters included herein.
STT-BDI-C-17:	The Forward Data channel tuner SHALL have agility over the frequency range of 70 to 130 MHz and be able to tune any nominal carrier frequency defined in Table 3, item 4 as directed by the CableCARD Device.
STT-BDI-C-18:	Bi-directional Host Devices SHALL have an Out–of–Band Reverse Data channel transmitter operating at QPSK modulation, but can only be used under control of the CableCARD Device.
STT-BDI-C-19:	Bi-directional Host Devices SHALL transmit the Out–of–Band Reverse Data channel over the range of output levels as defined in Table 3 - FDC Channel: RF Performance Parameters included herein.
STT-BDI-C-20:	The Reverse Data channel transmitter SHALL have agility over the frequency range of 5 to 26.5 MHz. All OpenCable bi-directional Host Devices delivered after December 31, 2000 SHALL support the frequency range of 5 to 42 MHz.
STT-BDI-C-84:	Uni-directional Host Devices SHALL physically disconnect a Reverse Data Channel (RDC) Transmitter, if present.

For complete information, see Digital Broadband Delivery System, Out-of-Band Transport, [17], and [18].

4.2.3.2 DOCSIS

ADV-BDI-001:	Out-of-Band Messaging for the Advanced Host MUST be implemented in accordance with the DOCSIS Set-top Gateway (DSG) Interface Specification [33].

4.3 Physical Layer Specifications

4.3.1 In-Band Downstream Channel, FDC Characteristics and RF Performance

STT-BDI-C-100:	The OpenCable Host Device SHALL meet all performance requirements while operating with the downstream transmission characteristics defined by SCTE 40 2003 (formerly DVS 313): Digital Cable Network Interface Standard [23].

The Physical Layer RF Performance Specifications are contained in Table 2 - Analog and FAT Channel: RF Performance Parameters, and Table 3 - FDC Channel: RF Performance Parameters, as provided below.

STT-BDI-C-21:	The OpenCable Host Device SHALL use a female “F” connector meeting SCTE specification [13] for the RF video input.
STT-BDI-C-22:	The “F” connector for RF video input on the OpenCable Host Device SHALL be labeled “Cable In.”

Table 2 - Analog and FAT Channel: RF Performance Parameters (0° - 40° C)

1.	RF Input Channel Bandwidth	6 MHz
2.	RF Input Tuning Range	54 MHz to 864 MHz IRC/HRC/Standard Channel Plans
3.	RF Input Return Loss	6 dB minimum over full tuning range
4.	RF Input Impedance	75 ohm unbalanced
5.	RF Input Level Range	Analog visual carrier(c) from 0 dBmv minimum to +15 dBmv maximum; Analog aural carrier from -10 to -17 dBc; Digital QAM 64 signal from -15 dBmv to +15 dBmv; Digital QAM 256 signal from -12 dBmv to +15 dBmv
6.	AGC Range	NTSC baseband video output level variation of not more than ±1 dB with the analog visual carrier or digital QAM signal input level ranges stated above. *(See Note 1)*
7.	AFC Range	Better than ±125 kHz or nominal tuning resolution of 62.5 kHz
8.	LO Leakage (Input EMC)	-37 dBmV over 54 MHz to 864 MHz
9.	Conversion Isolation: RF Input to Converted RF Output	65 dB minimum; where isolation is defined here as the ratio between the converted signal and the unconverted signal present at the channel 3/4 RF output. This parameter SHALL be met with the output measured on the same frequency as the input of the converter, and applies to all assigned input carrier frequencies over the input level range defined in 5 above. *(See Note 2)*
10.	RF Bypass Isolation	60 dB minimum over the input tuning range (54-864 MHz) when internal RF bypass option is installed. *(See Note 2)*
11.	CTB	Not worse than -63 dBc Channel loading assumptions: At least 110 AM-VSB channels at input level of +15 dBmV, at least 20 QAM channels at RF input level of +5 dBmV. *(See Note 2)*
12.	X-Mod.	Not worse than -57 dBc Channel loading assumptions: At least 110 AM-VSB channels at input level of +15 dBmV, at least 20 QAM channels at RF input level of +5 dBmV. *(See Note 2)*
13.	CSO	Not worse than -60 dBc Channel loading assumptions: At least 110 AM-VSB channels at input level of +15 dBmV, at least 20 QAM channels at RF input level of +5 dBmV. *(See Note 2)*
14.	Spurious Emissions within the output channel (channel 3/4) bandwidth	Not worse than -60 dBc Channel loading assumptions: At least 110 AM-VSB channels at input level of +15 dBmV, at least 20 QAM channels at RF input level of +5 dBmV. *(See Note 2)*
15.	Spurious Emissions outside the output channel (other than channel 3/4)	Not worse than -10 dBc *(See Note 2)*
16.	Signal Leakage/RFI	Per FCC 47 CFR Chapter 1 (10-1-98 Edition), Part 15 – Radio Frequency Devices, Class B [7]
17.	AM Hum Modulation	Not greater than 3% p-p *(See Note 2)*
18.	Adjacent Channel Rejection	60 dB min *(See Note 2)*

19.	(This Parameter deleted)	
20.	Group Delay Variation Tolerance	≤ 0.25 μsec/MHz across the 6-MHz channel
21.	Phase Noise Tolerance	≤ -88 dB/Hz @ 10 kHz offset (relative to the center of QAM signal spectrum)
22.	Amplitude Ripple Tolerance Digital channels Analog channels	 ≤ 5 dB p-p within the 6 MHz channel ≤ 4 dB p-p within the 6 MHz channel
23.	Microreflection Tolerance (assumes one dominant echo with max. specified amplitude in dB relative to the primary QAM signal)	-10 dB at < 0.5 μsec -15 dB at < 1 μsec -20 dB at < 1.5 μsec -30 dB at < 4.5 μsec Echoes > 4.5 μs*ec (see Note 3*)
24.	Burst Noise Tolerance	Not longer than 25 μsec at 10 Hz repetition rate
25.	Image Rejection *(See Note 2)*	Image response less than 60 dBc at final IF or baseband video output, 54 to 714 Mhz Image response less than 50 dBc at final IF or baseband video output, 714 to 860 Mhz 60dB standard to apply at 714 Mhz Two equal power CW signals, +15 dBmv $F_{image} = F_{desired} + 90$ Mhz
26.	Spurious Emissions, 5 – 864 MHz	< -37 dBmV

Table Notes:

1. *Applicable only when analog video outputs are provided.*
2. *Applicable only when converted RF outputs are provided.*
3. *Micro-reflection longer than 4.5 microseconds rarely occur in conventional cable television systems. Moreover, very low-level micro-reflections (e.g., -40dB) longer than 4.5 microseconds cannot be measured reliably with readily available instruments. Studies on the subject of long Micro-reflections are continuing, which may result in quantifying this parameter at a future date.*

Table 3 - FDC Channel: RF Performance Parameters (0° - 40° C)

1.	Transmission Rate	1.544/3.088 Mbps [17] 2.048 Mbps [18]
2.	RF Input Channel Spacing	1.0/2.0 MHz [17] 1.8 MHz [18]
3.	RF Input Tuning Range	70 MHz to 130 MHz
4.	Nominal carrier frequency	Any integer multiple of 250 kHz between the minimum and maximum carrier frequencies, inclusive and the specific fixed frequency of 104.200 MHz.
5.	Frequency acquisition range	+/- 50 ppm
6.	RF Input level range	-15 to +15 dBmV rms (75 ohms) (*See Note 1*)
7.	Differential Encoding	The differential encoder SHALL accept bits (A, B) in sequence and generate phase changes as follows: A B Phase Change default alternative 0 0 none none 0 1 +90 deg -90 deg 1 0 -90 deg +90 deg 1 1 180 deg 180 deg
8.	(This parameter deleted)	
9.	(This parameter deleted)	
10.	Group Delay variation tolerance	200 ns max in channel, measured over Nyquist bandwidth
11.	Channel Tune / Carrier acquisition time	< 500ms
Table Notes: *1. See section 4.3.1.1 for the variation in level between adjacent channels*		

4.3.1.1 DOCSIS Downstream

The downstream RF performance parameters for the embedded DOCSIS-compatible cable modem of the Advanced Host are detailed in [30].

4.3.1.2 RF Signal Levels and Adjacent Channel Characteristics

4.3.1.2.1 RF Signal Levels

The OpenCable Host Device SHALL be capable of receiving an analog signal with a visual signal level that is within ± 3 dB of the visual signal level of any adjacent analog channel (within a 6 MHz nominal frequency separation as specified in FCC 47 CFR Chapter 1 (10-1-98 Edition), Part 76 – Cable Television Service [8]).

To determine the adjacent channel characteristics between digital and analog signals, the following information is provided. The nominal relative carrier power levels for analog and digital signals are given by:

Analog channel:	0 dBc (reference level)
256 QAM FAT:	-5 ± 2 dBc
QPSK FDC:	-8 ± 5 dBc
64 QAM FAT:	-10 ± 2 dBc

The OpenCable Host Device SHALL be capable of receiving a digital signal with an average RMS signal power that is within ± 6 dB of its nominal level with respect to the nominal level of the adjacent channel digital or analog signal.

It is noted that the nominal carrier power levels provided above fall within the absolute power range for digital signals, -15 dBmV to +15 dBmV. The analog signal power is measured as the peak envelope power (PEP), which is the average RMS carrier power measured during horizontal sync level. The digital signal power is measured as the average RMS signal power.

4.3.1.2.2 Adjacent Channel Characteristics

The OpenCable Host Device SHALL be capable of receiving digital and analog signals with "Worst Case" Adjacent Channel performance as characterized in Table 4 - Adjacent Channel Characteristics, provided below.

Table 4 - Adjacent Channel Characteristics

	Desired (D) Channel Modulation	Undesired (U) Adjacent Channel Modulation	Worst Case D/U Ratio*
1.	Analog NTSC	64-QAM	-1 dB
2.	Analog NTSC	256-QAM	-6 dB
3.	Analog NTSC	QPSK FDC	-6 dB
4.	64-QAM	Analog NTSC	-21 dB
5.	64-QAM	256-QAM	-21 dB
6.	64-QAM	QPSK FDC	-21 dB
7.	256-QAM	Analog NTSC	-16 dB
8.	256-QAM	64-QAM	-11 dB
9.	256-QAM	QPSK FDC	-16 dB
10.	QPSK FDC	Analog NTSC	-22 dB
11.	QPSK FDC	64-QAM	-17 dB
12.	QPSK FDC	256-QAM	-22 dB
* Independent of the D/U ratios, the C/(N+I) and the absolute signal levels range shall meet the requirements for those parameters as described elsewhere in the specification.			

4.3.1.2.3 Ranges for Digital Signals

Independently of meeting the requirements specified in Sections 4.3.1.2.1 and 4.3.1.2.2 above, the OpenCable Host Device SHALL be capable of receiving digital signals that fall within the ranges specified in Table 2 (QAM signals) and Table 3 (QPSK FDC signals).

4.3.1.3 Spurious Emissions from Uni-directional Host Devices

STT-BDI-C-85: OpenCable Uni-directional Host Devices SHALL limit all spurious emissions according to the table shown below.

Table 5 - In Band Downstream Spurious Emissions

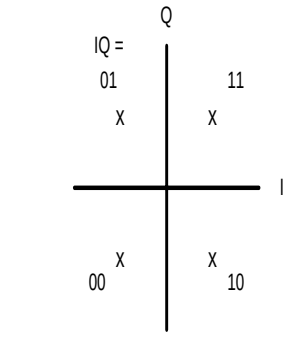
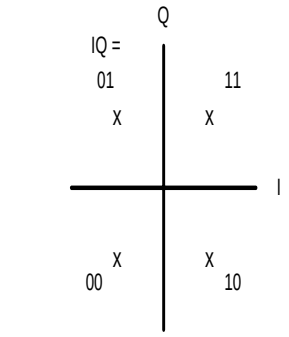
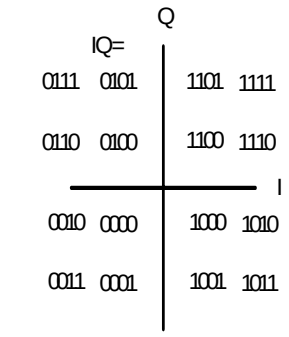
Item	Parameter	Uni-directional Host Requirement
1.	Spurious Emissions, 5 – 864 MHz	< -37 dBmV

4.3.2 Upstream Transmission Characteristics

The Upstream Transmission Characteristics are contained in Table 6 - Reverse Data Channel RF & Modulation Performance Parameters as provided below. The RF performance parameters for an OpenCable Advanced Host MUST meet the performance requirements from the combined OpenCable and DOCSIS return channel specifications, shown in the column marked Values for ADV-HOST Profiles.

Table 6 - Reverse Data Channel RF & Modulation Performance Parameters (0° - 40° C)

	Parameter	Values for all other Bi-Directional Profiles	Values for ADV-HOST Profiles
1.	Transmission Rate	1.544/3.088 Mbps SCTE 55-2 (formerly DVS 167 [17] 256 Kbps SCTE 55-2 (formerly DVS 178) [18]	256, 1544, 3088 Kbps 320, 640, 1280, 2560, 5120, 10240 Kbps
2.	Output Channel Spacing	1.0/2.0 MHz [17] 192 KHz [18]	192, 1000, 2000 KHz 200, 400, 800, 1600 and 3200 KHz
3.	Modulation type	QPSK only	QPSK and 16 QAM
4.	RF Output Frequency Range	5 MHz to 42 MHz	5 MHz to 42 MHz edge to edge
5.	Frequency Step Size Granularity *(Note 1)*	2 KHz	1 Hz
6.	Frequency Accuracy	+/- 50 ppm	The lesser of +/- 50 ppm or 10 Hz
7.	Differential Encoding	The differential encoder SHALL accept bits (A, B) in sequence and generate phase changes as follows: A B Phase Change default alternative 0 0 none none 0 1 +90 deg -90 deg 1 0 -90 deg +90 deg 1 1 180 deg 180 deg	The differential encoder SHALL accept bits (A, B) in sequence and generate phase changes as follows: A B Phase Change 0 0 none 0 1 +90 deg 1 0 -90 deg 1 1 180 deg

8.	Quadrant Mapping	 QPSK	 QPSK  16QAM
9.	Transmit spectral mask and excess bandwidth	As specified in [17] and [18]	See Section 4.2.10.4 of [30]
10.	Carrier suppression	> 30 dB	See Section 4.2.10.1 of [30]
11.	Carrier suppression: 4 symbols before start of first symbol of burst, or 4 symbols after end of last symbol.	> 35 dB	See Section 4.2.10.1 of [30]
12.	Carrier suppression when transmitter idle	> 60 dB with respect to level when transmitter is on	See Section 4.2.10.1 of [30]
13.	I/Q amplitude imbalance	< 1 dB	< 1dB
14.	I/Q phase imbalance	< 2 degree	< 2 degree
15.	Transmit level range at Host RF connector.	26 to 57 dBmV	+8 dBmV to 55 dBmV for 16 QAM +8 dBmV to 58 dBmV for QPSK
16.	Level step size	< 2 dB	1 dB
17.	Level absolute accuracy	< +/- 2 dB	< +/- 2 dB
18.	Level flatness, 4 - 42MHz	< 2 dB	See Section 4.2.10.1 of [30]
19.	Spurious outputs, 5 - 42 MHz	< -45 dBc	See Section 4.2.10.1 of [30]
20.	Harmonic outputs, 10 - 42MHz	< -45 dBc	See Section 4.2.10.1 of [30]
21.	Out-of-band spurious and harmonics, 54 – 864 MHz	< -37 dBmV	See Section 4.2.10.1 of [30]
22.	C/No, as measured +/- $f_w/2$ from center channel frequency, where f_w is the channel spacing. Carrier level > 35 dBmV	> 113 dB (1 Hz)	> 113 dB (1 Hz)

23.	C/No,–5 - 42 MHz when transmitter is idle	< - 105 dBmV (1 Hz) 75 ohms	< -105 dBmV (1 Hz) 75 ohms
24.	Return Loss, 75 ohms –8 - 14 MHz –4 - 26.5 MHz 26.5 – 42MHz	> 9 dB > 11 dB > 6 dB	> 9 dB > 11 dB > 6 dB
25.	Channel tune time	≤ 100 ms	< 100 ms
26.	Latency	Latency of the transmitter SHALL remain constant for a given symbol rate.	N/A

Table Notes:

1. *OpenCable Host Device implementations MAY be limited to all discrete frequencies defined in both [17] and [18].*

5 CABLECARD INTERFACE

The OpenCable Host Device provides an interface to the CableCARD Device to facilitate the processing of digital information, which is received over the forward application transport (FAT) channel and the OOB forward data channel (FDC). The Advanced Host Device Profiles provide an additional OOB channel using the DOCSIS Set-top Gateway DSG Tunnel [33]. The interfaces between the OpenCable Host Device (host) and the CableCARD Device are described in the OpenCable CableCARD Interface Specification, [10].

