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OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

Interactive systems for digital television distribution

Embedded Cable Modem device specification

ITU-T Recommendation J.126

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ITU-T Recommendation J.126

Embedded Cable Modem device specification

Summary

ITU-T Recommendation J.126 defines additional features that must be added to a Cable Modem for implementations that embed the Cable Modem with another application, such as an IPCablecom multimedia terminal adapter (MTA).

Source

ITU-T Recommendation J.126 was approved on 14 December 2007 by ITU-T Study Group 9 (2005-2008) under the ITU-T Recommendation A.8 procedure.

History

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FOREWORD

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ITU-T Recommendation J.126

Embedded Cable Modem device specification

1 Scope

This Recommendation defines additional features that must be added to a Cable Modem for implementations that embed the Cable Modem with another application, such as an IPCablecom MTA.

NOTE – The structure and content of this Recommendation have been organized for ease of use by those familiar with the original source material; as such, the usual style of ITU-T Recommendations has not been applied.

2 References

2.1 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[BB]	ITU-T Recommendation J.199 (2006), <i>Battery backup for cable-based devices</i> .
[BPI+]	ITU-T Recommendation J.125 (2004), <i>Link privacy for cable modem implementations</i> .
[DOCSIS0-OSSI]	ANSI/SCTE 22-3 2002, <i>Data-Over-Cable Service Interface Specification DOCSIS 1.0 Part 3: Operations Support System Interface (OSSI)</i> .
[DOCSIS0-RFI]	ANSI/SCTE 22-1 2002, <i>Data-Over-Cable Service Interface Specification DOCSIS 1.0 Radio Frequency Interface (RFI)</i> .
[DOCSIS1-OSSI]	ANSI/SCTE 23-3 2005, <i>DOCSIS 1.1 Part 3: Operations Support System Interface</i> .
[DOCSIS1-RFI]	ITU-T Recommendation J.112 Annex B (2004), <i>Data-over-cable service interface specifications: Radio-frequency interface specification</i> .
[DOCSIS2-OSSI]	ANSI/SCTE 79-2 2002, <i>DOCS 2.0 Operations Support System Interface</i> .
[DOCSIS2-RFI]	ITU-T Recommendation J.122 (2007), <i>Second-generation transmission systems for interactive cable television services – IP cable modems</i> .
[DOCSIS3-MULPI]	ITU-T Recommendation J.222.2 (2007), <i>Third-generation transmission systems for interactive cable television services – IP cable modems: MAC and upper layer protocols</i> .
[DOCSIS3-OSSI]	ANSI/SCTE 135-4 2007, <i>DOCSIS 3.0 Operations Support System Interface</i> .
[DOCSIS-OSSI]	Refers to [DOCSIS1-OSSI], [DOCSIS2-OSSI] and [DOCSIS3-OSSI].
[DOCSIS-RFI/MULPI]	Refers to [DOCSIS1-RFI], [DOCSIS2-RFI] and [DOCSIS3-MULPI].

[DSG]	ITU-T Recommendation J.128 (2005), <i>Set-top gateway specification for transmission systems for interactive cable television services.</i>
[eRouter]	ITU-T Recommendation J.218 (2007), <i>Cable modem IPv4 and IPv6 eRouter specification.</i>
[IETF RFC 768]	IETF RFC 768 (1980), <i>User Datagram Protocol.</i>
[IETF RFC 791]	IETF RFC 791 (1981), <i>Internet Protocol – DARPA Internet Program – Protocol Specification.</i>
[IETF RFC 1493]	IETF RFC 1493 (1993), <i>Definitions of Managed Objects for Bridges.</i>
[IETF RFC 2011]	IETF RFC 2011 (1996), <i>SNMPv2 Management Information Base for the Internet Protocol using SMIv2.</i>
[IETF RFC 2131]	IETF RFC 2131 (1997), <i>Dynamic Host Configuration Protocol.</i>
[IETF RFC 2132]	IETF RFC 2132 (1997), <i>DHCP Options and BOOTP Vendor Extensions.</i>
[IETF RFC 2863]	IETF RFC 2863 (2000), <i>The Interfaces Group MIB.</i>
[IETF RFC 3396]	IETF RFC 3396 (2002), <i>Encoding Long Options in the Dynamic Host Configuration Protocol (DHCPv4).</i>
[IETF RFC 3418]	IETF RFC 3418 (2002), <i>Management Information Base (MIB) for the Simple Network Management Protocol (SNMP).</i>
[IETF RFC 4293]	IETF RFC 4293 (2006), <i>Management Information Base for the Internet Protocol (IP).</i>

2.2 Informative references

[CableHome]	CableLabs (http://www.cablelabs.com/projects/cablehome/).
[CANN-DHCP]	<i>CableLabs DHCP Options Registry</i> , CL-SP-CANN-DHCP-Reg-I01-070119, January 19, 2007, Cable Television Laboratories, Inc.
[CCIF 2.0]	<i>CableCARDTM Interface 2.0 Specification</i> , OC-SP-CCIF2.0-I09-070105, January 5, 2007, Cable Television Laboratories, Inc.
[CH10]	ITU-T Recommendation J.191 (2004), <i>IP feature package to enhance cable modems.</i>
[CH11]	ITU-T Recommendation J.192 (2004), <i>A residential gateway to support the delivery of cable data services.</i>
[DOCSIS]	CableLabs (http://www.cablemodem.com/specifications/).
[HOST2.0]	<i>OpenCable Host Device 2.0 Core Functional Requirements</i> , OC-SP-HOST2.0-CFR-I14-070615, June 15, 2007, Cable Television Laboratories, Inc.
[IETF RFC 2578]	IETF RFC 2578 (1999), <i>Structure of Management Information Version 2 (SMIv2).</i>
[PacketCable]	CableLabs (http://www.packetcable.com/specifications/).
[PC10-MTA]	ITU-T Recommendation J.167 (2001), <i>Media terminal adapter (MTA) device provisioning requirements for the delivery of real-time services over cable television networks using cable modems.</i>
[PC10-MIB]	ITU-T Recommendation J.166 (2001), <i>IPCablecom Management Information Base (MIB) framework.</i>

[TEI] ITU-T Recommendation J.214 (2007), *Cable modem TDM emulation interface*.