STT-BDI-C-23:	The OpenCable Host Device SHALL implement the CableCARD Interface according to [10].
STT-BDI-C-66:	The OpenCable Host Device SHALL be required to support transport stream interface data rates of 26.97035 Mb/s and 38.81070 Mb/s averaged over the period between the sync bytes of successive transport packets with allowable jitter of +/- one MCLKI clock period.
STT-BDI-C-67:	The OpenCable Host Device SHALL implement all aspects of the Host operation specified in [46], Point-of-Deployment (POD) Module Firmware Upgrade Host Interface.
STT-BDI-C-86:	The uni-directional Host Device SHALL NOT utilize signals ITX, QTX, ETX, and CTX.
STT-BDI-C-87:	The OpenCable Host Device SHALL report a Low_Speed_Communication Resource Identifier of 0x00605043 for a Host Device with Cable Return Channel, or 0x00608043 for a Host with a Host Modem (e.g. DOCSIS). If no Low Speed Communication Resource Identifier is reported by the OpenCable Host Device then the Host Device is assumed to be a FDC only device.

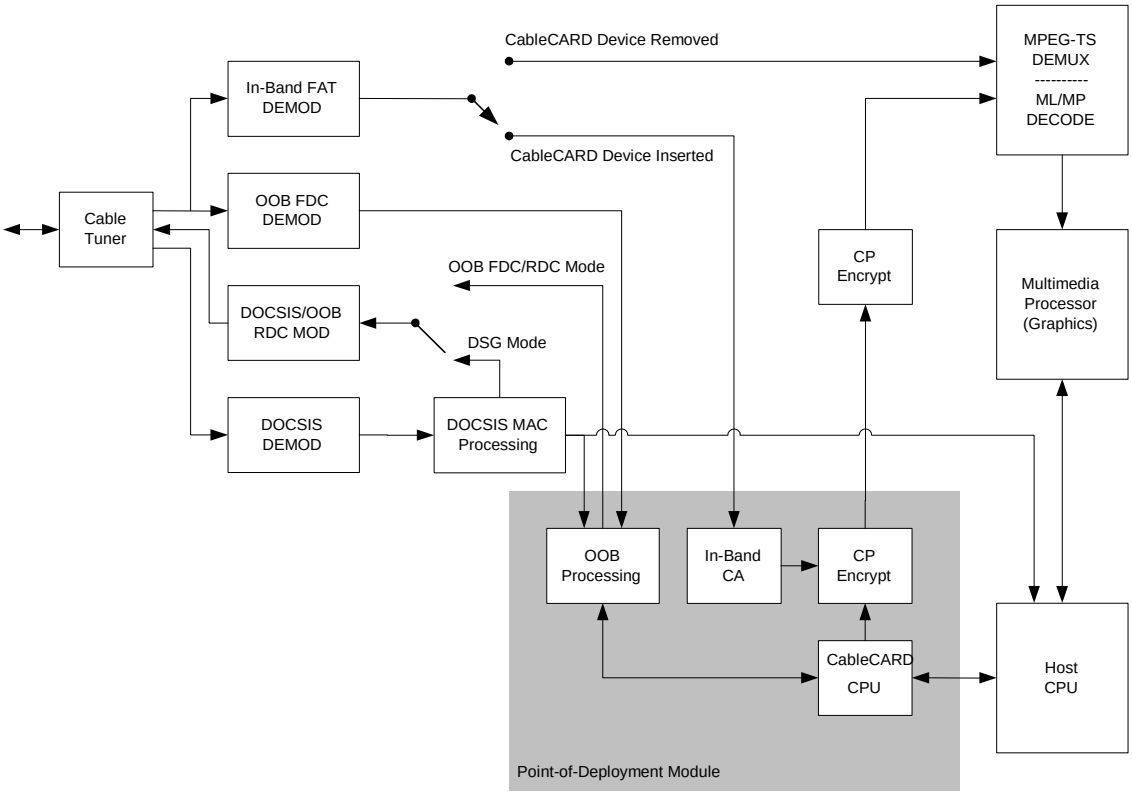


Figure 4 - Block Diagram of the OpenCable CableCARD Interface (Informative)

5.1 OpenCable Host Device Functionality without a CableCARD Device

The OpenCable Host Device SHALL function without a CableCARD security device and process the information received via the Analog and FAT channels directly. The Host SHALL have the following minimum performance characteristics without the CableCARD security device:

STT-BDI-C-92:	The OpenCable Host Device SHALL process and display unscrambled analog NTSC audio-visual programming transported in adherence to standard, HRC or IRC frequency plans EIA/CEA-542-A: Cable Television Channel Identification Plan [4].
STT-BDI-C-93:	The OpenCable Host Device SHALL discover, process and display unscrambled digital standard definition audio-visual programming according to Table 10 utilizing MPEG-2 main profile @ main level video and Dolby AC-3 audio and transported in adherence to standard, HRC or IRC frequency plans [4].
HD-BDI-001:	The HD Set-top SHALL discover, process and output to a display device digital standard- and high-definition audio-visual programming according to Table 11 utilizing MPEG-2 Main Profile @ High Level and Dolby AC-3 audio transported in the clear in adherence to standard HRC or IRC frequency plans of EIA/CEA-542-A .
STT-BDI-C-94:	When the OpenCable Host is operating without a CableCARD Device, and tuning digital transport streams containing multiple programs, each program SHALL be identified by the one-part channel number from the CVCT if present. Also, when the CVCT contains a two-part channel number for the program, the program SHALL be identified by the two-part channel number, and when the CVCT is not available, each program SHALL be identified by the two-part channel number from the TVCT.
STT-BDI-C-94a:	When the OpenCable Host is operating without a CableCARD Device any channel map created from OOB data while previously operating with a CableCARD Device SHALL not be used.
STT-BDI-C-96:	The OpenCable Host Device SHALL disable the Reverse Data Channel (RDC) transmit function.
ADV-BDI-002:	The Advanced Host Device MAY continue to use the DOCSIS return channel.

5.2 CableCARD Standby Power Management

The operation of the OpenCable Host Device in Standby mode is not defined in this document. The minimum requirements for Standby mode, however, SHALL include the following:

1. The Host OOB Receive circuitry MUST be fully powered.
2. The CableCARD Device MUST be fully powered.

5.3 Man Machine Interface (MMI) Support

The OpenCable Host Device MUST be capable of operating in a unidirectional system and MUST support copy protection in this operational case. As defined in the OpenCable Copy Protection System [11], for a unidirectional system, the copy protection system performs authorization utilizing the MMI resource.

STT-BDI-C-68:	The OpenCable Host Device SHALL support the MMI resource defined in the OpenCable CableCARD Interface Specification [10].
STT-BDI-C-69:	The OpenCable Host Device SHALL support a navigation method to allow user navigation with the MMI resource defined in [10].

5.4 OCAP 1.0 Implementation

Compliance with the requirements of this section is required only for OpenCable Host Devices that implement OCAP 1.0 [26].

STT-BDI-C-103: All OpenCable Host Devices that implement OCAP 1.0 SHALL support at least six concurrent MPEG_section *Service_type* flows.

STT-BDI-C-104: All OpenCable Host Devices that implement OCAP 1.0 SHALL support at least one *IP_U Service_type* flow.

STT-BDI-C-105: All OpenCable Host Devices that implement OCAP 1.0 SHALL support the Generic IPPV Resource defined in Section 7.10 of OpenCable CableCARD Interface Specification [10].

STT-BDI-C-106: All OpenCable Host Devices that implement OCAP 1.0 SHALL support the System Control Resource which is defined in Section 3.5 of OpenCable Common Download Specification [28].

STT-BDI-C-107: All OpenCable Host Devices that implement OCAP 1.0 SHALL support the Specific Application Support Resource which is defined in Section 7.1.1 of OpenCable CableCARD Interface Specification [10].

5.4.1 Extended Channel Support

In order for OCAP enabled devices to support IP Unicast, the OpenCable Host Device is required to have a unique MAC address specifically assigned to support IP Unicast over the CableCARD Interface. The MAC address will be utilized by the headend as a means to associate a requested IP address with the OpenCable Host Device. The first 24 bits of the MAC address shall consist of an Organizationally Unique Identifier (OUI) assigned to the OpenCable Host Device vendor by the IEEE. The remaining 24 bits of the MAC address shall consists of a unique 24-bit value that shall generated by the OpenCable Host Device vendor. The combination of the 48 bits shall create a unique 48-bit address for the OpenCable Host Device.

STT-BDI-C-108: If OCAP is supported, the OpenCable Host Device SHALL have a unique 48-bit MAC address specifically assigned to support IP Unicast over the CableCARD Interface.

STT-BDI-C-109: If OCAP is supported, the first 24 bits of the MAC address shall consist of an Organizationally Unique Identifier (OUI) assigned to an OpenCable Host Device vendor by the IEEE.

STT-BDI-C-110: If OCAP is supported, the remaining 24 bits of the MAC address shall consists of a unique 24-bit value that shall be generated by the OpenCable Host Device vendor.

STT-BDI-C-111: If OCAP is supported, the OpenCable Host Device shall not utilize the MAC address of the IEEE-1394 interface for the IP Unicast MAC address.

6 MULTI-MEDIA INTERFACES

The physical user interface seen by the cable subscriber SHALL have the following characteristics.

6.1 OpenCable Host Device Outputs

The required outputs from the Set-top Host Device are shown schematically in Figure 1 and detailed below. A Terminal Host Device MAY include those outputs in Figure 1. Copy protection must be applied as applicable to any of optional interfaces as defined in STT-BDI-C-5 through STT-BDI-C-8 above. Copy protection signaling is described in the OpenCable CableCARD Copy Protection System Specification [11].

The HD set-top will supply all of the outputs of the Bi-Directional set-top. The HD set-top will additionally have the outputs listed in section 14 of this document. This includes an optional analog component video output and the required digital High Definition DVI video output.

STT-BDI-C-24:	The Set-top Host Device SHALL have a RF-modulated output compliant with Table 7, Table 8, Table 9 and Table 12 below, which is subscriber configurable to analog NTSC channel 3 or 4. The default channel setting SHALL be configurable by the cable operator using the Generic Feature resource defined in [10].
STT-BDI-C-24a:	If the Terminal Host Device includes a RF-modulated output, that output SHALL be compliant with Table 7, Table 8, Table 9 and Table 12 below, which is subscriber configurable to analog NTSC channel 3 or 4. The default channel setting SHALL be configurable by the cable operator using the Generic Feature resource defined in OpenCable CableCARD Interface Specification [10].
STT-BDI-C-25:	The Set-top Host Device SHALL use a female “F” connector meeting SCTE specification [13] for the RF modulated output.
STT-BDI-C-25a:	If the Terminal Host Device includes a RF-modulated output, it SHALL use a female “F” connector meeting SCTE specification [13].
STT-BDI-C-26:	The “F” connector for a RF-modulated output on the Set-top Host Device SHALL be labeled “To TV/VCR”.
STT-BDI-C-27:	The Set-top Host Device SHALL have baseband video as defined by Table 8 and Table 9 and L&R baseband audio outputs as defined by Table 13 and Table 14.
STT-BDI-C-27a:	If the Terminal Host Device includes outputs, the baseband video outputs SHALL be defined by Table 8 and Table 9 and the L&R baseband audio outputs SHALL be defined by Table 13 and Table 14.
STT-BDI-C-28:	The Set-top Host Device SHALL use a female RCA phono connector for baseband video output.
STT-BDI-C-28a:	If the Terminal Host Device includes baseband video output, it SHALL use a female RCA phono connector.
STT-BDI-C-29:	The RCA phono connector for baseband video output on the Set-top Host Device SHALL have a yellow dielectric. This RCA phono connector SHALL be labeled “Video” or “Video Out”.
STT-BDI-C-29a:	If the Terminal Host Device includes a baseband video output, the RCA phono connector SHALL have a yellow dielectric. This RCA phono connector SHALL be labeled “Video” or “Video Out”.
STT-BDI-C-30:	The Set-top Host Device SHALL include a S-Video output that uses a female 4-pin connector.

STT-BDI-C-30a:	If the Terminal Host Device includes a S-Video output, it SHALL use the female 4-pin connector.
STT-BDI-C-31:	The 4-pin connector for S-Video output on the Set-top Host Device SHALL be labeled "S-Video".
STT-BDI-C-32:	The Set-top Host Device SHALL use female RCA phono connectors for left and right audio outputs.
STT-BDI-C-32a:	If the Terminal Host Device includes audio outputs, it SHALL use female RCA phono connectors for left and right audio outputs.
STT-BDI-C-33:	The RCA phono connector for the right audio output on the Set-top Host Device SHALL have a red dielectric. This RCA phono connector SHALL be labeled to indicate the function of right audio output, for example: "R", "Right" or "Right Audio".
STT-BDI-C-34:	The RCA phono connector for the left audio output on the Set-top Host Device SHALL have a white dielectric. This RCA phono connector SHALL be labeled to indicate the function of left audio output, for example: "L", "Left" or "Left Audio".
STT-BDI-C-35:	The Set-top Host Device SHALL use a female RCA phono connector for the S/P DIF audio output.
STT-BDI-C-35a:	If the Terminal Host Device includes a S/P DIF audio output, it SHALL use a female RCA phono connector or an IEC-61937 optical connector [40], or both.
STT-BDI-C-36:	The RCA phono connector for the IEC60958/61937 (S/P DIF) [40] audio output on the Set-top Host Device SHALL be labeled to indicate the function of the IEC60958/61937 (S/P DIF) audio output; for example "Digital Audio Output".
STT-BDI-C-37:	In order to support connections to multiple devices via the IEEE-1394 bus, the Set-top Host Device SHALL provide at least two 4-pin or 6-pin standard 1394 connectors operated as a source device. Both connectors MUST have the same number of pins.
STT-BDI-C-37a:	If the Terminal Host Device includes the IEEE-1394 interface, it SHALL provide at least two 4-pin or 6-pin standard IEEE-1394 connectors. Both connectors MUST have the same number of pins.

6.2 RF Output Requirements (Channel 3/4 RF Output)

Table 7 - Channel 3/4 RF Output Performance Parameters (0° - 40° C)

1.	RF Output Carrier Frequencies	Channels 3 & 4 standard
2.	RF Output Impedance	75 ohm, unbalanced
3.	RF Output Return Loss	Ch 3/4 RF output: 10 dB minimum for either channel
4.	Ch 3/4 RF Output Level	+4.5 dBmV to +15 dBmV
5.	Ch 3/4 RF Output Level Stability	Not vary more than ±1.5 dB
6.	Output Visual Carrier Frequency Accuracy	Within ±80 kHz or better
7.	Output Video Frequency Response for RF Output (worst case for analog NTSC or digital MPEG input signals)	-2 to +2 dB, -500 kHz to 3.75 MHz
8.	Terminal Contribution to Output Frequency Response for RF Output (worst case for analog NTSC or digital MPEG input signals)	-1 to +1 dB, -500 kHz to 3.75 MHz
9.	Output Visual/Aural Carrier Level Difference	Aural carrier is –10 to –17 dB relative to visual carrier level
10.	Output Visual/Aural Carrier Frequency Separation	4.5 MHz, ±5 kHz
11.	Output Depth of Modulation	85%, with variation not more than +5% to -2.5%
12.	Modulation Variation with APL	Not more than ±5%, relative to 50% APL over 10 % to 90% APL range
13.	Conversion Isolation: RF Input to Converted RF Output	65 dB minimum; where isolation is defined here as the ratio between the converted signal and the unconverted signal present at the channel 3/4 RF output. This parameter SHALL be met with the output measured on the same frequency as the input of the converter, and applies to all assigned input carrier frequencies over the input level range defined in 5 above.
14.	RF Bypass Isolation	60 dB minimum over the input tuning range (54-864 MHz) when internal RF bypass option is installed
15.	Spurious Emissions within the output channel (channel 3/4) bandwidth	Not worse than –60 dBc Channel loading assumptions: At least 110 AM-VSB channels at input level of +15 dBmV, at least 20 QAM channels at RF input level of +5 dBmV.
16.	Spurious Emissions outside the output channel (other than channel 3/4)	Not worse than –10 dBc
17.	AM Hum Modulation	Not greater than 3% p-p

6.3 OpenCable Host Device Inputs

STT-BDI-C-88:	If the Terminal Host Device includes an IEEE-1394 [9] digital interface, it SHALL provide at least two 4-pin or 6-pin standard IEEE-1394 connectors operated as a sink device. Both connectors MUST have the same number of pins.
STT-BDI-C-88a:	If the Terminal Host Device includes an IEEE-1394 [9] digital interface, it SHALL include copy protection as defined in STT-BDI-C-7 above, initialization and discovery as defined in STT-BDI-C-70 below, bit-mapped graphics support (profile 0b) as defined in Section 4.3.5 of [19], all normative elements of [24], and analog source switching as defined in Section 4.11 of [24].
STT-BDI-C-88b:	If the Set-top Host Device supports the sink function for the 1394 interface, it SHALL include copy protection on the [9] input as defined in STT-BDI-C-7 above, initialization and discovery as defined in STT-BDI-C-70 below, bit-mapped graphics support (profile 0b) as defined in Section 4.3.5 of [19], all normative elements of [24], and analog source switching as defined in Section 4.11 of [24].
STT-BDI-C-112:	A Terminal Host Device SHALL have a digital video interface compliant with the DVI-Digital (DVI-D) connector, which at a minimum supports the Single Link Transmission Minimized Differential Signaling as defined in Digital Display Working Group (DDWG) Digital Visual Interface (DVI) interface revision 1.0 [37].
STT-BDI-C-113:	The DVI interface on the Terminal Host Device SHALL employ the HDCP encryption system, as defined in the HDCP System specification [38].
STT-BDI-C-114:	The DVI input of a Terminal Host Device SHALL support the mandatory parts of [35] for a sink device. Other formats listed in [35] as optional MAY also be supported.

7 VIDEO

7.1 Analog Video

The OpenCable Host Device will be introduced into an environment containing many existing analog set-top devices. The OpenCable Host Device MUST be able to receive analog services in the clear. Analog video and audio SHALL be NTSC in accordance with current cable-system practice and applicable FCC rules.

7.1.1 Analog Tuning

STT-BDI-C-38:	The OpenCable Host Device SHALL support all existing clear, non-scrambled video analog services.
STT-BDI-C-39:	The OpenCable Host Device SHALL have the capability to tune and demodulate NTSC-encoded channels from 54 to 864 MHz.
STT-BDI-C-40:	The OpenCable Host Device SHALL support the Standard, IRC, and HRC channel plans as defined in [4].

7.2 Digital Video

The OpenCable Host Device is required to handle all digital transport streams according to the following requirements:

7.2.1 MPEG-2 Transport

STT-BDI-C-41:	The OpenCable Host Device SHALL be able to process MPEG-2 compliant Transport Streams in accordance with [22].
STT-BDI-C-42:	The OpenCable Host Device SHALL support System Information tables provided in [21], Service Information Carried Out-of-Band for Digital Television, for broadcast systems.
STT-BDI-C-43:	The OpenCable Host Device SHALL be capable of acquiring and displaying a Digital Service contained within the same multiplex within 1.5 seconds, worst case. The nominal acquisition and display target time SHALL be within 1.0 seconds. Network conditions in which these values are valid SHALL be defined in the OpenCable Test Plan. The nominal and worst-case acquisition and display times of the Host Device will be certified using a vendor-provided navigator to be tested according to CableLabs test procedure (TBD).
STT-BDI-C-44:	The OpenCable Host Device SHALL be capable of acquiring and displaying a Digital Service contained within a different multiplex within 2.0 seconds, worst case. The nominal acquisition and display time SHALL be within 1.0 seconds. Network conditions in which these values are valid SHALL be defined in the OpenCable Test Plan. The nominal and worst-case acquisition and display times of the Host Device will be certified using a vendor-provided navigator to be tested according to CableLabs test procedure (TBD).
STT-BDI-C-45:	The video channel map SHALL be stored in non-volatile memory in the OpenCable Host Device.

7.2.2 Digital Video Decoding

STT-BDI-C-46:	The OpenCable Host Device SHALL decode MPEG-2 Main Profile @ Main Level per IEC 13818-2. The constraints and extensions that apply to video SHALL be those specified in ATSC A/53B with Amendment 1: ATSC Digital Television Standard [2].

STT-BDI-C-46a:	The Terminal Host Device SHALL decode and display MPEG-2 Main Profile @ High Level per IEC 13818-2. The constraints and extensions that apply to video SHALL be those specified in [2]. The resolution of the displayed image SHALL be at the option of the Terminal Host Device manufacturer.
HD-BDI-002:	The HD Set-top SHALL decode MPEG-2 Main Profile @ Main Level and MPEG-2 Main Profile @ High Level per IEC 13818-2. The constraints and extensions that apply to video SHALL be those specified in ATSC A/53 Annex A.
STT-BDI-C-47:	The OpenCable Host Device SHALL decode the resolutions shown in Table 10 below.
STT-BDI-C-47a:	The Terminal Host Device SHALL decode pictures having the resolutions shown in Table 11 below. The resolution of the displayed image SHALL be at the option of the Terminal Host Device manufacturer.
HD-BDI-003:	The HD Set-top SHALL decode the resolutions shown in Table 10 and Table 11 below.
STT-BDI-C-48:	The OpenCable Host Device SHALL decode aspect ratios as shown in Table 10 below.
HD-BDI-004:	The HD Set-top SHALL decode MPEG-2 video with aspect ratios listed in Table 10 and Table 11 below.
STT-BDI-C-48a:	The Terminal Host Device SHALL decode pictures having aspect ratios as shown in Table 11 below. The aspect ratio of the displayed image SHALL be at the option of the Terminal Host Device manufacturer. As a minimum, user options to select letterbox and cropping of pictures that do not match the aspect of the display device SHALL be provided.
STT-BDI-C-49:	The OpenCable Host Device MPEG-2 decoder SHALL support a variable bit rate input with peak rates up to the maximum rate allowed by MPEG-2 Main Profile @ Main Level.
STT-BDI-C-49a:	The Terminal Host Devices MPEG-2 decoder SHALL support a variable bit rate input with peak rates up to the maximum rate allowed by MPEG-2 Main Profile @ High Level.
HD-BDI-005:	The HD Set-top MPEG-2 decoder SHALL support a variable bit rate input with peak rates up to the maximum rate allowed by MPEG-2 Main Profile @ High Level.
STT-BDI-C-50:	The OpenCable Host Device MPEG-2 decoder SHALL support error concealment to minimize macroblock and stream synchronization errors.

Standard test streams with known errors will be used to evaluate error concealment implementations. These streams will be documented in the OpenCable Host Test Plan.

7.2.3 Digital Television (DTV) In-Band Service/System Information

STT-BDI-C-90:	The OpenCable Host Device SHALL process in-band System and Service Information for programs that are transported in-the-clear in accordance with Section 5.5 of [22].

7.2.4 Digital Television (DTV) Out-of-Band Service/System Information

STT-BDI-C-91:	The OpenCable Host Device SHALL process out-of-band System and Service Information that is sent across the CableCARD interface in Extended Channel data flows, using Service_type MPEG_section, as defined in [10] and [21]. The set of MPEG-2 tables provided to support the navigation function in the OpenCable Host Device conforms to one or more of the profiles specified in [21]. The OpenCable Host Device SHALL be able to extract the channel map from all profiles specified in [21].

7.2.5 Digital Television (DTV) Closed Captioning

STT-BDI-C-51:	The Set-top Host Device SHALL process NTSC Closed Captioning information, when available in the MPEG-2 Picture User Data, as specified in [6], section 4, or as specified in [5]

	and transported according to [44] or [16] on a program-by-program basis. This will include all data of cc_type 00 and 01, as defined in [7] and [5]. The Set-top Host Device SHALL reconstruct line 21 VBI (both field 1 and field 2) according to [5] in all NTSC analog video outputs.
STT-BDI-C-51a:	If the Terminal Host Device includes baseband video outputs, it SHALL process NTSC Closed Captioning information, when available in the MPEG-2 Picture User Data, as specified in [6], section 4, or as specified [5] and transported according to [44] or [16] on a program-by-program basis. This will include all data of cc_type 00 and 01, as defined in [7].and [5]. The Terminal Host Device SHALL also reconstruct line 21 VBI (both field 1 and field 2) according to [5] in all NTSC analog video outputs.
STT-BDI-C-51b:	If the Set top Host Device provides component analog or uncompressed digital output streams, decoding and display of this caption data SHALL be provided according to [7].
STT-BDI-C-51c:	The Terminal Host Device SHALL decode and display this caption data according to [7].
STT-BDI-C-52:	All OpenCable Host Devices submitted to Cable Labs for certification for delivery after July 1, 2002 SHALL process the Digital Television (DTV) Closed Captioning information, when available in the MPEG-2 Picture User Data, as specified in [6], section 9 and delivered according to [2] Amendment 1 (with cc_type set to '10' or '11'). This caption data, when present, SHALL be passed through to a DTV display via the [9] interface.
STT-BDI-C-52a:	If the OpenCable Host Device provides component analog or uncompressed digital output streams, decoding and display of this caption data SHALL be provided by the OpenCable Host Device according to [7]. If the OpenCable Host Device provides an NTSC analog video output, and the network stream dual carries [5] caption data transported according to [44] or [16], then the OpenCable Host Device SHALL reconstruct line 21 VBI in the analog output as required by [7].
STT-BDI-C-53:	The OpenCable Host Device SHALL process the caption_service_descriptor, when available, as defined by [3] and SCTE-DVS097r7 (once it is harmonized with [3]) and carried in either the PMT of the in-band MPEG-2 transport stream or passed across the CableCARD Extended Data Channel according to [10].

7.2.6 Digital Television (DTV) Content Advisory Information

To support the interoperable availability of content rating information for hosts and/or CableCARD Devices, OpenCable specifies the use of the Content Advisory Descriptor found in section 6.7.4 of [3] (Program and System Information Protocol for Terrestrial Broadcast and Cable - PSIP). The syntax follows Table 6.18 in that reference. This descriptor is placed in the Program Map Table (PMT) as permitted in Table 6.16 of [3] and in accordance with the standard descriptor mapping for the TS_program_map_section() found in [41]. The only rating region currently defined for OpenCable use is Region One (value 0x01 for the rating_region field). Semantics for the coding of the fields found in the PSIP Content Advisory Descriptor follow the rules given in section 6.74 of [3].

STT-BDI-C-54:	For the purposes of passing the content advisory information through on line 21 of the NTSC analog video output, the Set-top Host Device SHALL process the content advisory information, when present, as specified in [5] and transported according to [44] or [16].
STT-BDI-C-54a:	If the Terminal Host Device includes NTSC analog video output, it SHALL process the content advisory information, when present, as specified in [5] and transported according to [44] or [16].
STT-BDI-C-54b:	The OpenCable Host Device MAY also process the content_advisory_descriptor, when present, as defined by [3]), SCTE-DVS097r7 (once it is harmonized with [3]) and EIA-766-A and transported in either the PMT of the in-band MPEG-2 transport stream or passed across the CableCARD Extended Data Channel according to [10].

STT-BDI-C-54c:	Digital programs passed through from a Set-top Host Device to a DTV receiver via the [9] interface SHALL contain content advisory information, when present.
STT-BDI-C-54d:	If the Terminal Host Device includes an IEEE-1394 interface, digital programs passed through it SHALL contain content advisory information, when present.
STT-BDI-C-54e:	The Set-top Host Device SHALL reconstruct line 21, when present, as specified in [5] and transported according to [44] or [16].
STT-BDI-C-54f:	If the Terminal Host Device provides an NTSC video output, then it SHALL reconstruct line 21 as defined in [5].
STT-BDI-C-54g:	If the OpenCable Host Device provides component analog or uncompressed digital output streams, decoding and display of this content advisory data SHALL be provided by the OpenCable Host Device as defined in [5] and required [7].
STT-BDI-C-97:	All OpenCable Host Devices SHALL have a priori knowledge of the U.S. RRT (Region Rating Table for Region One) that is defined in EIA-766 (i.e., the table is stored in the OpenCable Host Device).
STT-BDI-C-98:	The U.S. RRT SHALL be the default RRT for all OpenCable Host Devices. It is noted that this approach is consistent with that specified in Annex C.1 of [21].

7.2.7 Digital Television (DTV) Emergency Alert Service (EAS)

The OpenCable Host Device processes emergency messages that utilize the EAS message syntax, which is compatible with MPEG-2 transport and is defined in [20]. For in-band transmission, it appears in the transport packet with the same PID as those used for Service/System Information (SI). The table ID for the EAS message is 0xD8 as defined in [20]. For out-of-band (OOB) transmission, the EAS message is transmitted according to [20].

STT-BDI-C-55:	The OpenCable Host Device SHALL process EAS messages, when received, as defined in [20]

7.3 Video Performance Specifications

In Table 8, each line item parameter specification applies to both baseband and RF modulator output video signals unless otherwise stated.

Table 8 - Composite Analog Video Output Performance Parameters (0 °- 40 ° C)

1.	Video Standard	NTSC composite, EIA-563
2.	Signal Level (composite video)	1.0 volt peak-to-peak, sync tip (-40 IRE) to reference white (100 IRE) ±10%
3.	Long Time Distortion (Bounce)	±1%, settle in less than 1 second
4.	Field Time Distortion	±4%
5.	Line Time Distortion	Baseband: ±2%, RF Modulated: ±3
6.	Short Time Distortion	±6% (Rising and/or Falling)
7.	Chroma to Luminance Gain Inequality	Not more than ±10 % (+30% to -50% for Terminal Host Devices)
8.	Chroma to Luminance Delay for Baseband Video Output (box only, not including headend and plant)	≤ 100 nsec (AM-VSB analog)
9.	Frequency Response for Baseband Video Output (worst case for analog NTSC or digital MPEG input signals)	-2 to +2 dB, 0 kHz to 3.75 MHz (+2 to -6 dB for Terminal Host Devices).
10.	Terminal Contribution to Output Frequency Response for RF Output (worst case for analog NTSC or digital MPEG input signals)	-1 to +1 dB, 0 kHz to 3.75 MHz
11.	Luminance Non-Linearity	5% p-p maximum
12.	Chroma Non-Linear Phase Distortion	± 5°
13.	Chroma Non-Linear Gain Distortion	±5%
14.	Chroma/Luma Intermod	±3%
15.	Differential Gain (over 10% to 90% APL range)	10% peak to peak max. for RF modulated output; 5% peak to peak max. for baseband video output
16.	Differential Phase (over 10% to 90% APL range)	10° peak to peak max. for RF modulated output; 5° peak to peak max. for baseband video output
17.	920 kHz Beat	-52 dBc
18.	Video Signal-to-Noise Ratio (over the full input tuning range stated in item 2 above)	For RF Modulated Output: 53 dB with a digital input signal and 48 dB with an analog input signal at 0 dBmv (51 dB and 44 dB, respectively, for Terminal Devices). (*Note 1)* For Baseband Video Output: 57 dB with a digital input signal and 49 dB with an analog input signal at 0 dBmv (55 dB and 45 dB, respectively, for Terminal Devices. (*Note 1*)
19.	Baseband Video Output Impedance	75 ohm ± 10%
20.	Baseband Video Output Return Loss	16 dB minimum across video bandwidth

Table Notes:

1. Video SNR measured with Unified Weighting filter.

Table 9 - Analog Video Output Performance when processing a digital video program source (0 °- 40 ° C)

1.	Bar Level (rel. Back Porch)	100 IRE nominal
2.	Sync Polarity	Negative (normal)
3.	Sync Level (rel. Back Porch)	40 IRE ±4
4.	Color Burst Amplitude	40 IRE ±4
5.	Color Burst Duration	2.5 microseconds = 9 cycles ±1 (EIA RS-170)
6.	Front Porch Duration	1.4 microseconds minimum (+4 IRE to -20 IRE)
7.	Sync to Setup Duration	8.5 microseconds minimum (-20 IRE to +4 IRE)
8.	Horizontal Blanking Duration	10.9 microseconds, ±0.3 microseconds (+4 IRE to -4 IRE)
9.	Sync Pulse Duration	4.7 microseconds, ±0.2 microsecond (50% width)
10.	Sync Pulse Rise Time	140 nsec ± 30 nsec (10% to 90% amplitude)
11.	Equalization Pulse	2.3 microseconds ±0.2 (50% width)
12.	Vertical Pulse	(H/2 - 4.7 microsecond) ±0.2 (50% width)
13.	Breezeway Duration	0.6 microseconds
14.	Setup	7.5 IRE

Table 10 - Compression Format Constraints for OpenCable Host Device Processing

vertical_size_ value	horizontal_size_ value	aspect_ratio_ information	frame_rate_ code	Progressive_ sequence
480	704	2,3	1	1
480	720	2,3	1	1
480	704	2,3	4	0
480	720	2,3	4	0
480	528	2	1	1
480	544	2	1	1
480	528	2	4	0
480	544	2	4	0
480	352	2	1	1
480	352	2	4	0
480	704	2,3	2,4,5	1
480	720	2,3	2,4,5	1
480	704	2,3	5	0
480	720	2,3	5	0
480	640	1,2	1,2,4,5	1
480	640	1,2	4,5	0

Legend for MPEG-2 coded values in Table 10
aspect_ratio_information 1 = square samples 2 = 4:3 display aspect ratio 3 = 16:9 display aspect ratio
frame_rate_code 1 = 23.976 Hz 2 = 24 Hz 4 = 29.97 Hz 5 = 30 Hz
progressive_sequence 0 = interlaced scan 1 = progressive scan

8 HIGH DEFINITION PASS-THROUGH

The OpenCable Host Device supports pass-through of compressed High Definition (HD) Audio-Visual programs using MPEG-2 Transport Streams through the IEEE-1394 interface, if present, to an OpenCable-compatible Digital TV.

For the HD set-top, HD data is transferred via 1394 primarily to recording devices, and is not required to support display devices. The HD set-top must support HD decode as listed in Section 14.1 of this document. Note: If the HD set-top limits the use of the 1394 interface to only recording devices, it might be able to use the restricted authentication method of DTCP instead of the full authentication method.

STT-BDI-C-56:	The Set-top Host Device SHALL support the transfer of MPEG-2 single program transport streams (SPTS) containing HD programs via the [9] isochronous Data Channel as specified in sections 4.1 – 4.3, 4.5 – 4.8 and 8.1 – 8.2 of [24].
STT-BDI-C-57:	The Set-top Host Device SHALL support the Analog/Digital source selection function as defined in sections 4.10 – 4.11 and 6.1 of [24].
STT-BDI-C-70:	The Set-top Host Device SHALL comply with section 4.1 and section 4.2 of [19].
STT-BDI-C-99:	The Set-top Host Device SHALL support simultaneous local decode and pass-through of compressed Standard Definition MPEG-2 A/V programming.
STT-BDI-C-101:	The set-top Host Device SHALL support the Isochronous Resource Manager (IRM) functionality as defined in Section 8 of [9]: Standard for a High Performance Serial Bus specification.
STT-BDI-C-102:	The set-top Host Device SHALL support the Cycle Master functionality as defined in Section 8 of [9]: Standard for a High Performance Serial Bus specification.
HD-BDI-006:	The HD Set-top MAY discover the Unit Descriptor of receiving 1394 devices and not permit transfer of HD content to display devices (devices with a MONITOR Subunit Name).

Table 11 - Compression Format Constraints for HD Decoding & Pass Through

vertical_size_ value	horizontal_size_ value	aspect_ratio_ information	frame_rate_ code	Progressive_ sequence
1080	1920	1,3	1,2,4,5	1
1080	1920	1,3	4,5	0
1080	1440	3	1,2,4,5	1
1080	1440	3	4,5	0
720	1280	1,3	1,2,4,5,7,8	1
480	720	2,3	7,8	1
480	704	2,3	7,8	1
480	640	1,2	7,8	1

Legend for MPEG-2 coded values in Table 11
aspect_ratio_information 1 = square samples 2 = 4:3 display aspect ratio 3 = 16:9 display aspect ratio
frame_rate_code 1 = 23.976 Hz 2 = 24 Hz 4 = 29.97 Hz 5 = 30 Hz 7 = 59.94 Hz 8 = 60 Hz
progressive_sequence 0 = interlaced scan 1 = progressive scan

9 AUDIO

STT-BDI-C-58:	The OpenCable Host Device SHALL decode Dolby AC-3 digital audio in accordance with [1] as constrained per [2], with additional data rates up to 448 kbps.
STT-BDI-C-59:	Selected and authorized digital signals on Set-top Host Devices SHALL be present simultaneously on the baseband left and right outputs, the RF output, and the digital output for digital services as listed in Table 10 and Table 11 above.
STT-BDI-C-59a:	If the Terminal Host Device includes audio outputs, the selected and authorized digital signals SHALL be present simultaneously on all such outputs, including when present, the baseband left and right outputs, the RF output, and the digital output for digital services as listed in Table 10 and Table 11 above.
STT-BDI-C-59b:	For analog services on Set-top Host Devices, the selected and authorized audio signals SHALL be present on the baseband left and right outputs and the RF output, and MAY be present on the digital output.
STT-BDI-C-59c:	If the Terminal Host Device includes audio outputs, the selected and authorized analog signals SHALL be present simultaneously on all such outputs, including when present, the baseband left and right outputs and the RF output, and MAY be present on the digital output.
STT-BDI-C-60:	The OpenCable Host Device SHALL use the ISO 639 Language Descriptor as defined in [41] and constrained by [22], if present, to identify the language associated with audio tracks.
STT-BDI-C-71:	The OpenCable Host Device SHALL be certified by Dolby Laboratories Inc. for Dolby Digital™ decoding.

9.1 Audio Performance Specifications

All audio performance requirements are valid over the operational environmental parameters defined in Table 12, Table 13 and Table 14. These parameters apply to all OpenCable Host Devices with audio outputs.

9.2 Music Channel Services

Some music channel services provide both an audio elementary stream and a low frame-rate video elementary stream, typically at one frame every six seconds and a data rate of 50kbps. These low frame-rate video streams have the **low_delay** flag set to "1". The low_delay flag is contained in the sequence_extension(), following the sequence_header() of the viewo_sequence(). The following is from the MPEG-2 standard [12] concerning the use of the **low_delay** flag.

> "**low_delay** - This flag, when set to "1", indicates that the sequence does not contain any B-pictures, that the frame reordering delay is not present in the VBV description and that the bitstream may contain 'big pictures' ".

'Big pictures' are images that may reside in the VBV buffer for longer thatn two fields. The VBV buffer must be examined periodically before removing the coded picture to prevent buffer underflow. See Section C.7 of [12] for details

All MPEG-2 decoders compliant with the Main Profile and Main Level are expected to be able to decode video streams with the **low_delay** flag enabled.

Table 12 - RF Output

1.	Modulated Audio Mode	Monophonic or BTSC encoded
2.	Modulation Note: For set-tops with volume control, this spec applies when commanded to "unity" or "nominal" gain	50 kHz peak deviation ±7 kHz for a digital audio signal of 400Hz at 0dBFS. For analog inputs, the RF output MUST reproduce the original carrier deviation, + or - 10%.
3.	Audio Mute	Minimum 48 dB attenuation

Table 13 - Baseband Audio Output when a Digital Service is Selected

1.	Audio Frequency Response	+/-1 dB from 20 Hz to 20 kHz
2.	Audio Mute	Minimum 60 dB attenuation
3.	Baseband Audio Output Impedance	< 5k ohm for each L&R audio outputs
4.	Audio Output Signal Level (as measured into a 100k ohm load) Note: For set-tops with volume control, this spec applies when commanded to "unity" or "nominal" gain	2.4V p-p +/- 10% with digital levels (0 dBFS), and excluding the effects of dialog normalization and dynamic range compression
5.	Intermodulation Distortion (CCIF method using 4040 Hz and 3960 Hz tones at -14 dBFS input per tone)	0.15% max. referenced to output
6.	Stereo L&R Channel Separation	60 dB min. from 20 Hz to 20 kHz
7.	Stereo L&R Channel Gain Difference	+/- 0.5 dB max. from 20 Hz to 20 kHz, referenced to the left channel response
8.	Stereo L&R Channel Phase Difference	5° max. from 20 Hz to 20 kHz
9.	Total Harmonic Distortion	0.3% max. from 20 Hz to 20 kHz at -10 dB relative to full scale
10.	Audio Signal-to-Noise Ratio Note: For set-tops with volume control, this spec applies when commanded to "unity" or "nominal" gain	80 dB min., 20 Hz to 20 kHz, with 1 kHz test tone at full scale encoder input, dialog normalization and dynamic range compression disabled, using CCIR- 2k weighting
11.	Audio to Video Transmission Time Difference	± 20 msec max

Table 14 - Baseband Audio Output with Analog Service*

1.	Audio Frequency Response	Mono or BTSC Signal: ±3 dB from 50 Hz to 13 kHz (50 Hz to 10 kHz for Terminal Devices).
2.	Audio Mute	Minimum 60 dB attenuation.
3.	Baseband Audio Output Impedance	< 5k ohm for each L&R audio outputs.
4.	Audio Output Signal Level (as measured into a 100k ohm load) Note: For set-tops with volume control, this spec applies when commanded to "unity" or "nominal" gain	Mono Signal: 1.2V p-p, +/- 10%, with 400 Hz test tone at +/-25 KHz p-p audio subcarrier deviation. BTSC Signal: 1.2V p-p, +/- 10%, with 400 Hz test tone at +/- 12.5 kHz p-p audio subcarrier deviation for each L&R channel.
5.	Stereo L&R Channel Separation	BTSC Signal: 20 dB min. at 1 kHz.
6.	Stereo L&R Channel Gain Difference	BTSC Signal: +/- 0.5 dB maximum from 50 Hz to 13 kHz, referenced to the left channel response.
7.	Stereo L&R Channel Phase Difference	BTSC Signal: 15° maximum from 50 Hz to 13 kHz.
8.	Total Harmonic Distortion	Mono and BTSC Signals: 3.5% max. from 50 Hz to 13 kHz.
9.	Audio Signal-to-Noise Ratio Note: For set-tops with volume control, this spec applies when commanded to "unity" or "nominal" gain	Mono and BTSC: 48 dB min., 50 Hz to 13 kHz, referenced to a 1000 Hz test tone at +/- 25 kHz p-p audio subcarrier deviation, CCIR-2k weighting (45 dB min. from 50 Hz to 10kHz for Terminal Devices).

Table Notes:

* *Requirements are based on input test signals provided by NTSC and BTSC signal sources RF modulated to Channel 4.*

10 OPENCABLE HOST DEVICE POWERING STATES

Once the OpenCable Host Device has AC power applied and has performed CableCARD installation and initialization, it always has access to network services through the out-of-band channel, for network monitoring purposes or for receipt of messages, alarms, or notifications. Thus, when the OpenCable Host Device is "On" (from the subscriber's perspective), it is fully active and providing services that are displayed on the subscriber's television. When it is "Off", it still maintains network connectivity and thus is still consuming power and running the processor, operating system, and navigator shell.

When the OpenCable Host Device is disconnected from AC power or from the cable connection, it is truly off (i.e., not connected to the network). When reconnected, the OpenCable Host Device does not have to re-initialize, but MUST re-establish network connectivity. The AC power up sequence is slightly longer than the "Off" to "On" sequence, but not as long as initialization.

11 OPENCABLE HOST DEVICE DIAGNOSTICS

STT-BDI-C-61: The OpenCable Set-top Host Device SHALL be capable of performing self-diagnostics and displaying the results via the LED readout. A minimum set of diagnostics SHALL be available, including, but not limited to:

- OpenCable Set-top Host Device power status
- OpenCable Set-top Host Device boot status
- Indication of fatal error (e.g., Checksum error)

STT-BDI-C-62: The OpenCable Host Device SHALL be capable of performing self-diagnostics and displaying via the on-screen display (OSD) the results, that SHALL include, but are not limited to:

- OpenCable Host Device power status
- OpenCable Host Device boot status
- OpenCable Host Device memory allocation
- Software version numbers of code in the OpenCable Host Device
- Firmware version
- MAC addresses
- OpenCable Host Device network addresses
- Status of FDC
- Status of FAT
- Status of RDC (for bi-directional Host Devices only)
- Current channel status
- IEEE-1394 Port status (when present)
- Status of embedded cable modem (for ADV-HOST only)

These diagnostics MAY also be displayed on the LED.

HD-BDI-007: In addition to the self-diagnostics defined in STT-BDI-C-62, HD Host Devices SHALL be capable of performing self-diagnostics and displaying via the on-screen display (OSD) the results, that SHALL include, but are not limited to:

- DVI Port status

HD-BDI-008: HD Host Device SHALL be capable of displaying and reporting DVI Port status results that shall include, but are not limited to:

- Connection status (no connection exists, device connected – not repeater, device connected – repeater)
- HDCP status (not enabled, enabled)
- Video format:
  - The number of horizontal lines associated with the video format on the DVI link
  - The number of vertical lines associated with the video format on the DVI link
  - The scan rate associated with the video format on the DVI link
  - The aspect ratio associated with the video format on the DVI link (4:3, 16:9)
  - Progressive or interlaced video

STT-BDI-C-63: The OSD display of diagnostics can only be triggered by a pre-determined keystroke sequence, which is defined by the manufacturer.

STT-BDI-C-64: The Bi-directional OpenCable Host Device self-diagnostics SHALL be reportable to the CableCARD Device through the Generic Diagnostic Support resource.

11.1 Diagnostic Parameters

The following paragraphs detail a minimal set of parameters that are displayed and remotely controllable and reportable are reportable to the CableCARD Device for the self-diagnostics specified in STT-BDI-C-62.

11.1.1 OpenCable Host Device Memory Allocation

STT-BDI-C-73: The OpenCable Host Device SHALL be capable of displaying and reporting self-diagnostic memory allocation results that SHALL include, but are not limited to:

- Type of memory being reported (as applicable: ROM, DRAM, SRAM, Flash, and NVM)
- Physical size of memory type (in kilobytes, defined to 1024 bytes)

11.1.2 Software Version Numbers of Code in the OpenCable Host Device

STT-BDI-C-74: The OpenCable Host Device SHALL be capable of displaying and reporting self-diagnostic software version number results, of all available applications, that SHALL include, but are not limited to:

- Application's name string
- Application's version number
- Software status (active, inactive or downloading)
- If applicable, Application's signature

11.1.3 Firmware Version (OpenCable Host Device)

STT-BDI-C-75: The OpenCable Host Device SHALL be capable of displaying and reporting self-diagnostic firmware version results that SHALL include, but are not limited to:

- Firmware version number of entire firmware image
- Firmware's release or installation date of entire firmware image.

11.1.4 MAC Addresses

STT-BDI-C-76: The OpenCable Host Device SHALL be capable of displaying and reporting self-diagnostic media access control (MAC) address results that SHALL include, but are not limited to:

- Type of devices being reported (as applicable: Host, CableCARD Device, IEEE-1394, USB, DOCSIS, and/or Ethernet)
  NOTE: If multiple devices of the same type exist, then the MAC address for each device type SHALL be reported.
- MAC address of each reported device

11.1.5 OpenCable Host Device Network Addresses

STT-BDI-C-77: The OpenCable Host Device SHALL be capable of displaying and reporting self-diagnostic network address results that SHALL include, but are not limited to:

- Network address of device
  NOTE: If multiple network addresses exist, then each network address SHALL be reported.

11.1.6 Status of FDC

STT-BDI-C-78: The OpenCable Host Device SHALL be capable of displaying and reporting forward data channel (FDC) status results that SHALL include, but are not limited to:

- FDC center frequency, in MHz
- Carrier lock status (e.g. LOCKED – NOT LOCKED)

11.1.7 Status of FAT

STT-BDI-C-79: The OpenCable Host Device SHALL be capable of displaying and reporting forward application transport (FAT) channel status results that SHALL include, but are not limited to:

- Modulation mode indicator; analog, 64 QAM, or 256 QAM.
- Carrier lock status
- If the currently tuned channel is digital, then PCR lock status; the FAT channel tuner is locked or not locked to the currently tuned service
- Numerical estimate of the channel's signal to noise ratio in tenths of a dB
- Numerical estimate of the signal level in tenths of a dBmV
  NOTE: When operated at nominal line voltage, at normal room temperature, the reported Level and SNR MUST be within 6 dBmV and 3 dB of the actual received channel level and SNR, respectively, for the input level range of -15 dBmV to +15 dBmV. Across the input level range from -15 dBmV to +15 dBmV, for any 1 dB change in input level or SNR, the Host MUST report a power change in the same direction that is not less than 0.5 dB and not more than 2.0 dB.

11.1.8 Status of RDC

STT-BDI-C-80: If the return data channel (RDC) is established, then the OpenCable Host Device SHALL be capable of displaying and reporting reverse data channel (RDC) status results that SHALL include, but are not limited to:

- RDC center frequency, in MHz
- RDC transmitter power level, in dBmV
- RDC data rate (256kbps, 1544kbps, 2048kbps or 3088kbps)

STT-BDI-C-81: If a DOCSIS cable modem is present, then the RDC status results SHALL also include, but are not limited to:

- DOCSIS modulation type (QPSK or 16-QAM)

11.1.9 Current Channel Status

STT-BDI-C-82: The OpenCable Host Device SHALL be capable of displaying and reporting current channel status results that SHALL include, but are not limited to:

- Channel type; analog or digital
- Authorization status; OpenCable Host Device is authorized or not authorized for currently tuned service
- Purchasable status; currently tuned service MAY or MAY NOT be purchased
- Purchased status; currently tuned service is or is not purchased
- Preview status; currently tuned service is or is not in preview mode
- If the OpenCable Host Device is utilizing parental control, then parental control status; currently tuned service is blocked or is not blocked via parental control

11.1.10 IEEE-1394 Port Status

STT-BDI-C-83: The OpenCable Host Device SHALL be capable of displaying and reporting IEEE-1394 Port status results that include, but are not limited to:

- Loop status (loop/no loop exists)
- Root status (OpenCable Host Device is/is not Root node)
- Cycle Master status (OpenCable Host Device is/is not Cycle Master)
- Port connection status
  - Port 1 — connected/not connected
  - Port 2 — connected/not connected
- Total number of nodes (devices) connected to IEEE-1394 bus.

12 MECHANICAL

STT-BDI-C-65:	The OpenCable Host Device SHALL be capable of dissipating the heat from a CableCARD Device drawing an average of 2.5 watts across the CableCARD interface, and with compliance of item 15 of Table 15.	
STT-BDI-C-72:	The OpenCable Host Device SHALL have a non-removable nameplate(s) or sticker(s) that includes the following information:	
	Vendor ID:	24-bit vendor ID represented as 3 bytes (6 hexadecimal digits). This number SHOULD be assigned by OpenCable to ensure uniqueness.
	Vendor Name:	40 ASCII characters maximum.
	Serial Number or Serial No:	40 ASCII character maximum.
	Return Path Capability:	(Indicate all that apply): N=None, T=Telco Return, R=OpenCable RF return, D=DOCSIS, X=Other.

Table 15 - Environmental / Mechanical Requirements

(Meet all operational specs. without malfunction, or hard or soft failures, under the following)

1.	Required Compliance	All applicable regulatory requirements including, but not limited to: FCC, UL, CSA, and EIA
2.	Input Line Voltage	95 to 125 volts AC
3.	Input Line Frequency	57 to 63 Hz
4.	Nominal Power Consumption	To be specified in watts by manufacturer
5.	Physical Security/Tampering-Resistance	Secure means of evidencing entry into the security portions of the device
6.	RF Susceptibility	RF field of 2 volts/ meter from 40 MHz to 1 GHz
7.	Radiated RF	[7] compliant
8.	Conducted	[7], ANSI C63.4-1992 compliant
9.	Lightning Surge Tolerance	UL 1409 voltage surge test 38.1, UL 1449, IEEE C62.41, IEEE 587 compliant. RF Input: 1.5 kV at 1kV/usec, 60 amp peak; AC line input: 6 kV, oscillatory 0.5 μsec rise time 100 kHz.
10.	Line Surge Test	FCC part 68, UL 1459, CSA compliant. Metallic: 3500 v minimum at 5 μsec max. rise time and 600 μsec min. fall time, 20 joules min. Longitudinal: 6500 v at 5 μsec max. rise time, 600 μsec min. decay time, 30 joules min. Note: Only applies to a Host with a phone return modem.
10a.	Line Surge Test	UL 1449 Measured Limiting Voltage test Duty Cycle Test Abnormal Over Voltage Tests.
11.	Power Cross (if Host supports phone modem return)	Metallic: will survive 10 events of 600 v, 10 sec duration and operate. Longitudinal: will survive 10 events of 600 v, 10 sec duration and operate.
12.	Electrostatic Discharge	IEC 801-2, withstand 10 discharges at 15 kV to each corner and center of keypad, through a 150 pf capacitor in series with 150 ohm resistor, with device chassis grounded to ESD generator
13.	Brown Out Effects	No corruption of non-volatile memory due to input voltage fluctuations from nominal to zero volts
14.	Operating Ambient Temperature and Humidity	0° to 40° C and 5% to 95% RH non-condensing humidity *(See Note 1)*
15.	External Surface Temperature (with 125 vac input applied and device on, 25° C ambient temperature, without internal or external fan)	UL 1409 compliant. No external protruding surface point hotter than 50° C for metallic and 60° C for nonmetallic surfaces. No non-accessible surface point hotter than 65° C.
16.	Storage Temperature (non-powered, non-operating)	-20° to +60° C *(See Note 1)*
17.	Storage Humidity (non-powered, non-operating)	5% to 95% RH non-condensing at 40° C *(See Note 1)*

18.	Altitude	Operating: -150 to 10,000 ft. AMSL Storage: -150 to 15,000 ft. AMSL *(See Note 1)*
19.	Thermal Shock	Device meets all operational specs after subjection to: -40° C. for 30 minutes +25° C. for 10 minute +60° C. for 30 minutes *(See Note 1)*
20.	Humidity Shock	Mil-std-810d method 507.2 Device meets all operational specs after subjection to: raise temp to +60° C and 95% RH over 26 hrs., maintain for 6 hrs., drop to 85% RH while reducing temp to +30° C over 8 hrs., maintain +30° C and 95% RH for 8 hrs. Repeat for 10 cycles. *(See Note 1)*
21.	Solvent Resistance	No external surface deformation effect of common household solvents, cleaners, waxes *(See Note 1)*
22.	Shipping Vibration	Fully operational after subjection to swept frequency vibration test applied in each of x, y, z planes with excursion of 0.3 inches at a frequency varied from 10 to 30 Hz back to 10 Hz done six times within 30 minutes. *(See Note 1)*
23.	Mounting Feet	No marks or stain to varnished wooden surface after 40° C and 95% RH exposure for 10 days under force of 0.75 kg *(See Note 1)*
24.	Keypad Keys	Fully operational after subjection to 100,000 cycles of each key through its full travel to closure with a 10- to 12-ounce force applied at 60 times per minute. *(See Note 1)*
25.	Impact Test	Device will not develop any openings creating electrical shock risks after subjection to an impact force of 5 ft. lbs. obtained from a free fall of a 2-inch diameter solid smooth steel sphere weighing 1.18 lbs. *(See Note 1)*
26.	Static Load on Keypad Keys	No mechanical damages or visible deformation after keypad subjection to a static load of 25 lbs. in the direction of operation of the keys. *(See Note 1)*
27.	Handling Drop Test	Device fully operational and not develop any openings exposing risk of electrical shock after subjection to one drop on the face of the device from a height of 20 inches onto a 2-inch thick smooth surface concrete floor. *(See Note 1)*
28.	Strain Relief Test	For permanently attached power supply cords, device will withstand steady pull force of 35 lbs. applied to the cord. *(See Note 1)*
29.	Non-volatile Memory Battery Life	Batteries used to back up non-volatile memory will have a minimum life of: unplugged: 1.5 yrs storage life @ 60° C or less; powered 8 yrs @ 40° C or less.
30.	Microphonic Shock	Device will remain error- or interference-free (i.e., no audio pops, clicks, no data errors, no video artifacts) when subjected to tapping with a reasonable force by placing device on a hard surface without padding or mats and inducing 20 taps from knuckles, flat hands, fists, finger nails, screwdriver handles, plastic hammers to all external surfaces of the device. *(See Note 1)*

Table Notes:

1. *For Terminal Host Devices, these parameters are superseded by the manufacturer's specifications.*

13 REQUIREMENTS UNIQUE TO ADVANCED HOSTS

This section describes requirements unique to Advanced Host Devices.

13.1 One-way and Two-way Embedded Cable Modem Operation

ADV-BDI-003: The Advanced Host MUST be able to function in either a one-way or two-way cable modem environment.

In a one-way environment, the DOCSIS downstream channel is active, while the DOCSIS return channel is either impaired or not active. The functionality available in a one-way environment may be limited to:

- Analog NTSC audio-visual programming; (clear, non-scrambled).
- Digital definition audio-visual programming utilizing MPEG-2 video and Dolby AC-3 audio.
- Broadcast (in-the-clear), subscription-based (scrambled or encrypted), and call-ahead Pay-Per-View (PPV) (scrambled or encrypted) services. (Call-ahead Pay-Per-View is a paid service in which the viewer pre-subscribes selected programming via telephone.)
- Processing and enforcement of Copy Protection.
- Pass through of digital high definition audio-visual programming.

Applications that make use of the DOCSIS return channel must be robust to intermittent outages of the return channel. Some of the applications that may be affected by loss of the return channel include the following, which must be able to identify and indicate to the user that some functionality has been lost:

- Impulse Pay Per View (IPPV)
- Video on Demand (VOD)

ADV-BDI-004: When in the DSG mode of operation the Advanced Host MUST use a two-way IP session over DOCSIS for all return traffic.

A two-way IP session over DOCSIS for return traffic looks like the following:

- An Out-Of-Band polling message is sent from the network controller server to the set-top via the DOCSIS Set-top Gateway
- The Host and/or CableCARD Device response to the message is returned to the headend via IP over DOCSIS

The Host cable modem will follow standard DOCSIS initialization and registration process, with the following specific exceptions:

- In acquiring the appropriate DOCSIS forward carrier, the set-top will search for the first DOCSIS carrier that contains the well-known Ethernet MAC address(es) reserved by the CA/CableCARD provider.
- The Host must only attempt to register on the network after acquiring the appropriate DOCSIS forward carrier.
- The Host and embedded DOCSIS-compatible cable modem MUST NOT reboot under circumstances in which the reverse channel is impaired. Instead of rebooting, the Advanced Host will continue to receive and process the DOCSIS forward channel.
- The Host must periodically attempt to re-register after loss of the reverse channel.

ADV-BDI-005:	When in the DSG mode of operation the Advanced Host MUST only attempt to register on the network after acquiring the appropriate DOCSIS forward carrier.
ADV-BDI-006:	When in the DSG mode of operation the Advanced Host MUST periodically attempt to re-register after loss of the reverse channel.

Figure 5 - Host State Transition Diagram shows a state transition diagram between the one-way and two-way modes of operation. The specifics of how this state transition is implemented are detailed in the following section.

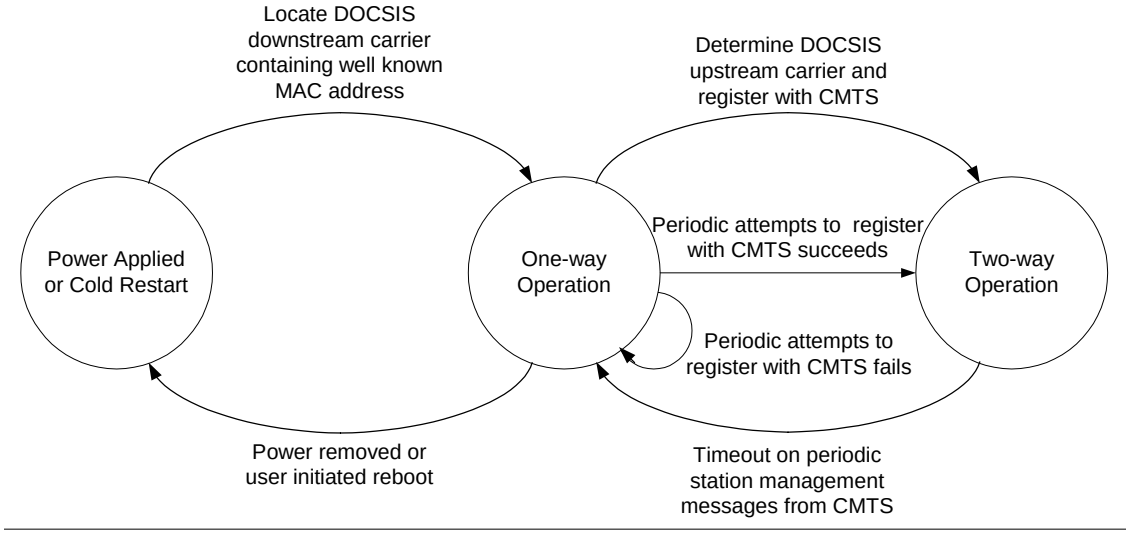


Figure 5 - Host State Transition Diagram

13.1.1 Embedded Cable Modem Initialization in Advanced Host

The DOCSIS-compatible cable modem that is embedded in the Advanced Host will have an initialization sequence that differs slightly from the standard DOCSIS cable modem. The differences primarily relate to how the CM responds to the various timeouts and error conditions. The embedded CM in the Advanced Host will continue to remain tuned to the DOCSIS downstream containing the DSG packets and continue to process the IP packets carried in the DSG tunnel even when the return channel is impaired or two-way connectivity is lost. This is necessary to enable the delivery of downstream OOB messages regardless of two-way capabilities.

The embedded CM initialization sequence is based on the CM initialization sequence defined in Section 9.2, Cable Modem Initialization, of [30]. The differences from the DOCSIS standard are detailed in the following sections as well as highlighted in the accompanying figures. The embedded CM initialization sequence for the Advanced Host introduces two new timers and two new retry timers. These are:

- Tdsg1 – The timeout period for the DSG packets during initialization of the embedded CM
- Tdsg2 – The timeout period for the DSG packets during normal operation of the embedded CM
- Tdsg3 – Two-way retry timer – The retry timer that determines when the embedded CM attempts to reconnect with the CMTS and establish two-way connectivity.
- Tdsg4 – One-way retry timer – The retry timer that determines when the embedded CM attempts to rescan for a downstream DOCSIS channel that contains DSG packets after a Tdsg1 or Tdsg2 timeout.

In general, the intent of this initialization sequence is to avoid rebooting the Advanced Host if at all possible and continue to receive downstream OOB messages via the DSG in all cases. To achieve this the Advanced Host introduces a one-way mode of operation that is distinguished from normal two-way DOCSIS operation by remaining tuned to and processing the DOCSIS downstream during periods when the reverse channel is impaired or other timeout conditions occur. As shown in the following sections, this is achieved by modifying all instances that would result in resetting the MAC layer in DOCSIS to go to the one-way mode of operation.

The embedded CM in the Advanced Host recovers from these error conditions by periodically attempting to reacquire the reverse channel and establish two-way connectivity.

When an Advanced Host loses its return channel capability, either through return channel impairment or other reasons, it will no longer appear to respond to periodic ranging requests from the CMTS. The CMTS will eventually de-register the embedded CM in this Advanced Host. Consequently, when the embedded CM attempts to reacquire two-way connectivity it will begin the process by collecting UCD messages.

Further, since the DSG tunnel is not guaranteed to be present on all downstream DOCSIS channels, the initialization sequence is also modified to make certain that a valid DOCSIS downstream, one containing DSG packets, is acquired.

ADV-BDI-007: The DOCSIS-compatible cable modem that is embedded in the Advanced Host MUST have an initialization sequence as described in the following seven subsections.

13.1.1.1 Embedded Cable Modem Initialization Overview

The following figure corresponds to Figure 9-1 in [30]. The difference in the initialization of the embedded CM in the Advanced Host is the scan for the downstream DOCSIS channel with a DSG tunnel. This process is described in detail in the next section.

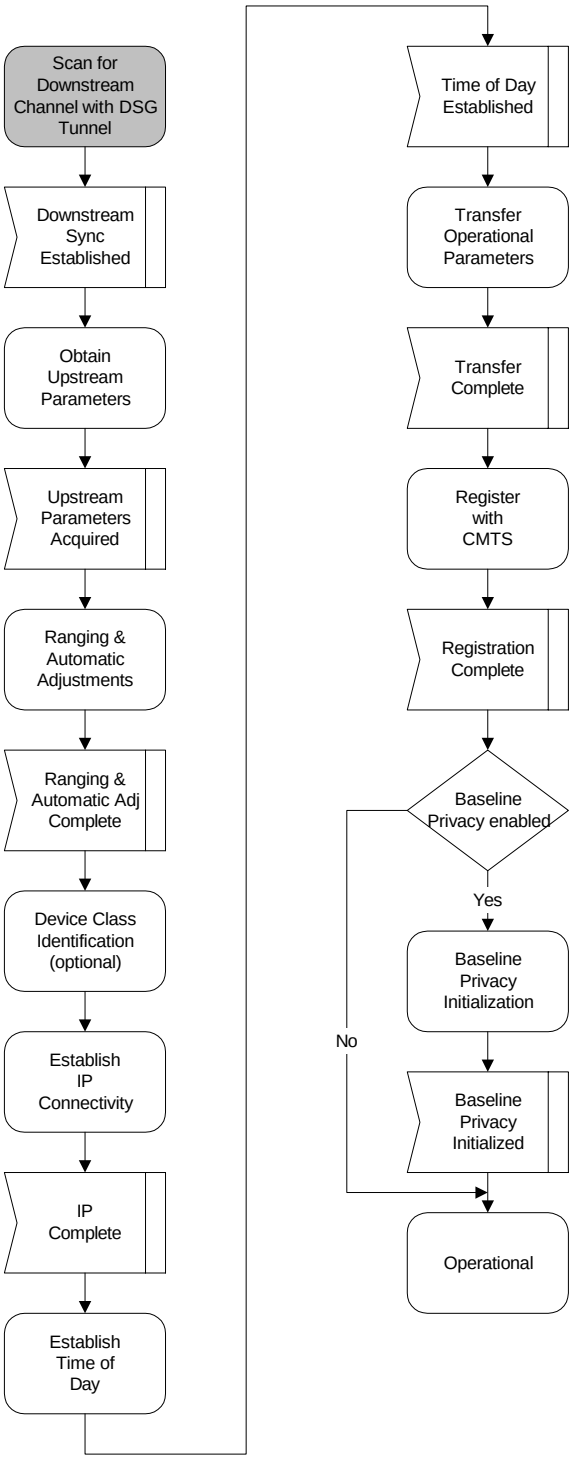


Figure 6 - Advanced Host CM Initialization Overview

13.1.1.2 Embedded Cable Modem Scan For Downstream Channel

This section corresponds to Section 9.2.1, Scanning and Synchronization to Downstream in [30]. In addition to the steps required to acquire a valid downstream channel, it is necessary that the downstream channel contain DSG packets. If a DOCSIS downstream channel containing DSG packets cannot be found then the embedded CM MUST proceed with attempting DOCSIS registration. In this way, SNMP can be used to signal the Network Management System of the lack of DSG packets via the DOCSIS two-way channel.

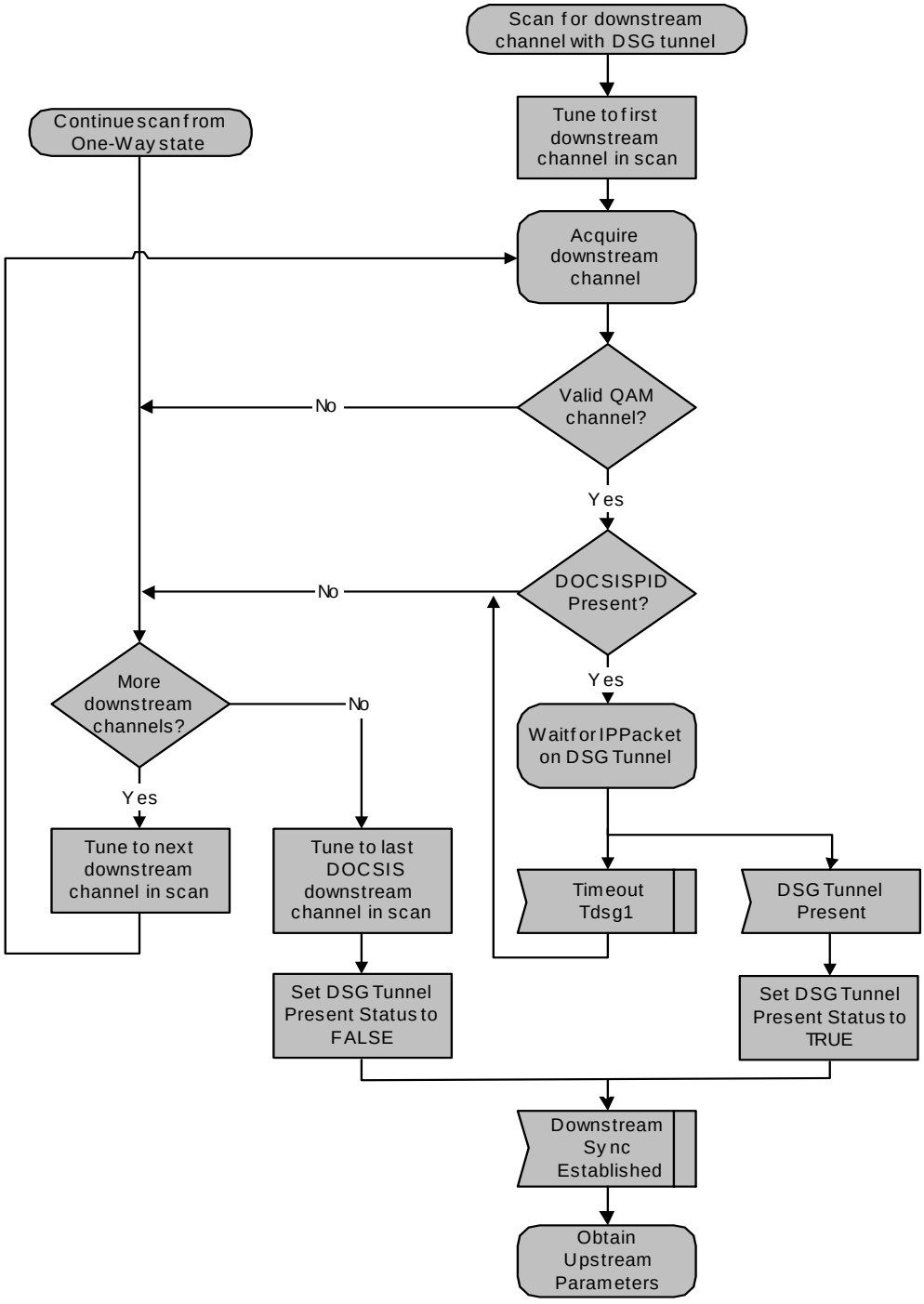


Figure 7 - Advanced Host CM Scan for Downstream

13.1.1.3 Embedded Cable Modem Obtaining Upstream Parameters

This section corresponds to Section 9.2.2 Obtain Upstream Parameters in [30]. The difference in this case is that a T1 timeout takes the embedded CM to the one-way mode of operation.

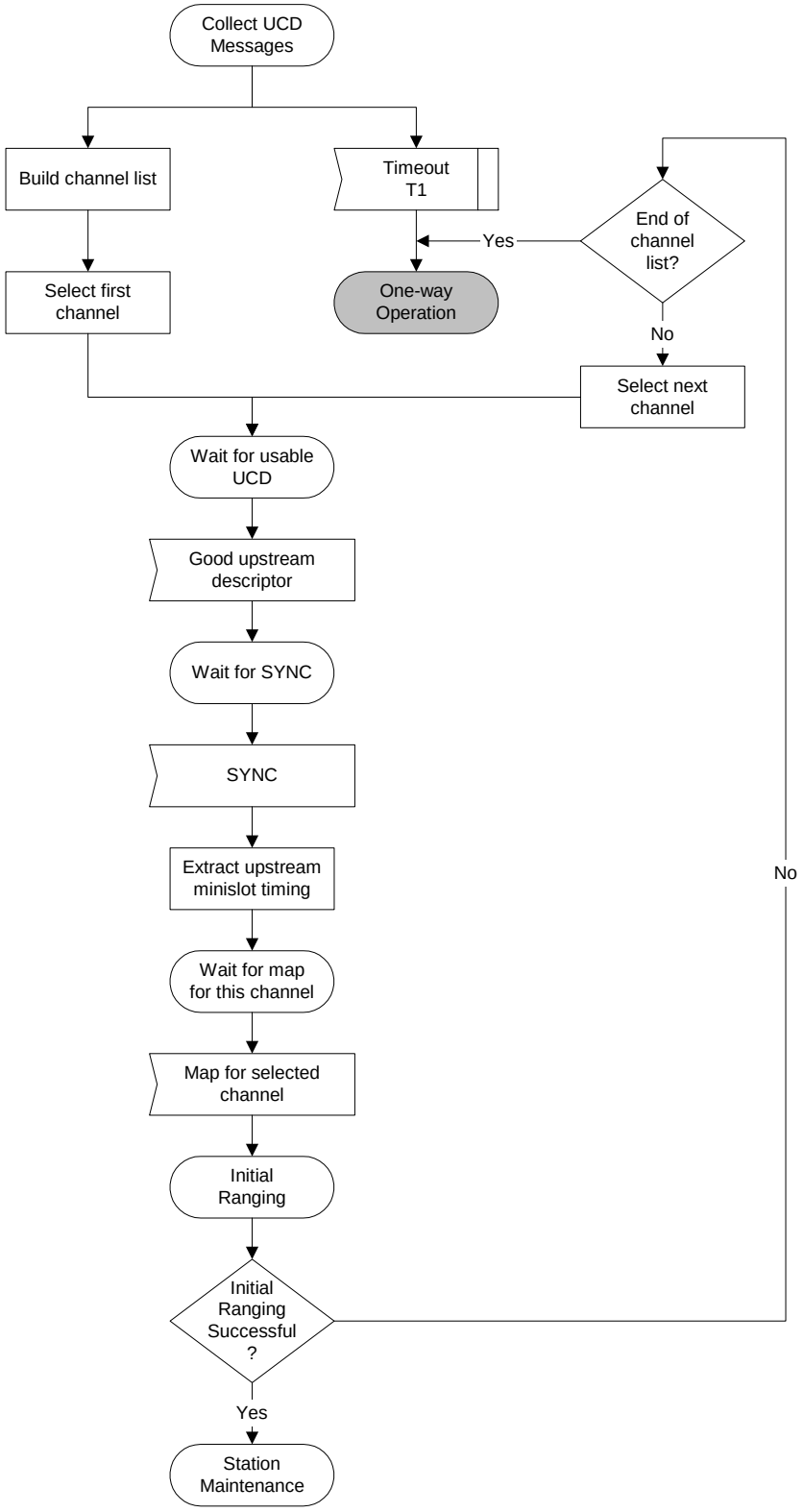
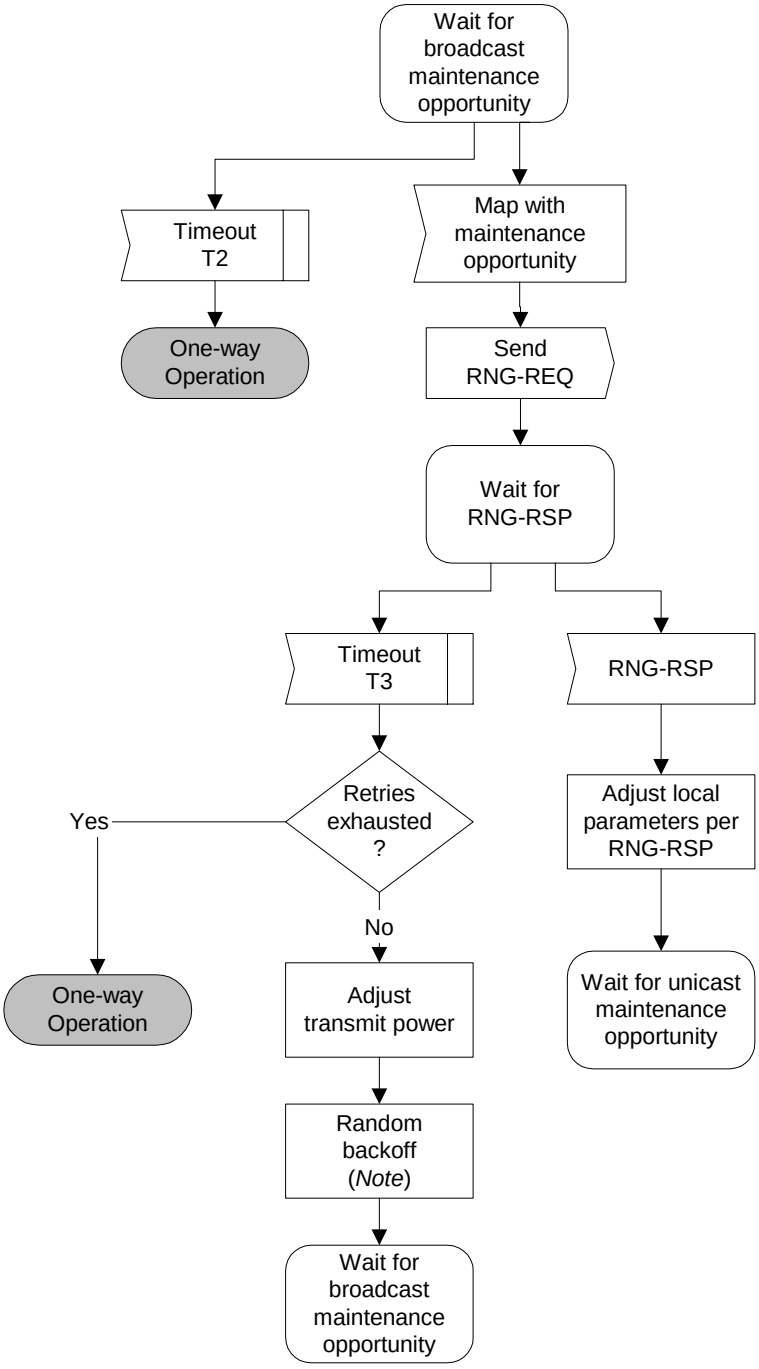


Figure 8 - Advanced Host CM Obtaining Upstream Parameters

13.1.1.4 Embedded Cable Modem Ranging and Automatic Adjustments

This section corresponds to Section 9.2.4 Ranging and Automatic Adjustments in [30]. The differences in this case is that is a T2 or T4 timeout, or other error conditions takes the embedded CM to the one-way mode of operation.



Note: Timeout T3 may occur because the RNG-REQs from multiple modems collided. To avoid theses modems repeating the loop in lockstep, a random backoff is required. This is a backoff over the ranging window specified in the MAP. T3 timeouts can also occur during multi-channel operation. On a system with multiple upstream channels, the CM MUST attempt initial ranging on every suitable upstream channel before moving to the next available downstream channel.

Figure 9 - Advanced Host CM Initial Ranging

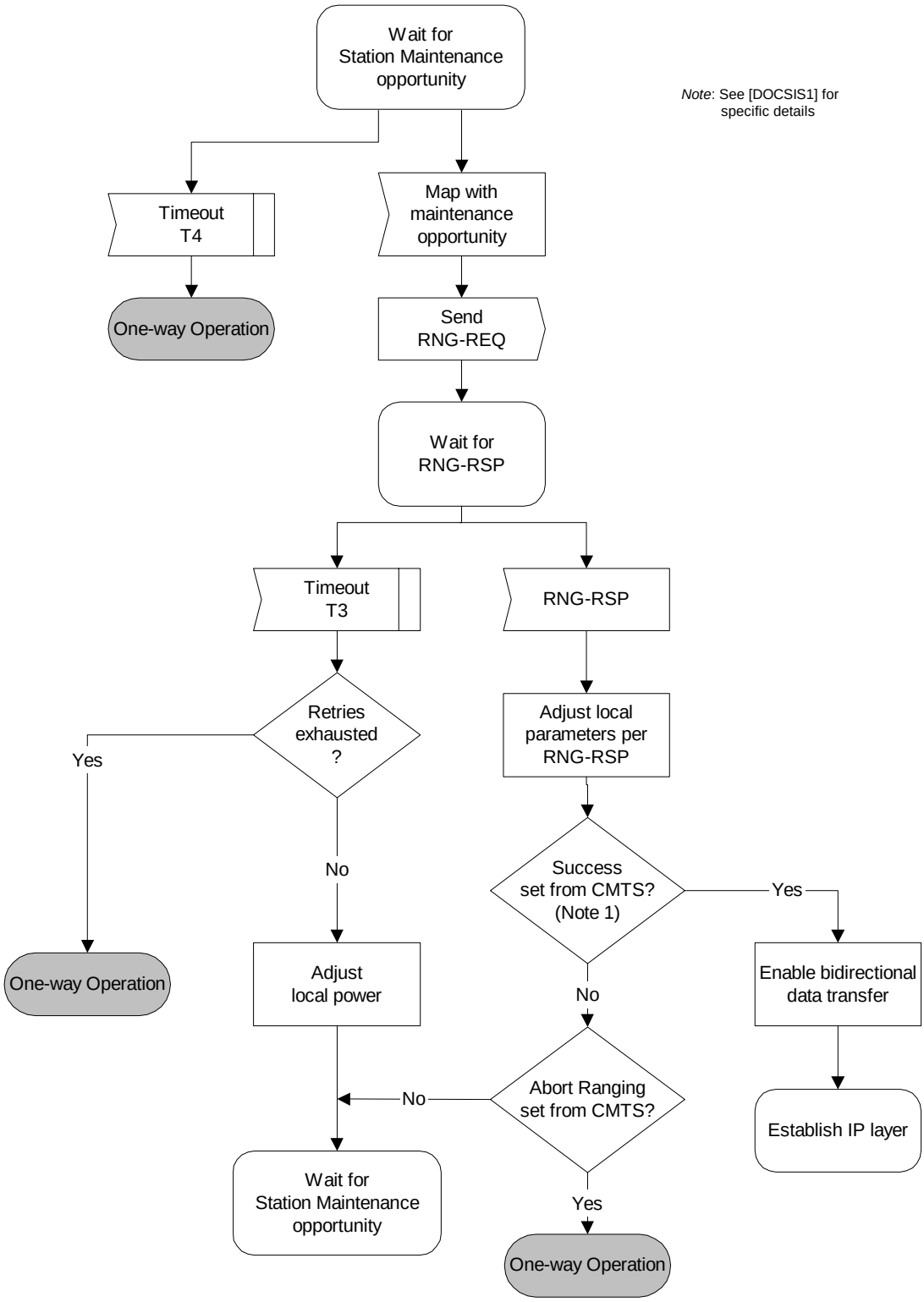


Figure 9 - Advanced Host CM Initial Ranging (continued)

13.1.1.5 Embedded Cable Modem Registration

This section corresponds to Section 9.2.9 Registration in [30]. The difference in this case is that when retries for the Config File are exhausted, T6 timeout retries are exhausted, or the registration response is not OK, the embedded CM is taken to the one-way mode of operation.

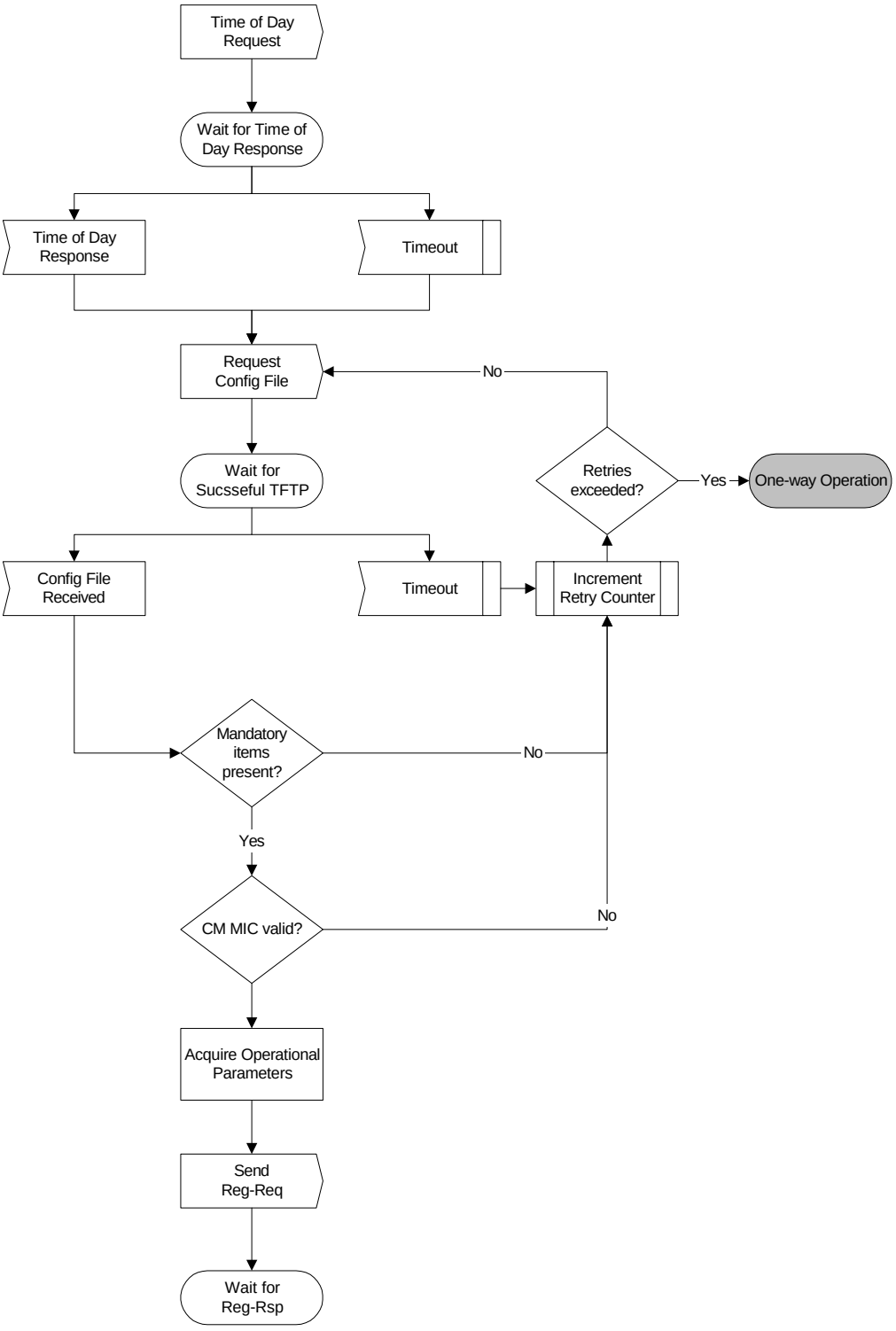


Figure 10 - Advanced Host CM Registration

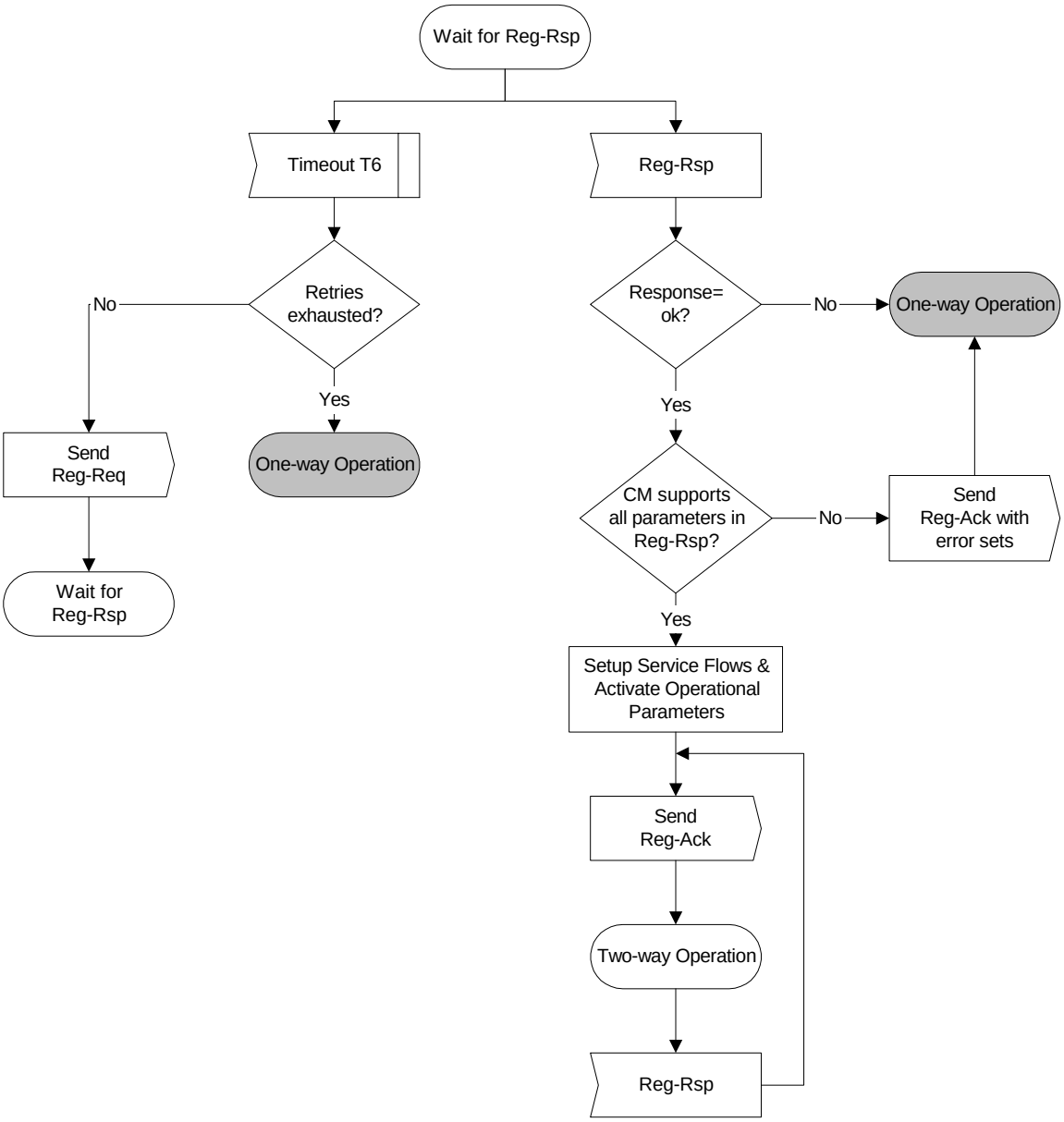


Figure 11 - Advanced Host Wait for Registration Response

13.1.1.6 Embedded Cable Modem Periodic Ranging

This section corresponds to Section 9.3.1 Periodic Signal Level Adjustment in [30]. This difference in this case is that a Tdsg2 timeout is introduced, that indicates that no DSG packets have been received in the past Tdsg2 seconds. A status flag is set to indicate this condition. An SNMP trap MAY be used to signal this condition to the Network Management System.

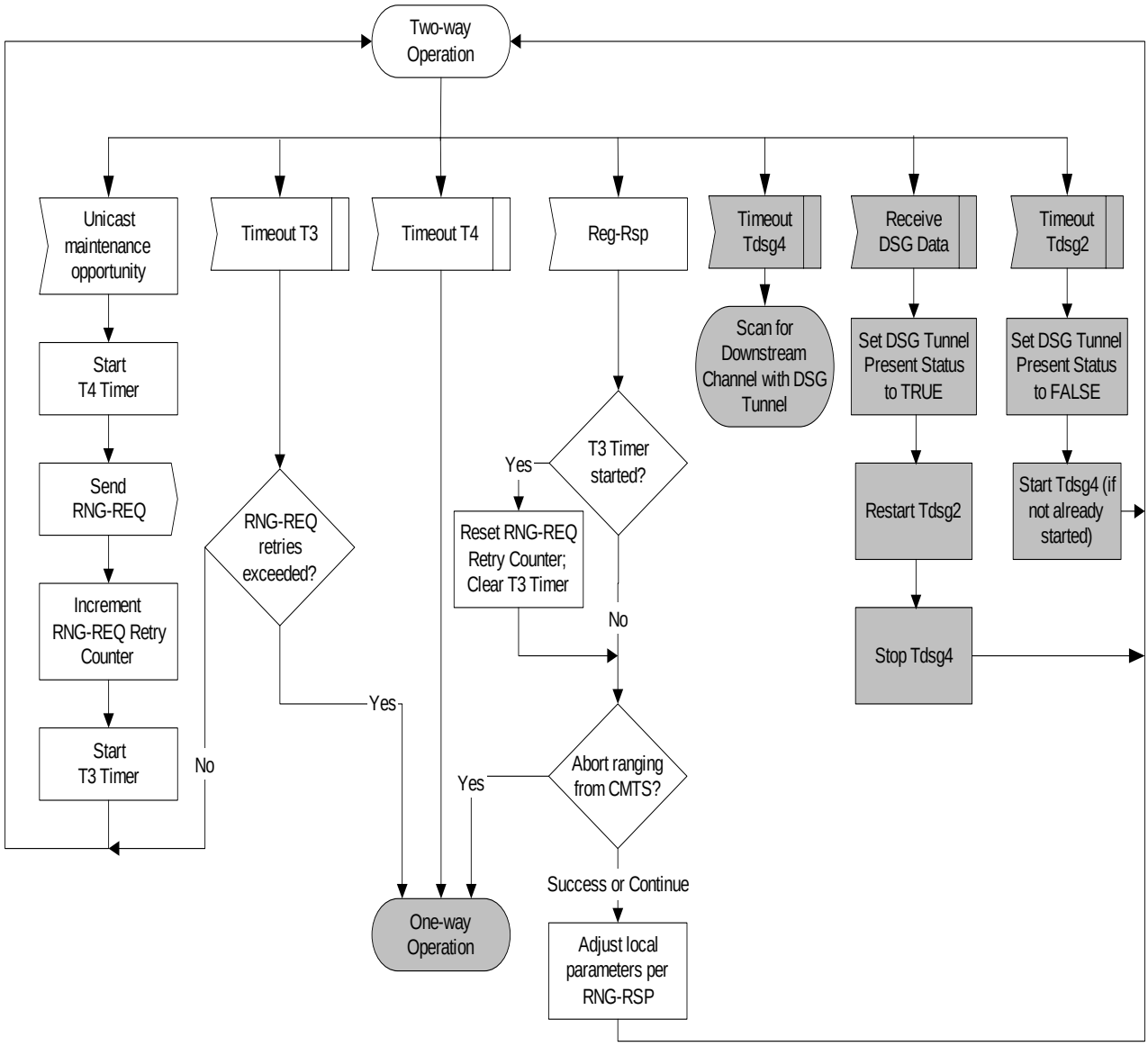


Figure 12 - Advanced Host CM Periodic Ranging

13.1.1.7 One-Way Operation

This section does not have a corresponding section in [30]. This section details the one-way operation of the embedded CM in the Advanced Host. When the embedded CM enters the one-way mode of operation as a

consequence of any of the timeouts or error conditions indicated in the preceding sections it remains tuned to and processes IP packets on the DOCSIS downstream channel.

While the embedded CM is in this mode of operation there are two things that can take place.

1. Periodic attempts to reacquire two-way IP connectivity as a result of the two-way retry timer expiring. Attempts to reacquire two-way IP connectivity start with collecting UCD messages.
2. Tdsg2 timeout on DSG packets.

The second event (Tdsg2 timeout) is more problematic, as the Advanced Host no longer is receiving OOB messaging and it lacks two-way connectivity to signal the headend of this condition. There are typically three events that could give rise to this condition:

1. Temporary outage of the Network Controller
2. Temporary outage of the DOCSIS Set-top Gateway
3. Changing the DOCSIS downstream carrier for the DSG packets

In the first two cases, the embedded CM will remain tuned to the same DOCSIS downstream channel, as the DSG packets will eventually resume on this carrier. In the third case it is necessary for the set-top to rescan for the new DOCSIS downstream carrier. The one-way retry timer is what determines how long the embedded CM waits before attempting this rescan. Alternatively, a dynamic channel change message could be sent to the embedded CMs affected proactively.

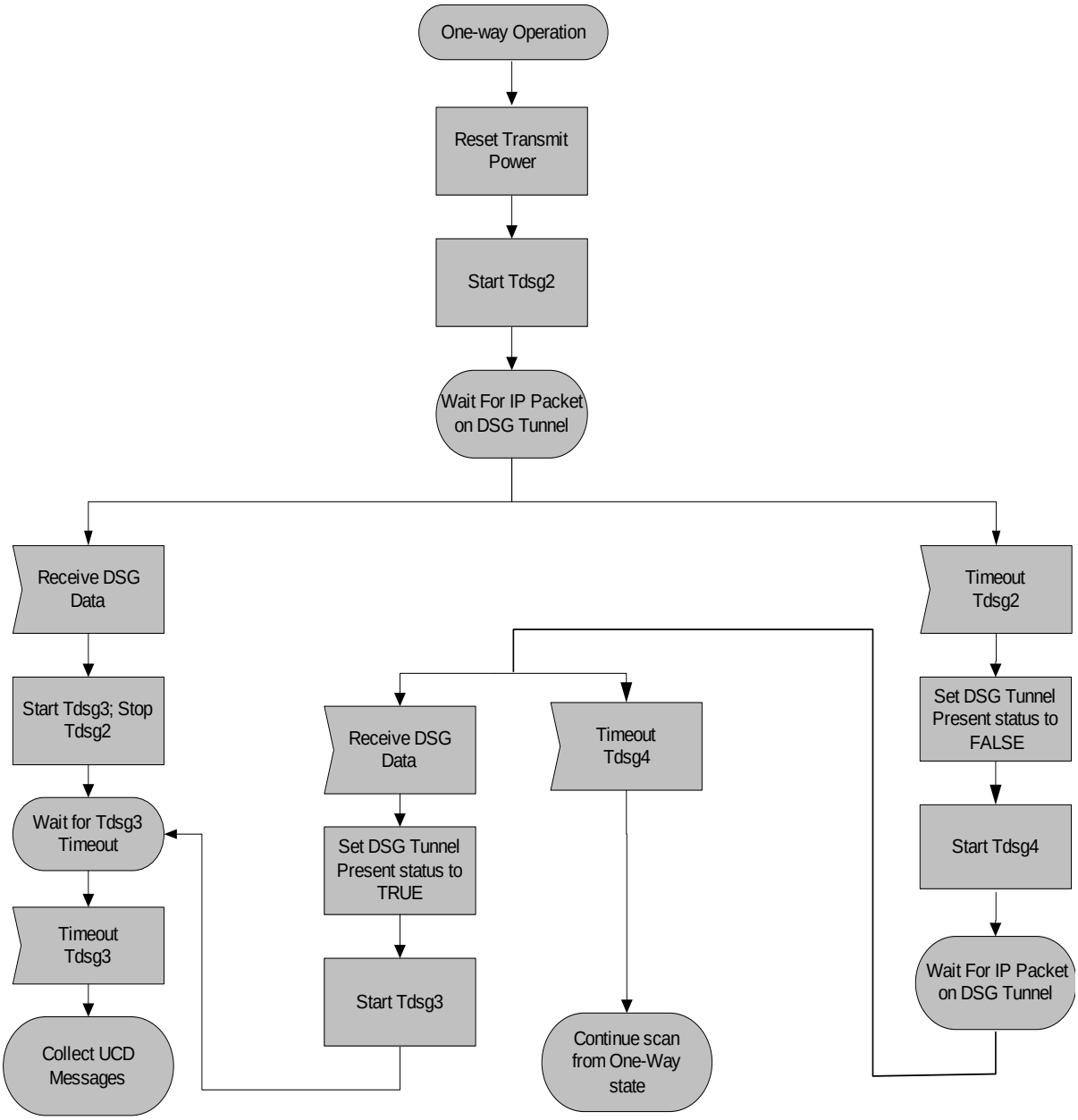


Figure 13 - Advanced Host CM One-way Operation

13.1.2 Timer Values

The following Table contains values for the timers TDSG1-4 introduced in the previous flowcharts.

Table 16 - Timer values

Timer	Flowchart Figure	Value
Tdsg1	Figure 7 - Advanced Host CM Scan for Downstream	2 seconds
Tdsg2	Figure 12 - Advanced Host CM Periodic Ranging	10 minutes
Tdsg3	Figure 13 - Advanced Host CM One-way Operation	5 minutes
Tdsg4	Figure 13 - Advanced Host CM One-way Operation	30 minutes

13.1.3 Software

ADV-BDI-008: The Advanced Host MUST provide an implementation of either version of the OpenCable Application Platform (OCAP) [26], [27].

13.1.3.1 Software Download

ADV-BDI-009: The Advanced Host MUST support the download of software based on the transfer protocols and security systems of DOCSIS and OpenCable as specified in the OpenCable Common Download Specification [28].

13.1.4 DOCSIS Compatibility

ADV-BDI-010: A Host using the DOCSIS Set-top Gateway service MUST coexist with other DOCSIS devices on the same DOCSIS channel (CM+PC, MTA, etc.).

13.1.5 DOCSIS Set-top Gateway

ADV-BDI-011: When operating in the DSG mode of operation the Advanced Host MUST use the DOCSIS Set-top Gateway for transport of Out-of-Band messaging.

13.1.6 DHCP Options

ADV-BDI-012: The OpenCable Advanced Host MUST implement a dual IP stack model: one IP address allocated to the DOCSIS CM and a second, separate IP address allocated to the Host or the Customer Premise Equipment (CPE) component of the device. Therefore, there are at minimum two independent DHCP DISCOVER requests that occur during the device provisioning process. The first DHCP DISCOVER is for the DOCSIS CM and the second is for the CPE device.

ADV-BDI-013: The OpenCable Advanced Host MUST implement the Vendor Class Identifier Option (DHCP option 60) and Vendor Specific Information Option (DHCP option 43) as specified in Table 17.

Table 17 - DHCP Options For OpenCable Advanced Host

DHCP Request Options	Value	Description
Embedded CM DHCP Request		
CM Option 60	"31.1"	
CM Option 43 sub-option 1	request sub-option vector	List of sub-options (within option 43) to be returned by server
CM Option 43 sub-option 2	"ECM"	Embedded cable modem
CM Option 43 sub-option 3	"ECM:ESTB"	List of embedded devices
CM Option 43 sub-option 4	e.g., "123456"	Device serial number
CM Option 43 sub-option 5	e.g., "V1.2.3"	Hardware version number
CM Option 43 sub-option 6	e.g., "V3.2.1"	Software version number
CM Option 43 sub-option 11	"xxxxxx"	CM capabilities
Embedded OpenCable Set-top CPE DHCP Request		
CPE Option 60	"OpenCable1.0"	
CPE Option 43 sub-option 1	request sub-option vector	List of sub-options (within option 43) to be returned by server
CPE Option 43 sub-option 2	"ESTB"	Embedded set-top box
CPE Option 43 sub-option 3	"ECM:ESTB"	List of embedded devices
CPE Option 43 sub-option 4	e.g., "123456"	Device serial number
CPE Option 43 sub-option 5	e.g., "V1.2.3"	Hardware version number
CPE Option 43 sub-option 6	e.g., "V4.5.6"	Software version number
CPE Option 43 sub-option 11	"yyyyy"	Set-top capabilities

14 REQUIREMENTS UNIQUE TO HIGH DEFINITION SET-TOPS

This section describes requirements unique to High Definition Set-tops.

14.1 HD All-Format Decoder

HD-BDI-009:	The MPEG-2 decoder within the HD Set-top MUST be able to decode all MPEG-2 formats in Table 3 of [36] Digital Video Systems Characteristics Standard for Cable Television
HD-BDI-010:	The HD Set-top MUST be able to convert the decoded picture to the selected resolution of the output interface.
HD-BDI-011:	The HD Set-top MUST be able to reduce the resolution of the decoded picture to the defined constrained image resolution when required.

14.2 Physical Interfaces

In addition to the analog audio and video interfaces defined in Section 6, the HD set-top device has the output interface requirements defined in this section.

14.2.1 HD Analog Component Video Interface

HD-BDI-012:	The HD set-top host device MAY have an HD analog component video interface.
HD-BDI-013:	If a HD analog component video interface is present on the HD set-top, it SHALL comply with [34] EIA/CEA-770.3-C, High Definition TV Analog Component Video Interface specification, and employ three RCA Phono connectors (plug and jack) as designated in the [34] EIA/CEA-770.3-B specification and duplicated below in Table 18 - Connector Color Code Assignment.

Table 18 - Connector Color Code Assignment

Signal Assignment	Color Code
Y	Green
PB	Blue
PR	Red

HD-BDI-013a:	If a HD analog component video interface is present on the HD set-top, a user controlled selection switch (hardware or software) MUST be provided to allow the user to match the HD output format with the chosen display.

14.2.2 The DVI HD Digital Interface

HD-BDI-014:	The HD set-top MUST have a Digital Visual Interface - Digital (DVI-D) connector, which at a minimum supports the Single Link Transmission Minimized Differential Signaling as defined in Digital Display Working Group (DDWG) Digital VIsual Interface (DVI) revision 1.0 [37].
HD-BDI-014a:	The DVI interface on the HD Host MUST employ the HDCP encryption system, as defined in the HDCP System specification [38].

14.3 Signal Formats

This subsection lists the requirements on a HD Host with respect to the scanning formats and colorimetry of the HD interfaces.

14.3.1 Scanning Formats for the Analog HD Interface

HD-BDI-015:	If the analog HD video interface is present, each of the MPEG formats described in Table 3 of SCTE 43 2001 (formerly DVS 258) [36] MUST be converted to the selected HD output format on the HD Analog Interface.
HD-BDI-016:	If the analog HD video interface is present, it MUST employ the Y', P_B', P_R' component format according to Section 8 of EIA/770.3-C [34].

14.3.2 Colorimetry for the Analog HD Interface

HD-BDI-017:	If the analog HD video interface is present, the interface colorimetry MUST correspond to the requirements in ITU-R-BT.709 and Section 5 of EIA/770.3-C [34].
HD-BDI-018:	When available, the MPEG sequence display extension MUST be observed to determine when color matrix conversion is necessary. For any standard definition MPEG format listed in Table 8 - Composite Analog Video Output Performance Parameters that does not include the sequence display extension, the colorimetry will be converted by default from SMPTE-170M to ITU-R-BT.709. User selectable colorimetry conversion MAY be available to override default settings.

14.3.3 Scanning Formats for the DVI Interface

HD-BDI-019:	The scanning systems supported on the DVI output MUST include all of those identified as mandatory for a source device in EIA/CEA-861B [35], except for the 640x480p format, which is optional. Other formats listed in EIA/CEA-861B [35] as optional MAY also be provided.
HD-BDI-020:	Each of the MPEG formats described in Table 3 of SCTE 43 2001 (formerly DVS 258) [36] MUST be converted to the preferred format and aspect ratio of the display device connected to the DVI output, as discovered via the Enhanced Extended Display Identification Data (E-EDID) Detailed Timing Descriptions or the CEA Timing Extensions structures communicated from the display to the host via the DVI interface, and as constrained by EIA/CEA-861B [35]. In the event a supported format is not listed in either of these structures, the DVI output must be disabled, unless the 640x480p mode is supported, which can be used instead.

14.3.4 Video Transmission Format for the DVI Interface

HD-BDI-021:	The DVI interface in compliance with this specification MUST employ the RGB component format according to Section 5 of EIA/CEA-861B [35].

14.3.5 Colorimetry for the DVI Interface

HD-BDI-022:	The DVI interface in compliance with this specification MUST employ the colorimetry requirements according to Section 5 of EIA/CEA-861B [35]. When available, the MPEG sequence display extension MUST be observed to determine when color matrix conversion is necessary. User selectable colorimetry conversion MAY be available to override default settings.

14.3.6 Simultaneous Outputs

HD-BDI-023:	HD Video and graphics (including on-screen displays and set-up menus) MAY be output simultaneously to the primary SD NTSC output, the HD analog output (if present), and the HD DVI digital output, subject to copy control restrictions. Note that this may require simultaneous output to interfaces that use different color spaces (RGB for DVI and YPrPb for NTSC and HD analog).
HD-BDI-024:	Incoming Standard Definition video content, received either as an analog or digital signal, MUST be up-converted to support output to the active High Definition output(s).

14.3.7 Middleware

HD-BDI-029:	HD Set-tops MUST provide an implementation of either version of the OpenCable Application Platform (OCAP) [26], [27].

14.3.8 Software Download

HD-BDI-030:	The HD Host MUST support the download of software based on the transfer protocols and security systems of DOCSIS and OpenCable as specified in the OpenCable Common Download Specification [28].

15 REFERENCES

15.1 Normative References

In order to claim compliance with this specification, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights may be required to use or implement such normative references.

[1] ATSC A/52A: ATSC Digital Audio Compression Standard

[2] ATSC A/53B with Amendment 1: ATSC Digital Television Standard

[3] ATSC A/65A and Amendments 1A, 2 and 3: Program and System Information Protocol for Terrestrial Broadcast and Cable

[4] EIA/CEA-542-A: Cable Television Channel Identification Plan

[5] EIA/CEA-608-B: Recommended Practice for Line 21 Data Service

[6] EIA 708B: Digital Television (DTV) Closed Captioning

[7] FCC 47 CFR Chapter 1 (10-1-98 Edition), Part 15 – Radio Frequency Devices, Class B

[8] FCC 47 CFR Chapter 1 (10-1-98 Edition), Part 76 – Cable Television Service

[9] IEEE-1394-1995: Standard for a High Performance Serial Bus

[10] OC-SP-CC-IF-I15-031121: OpenCable CableCARD Interface Specification

[11] OC-SP-CCCP-IF-I12-031121: OpenCable CableCARD Copy Protection System Specification

[12] ISO/IEC 13818-2, 1998, Information technology—Generic coding of moving pictures and associated audio (MPEG): Video

[13] ANSI/SCTE 01 1996 (formerly IPS-SP-400): Recommended “F” Port (Female) Specification

[14] ANSI/SCTE 07 2000 (formerly DVS/031): Digital Video Transmission Standard for Cable Television

[15] EIA-679-B (Part B): National Renewable Security Standard, March 2000

[16] ANSI/SCTE 20 2001 (formerly DVS 157): Standard Methods for Carriage of Closed Captions and Non-Real Time Sampled Video. Note: Non-Real Time Sampled Video support is “optional” for Host Devices.

[17] ANSI/SCTE 55-2 2002 (formerly DVS 167): March 10, 2002, Digital Broadband Delivery System: Out-of-Band Transport – Mode B Part 2: Mode B, Society of Cable Telecommunications Engineers

[18] ANSI/SCTE 55-1 2002 (formerly DVS 178): February 25, 2002, Digital Broadband Delivery System: Out-of-Band Transport Part 1: Mode A

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15.2 Informative References

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[44] ANSI/SCTE 21 2001 (formerly DVS 053): Standard for Carriage of NTSC VBI Data in Cable Digital Transport Streams

[45] SCTE-DVS/216r4: POD Extended Channel Specification

[46] SCTE-DVS/267r1: Point-of-Deployment (POD) Module Firmware Upgrade Host Interface

[47] CableLabs POD-Host Interface License Agreement

15.3 Reference Acquisition

CableLabs Specifications:

Cable Television Laboratories, Inc., 400 Centennial Parkway, Louisville, CO 80027;
Phone: 303-661-9100; Fax 303-661-9199; http://www.cablelabs.com/.

SCTE/DVS Standards:

SCTE - Society of Cable Telecommunications Engineers Inc., 140 Philips Road, Exton, PA 19341
Phone: 610-363-6888 / 800-542-5040; Fax: 610-363-5898; http://www.scte.org/.

ISO/IEC Standards:

ISO Central Secretariat: International Organization for Standardization (ISO), 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland; Internet: http://www.iso.ch/.

DDWG Specifications:

Digital Display Working Group (DDWG), M/S JF3-361; 2111 NE 25th Avenue, Hillsboro, OR 97124-5961, USA. Fax +1-503-264-5959; Email: ddwg.if@intel.com; Internet: www.ddwg.org

16 REVISION HISTORY

OC-SP-HOST-CFR-I15-031121 – contains modifications per ECNs: 03-0431, 03-0454, 03-0466, 03-0471, 03-0473, 03-0502

OC-SP-HOST-CFR-I14-030905 – contains editorial changes, updating POD to CableCARD

OC-SP-HOST-CFR-I13-030707 – contains modifications per ECNs: 02-0247, 02-0251, 02-0295, 02-0333, 02-0334, 03-0370, 03-0387, 03-0417, 03-0432

OC-SP-HOST-CFR-I12-030210 – contains modifications per ECNs: 02-0250, 02-0304, 02-0318, 02-0332, 02-0340

OC-HOST-CFR-I11-021126 – contains modifications per ECNs: 02-299r1, 02-0286, 02-0287, 02-0288, 02-0290, 02-0303, 02-0309

OC-HOST-CFR-I10-020628 – contains only editorial reformatting and updates/corrections to obvious cross-reference errors, no ECNs are included in the modifications.

OC-HOST-CFR-I09-020524 – contains modifications per ECN02-0248, and ECN02-0249.

OC-HOST-CFR-I08-020331 – contains modifications per ECN01234, ECN020236, ECN020237, ECN020238, ECN020241, and ECN020252.

OC-HOST-CFR-I07-011207 – contains modifications per ECN01224, ECN01226, ECN01227 and ECN01230.

CFR-OCS-BDC-INT06-010803 – contains modifications per ECN01223.

CFR-OCS-BDC-INT05-010515 - contains modifications per ECN00200, ECN01205, ECN01208, ECN01210, ECN00186, ECN01218.

CFR-OCS-BDC-INT04-010122 – contains modifications per ECN00035, ECN00139, ECN00153, ECN00162, ECN 00164, ECN00171, ECN00182, ECN 00183, ECN 00185, ECN00199, ECN00201, ECN00204.

CFR-OCS-BDC-INT03-000818 – contain modifications per ECN99018, ECN99022, ECN99023, ECN00033, ECN00034, ECN00036, ECN00037, ECN00040, ECN00043, ECN00048, ECN00055, ECN00060, ECN00084, ECN00095, ECN00117, ECN00123, ECN00129, ECN00130, ECN00134, ECN00135, ECN00144, ECN00149, ECN00152, and ECN00155.

CFR-OCS-DC-INT02-000418 – contain modifications per ECN99014, ECN99015, ECN00021, ECN00038, ECN00039, ECN00041, and ECN00044.