3 Definitions

This Recommendation defines the following terms:

3.1 CableHome: This is a Cable Television Laboratories, Inc. ("CableLabs") specification (see <http://www.cablelabs.com/projects/cablehome/>) for the interfaces necessary to extend high-quality cable-based services to network devices within the home. The CableHome project addresses issues such as device interoperability, QoS (Quality of Service), and network management. This term is also used for a system or device that is compliant with the CableHome specifications [CH10] or [CH11].

3.2 DOCSIS: The term for a system or device compliant with any one of the Cable Television Laboratories, Inc. ("CableLabs") series of specifications located at: <http://www.cablemodem.com/specifications/>.

3.3 CableModem base specifications: There are currently four versions of what are in this Recommendation referred to as the CableModem Base Specifications. The original CableModem is specified in SCTE 22-1 2002: *DOCSIS 1.0 Radio Frequency Interface* and SCTE 22-3. SCTE 22-1 is J.112 (1998) with some corrections and minor additions. The second specification is J.112 with SCTE 23-3, the third specification is J.122 with SCTE 79-2, and the fourth specification is J.222.

3.4 eCM: An eCM is an embedded Cable Modem, i.e., one that has been enhanced with the features of this Recommendation.

3.5 eDOCSIS: eDOCSIS is a CableLabs specification that defines the interface between the eCM and an eSAFE. The international version of the specification is this Recommendation.

3.6 eDOCSIS device: An eDOCSIS device is one that includes an eCM entity, one or more eSAFEs and supports a single software image using a CableModem secured software download mechanism.

3.7 embedded multimedia terminal adapter (eMTA): An embedded version of an MTA.

3.8 embedded MTA device (e-MTA): An eDOCSIS device that contains both an eMTA and an eCM.

3.9 embedded portal service element (ePS): An IPcable2Home-compliant eSAFE that provides management and network address translation functions between the cable data network and the home network.

3.10 logical CPE interface: A bidirectional, data-only 802.3/Ethernet MAC frame interface between eCM and an eSAFE.

3.11 multimedia terminal adapter (MTA): An IPcablecom device that contains the interface to a physical voice device, a network interface, CODECs, and all signalling and encapsulation functions required for VoIP transport, class features signalling and QoS signalling.

3.12 embedded service/application functional entity (eSAFE): An embedded version of a specified application, such as an IPcablecom multimedia terminal adapter (MTA), that provides a service using the CableModem IP platform, or a function or set of functions, such as the IPcable2Home Portal Service logical element, that supports the delivery of one or more services over an IP platform.

3.13 PacketCable: PacketCable is a CableLabs specification located at: <http://www.packetcable.com/specifications/>. The PacketCable specifications are interoperable interface specifications for delivering advanced, real-time multimedia services over a two-way cable plant. Built on top of the industry's highly successful cable modem infrastructure,



Documents

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PacketCable networks uses Internet Protocol (IP) technology to enable a wide range of multimedia services, such as IP telephony, multimedia conferencing, interactive gaming, and general multimedia applications. This term is also applicable to a system or device that is compliant to the PacketCable specifications. The international version of PacketCable is standardized in ITU-T J-series Recommendations J.160 to J.179.

3.14 point of deployment (POD) module: A removable conditional access module which, when inserted into certain eSTB implementations, enables delivery of digital video programming and other services. POD module functionality includes copy protection and signal demodulation. The interface between the POD module and the eSTB is specified by [CCIF 2.0].

3.15 eRouter: DOCSIS Embedded Router. An eSAFE that is compliant with [eRouter], providing version 4 and/or version 6 Internet Protocol-formatted data forwarding, address configuration, and Domain Name services to Internet Protocol host devices connected to the cable modem in a customer's premises.

3.16 embedded set-top box (eSTB): An eSAFE that is compliant with [DSG], providing video, audio and data services. An example OpenCable-compliant eSTB is further specified in [HOST2.0].

3.17 embedded TDM emulator adapter (eTEA): An eSAFE that is compliant with [TEI], providing T1 and E1 Circuit transport over IP.

3.18 monolithic firmware image: A single firmware image containing one or more code images for the entire eDOCSIS device. For eDOCSIS devices, the Monolithic Firmware Image contains both the eCM code image as well as the applicable eSAFE code image. As an example for an eDOCSIS device containing an eSTB, the Monolithic Firmware Image contains the eCM code image as well as the eSTB code image (which may also be composed of multiple eSTB code images).

3.19 network virtual terminal (NVT): As defined in the Telnet Protocol. NVT was a bidirectional character device, representing characters as 7-bit ASCII codes, using an 8-bit field.

3.20 OpenCable host eSTB: An eSTB device built to CableLabs OpenCable Host specifications.

3.21 embedded security eSTB: An eSTB with integrated security functions.

3.22 secure microprocessor: The security element in a device that supports downloadable conditional access.

3.23 set-top device: An eDOCSIS device that contains an eSTB.

3.24 time division multiplexing (TDM): The means by which multiple digital signals can be carried on a single transmission path by interleaving portions of each signal in time.

4 Abbreviations and conventions

4.1 Abbreviations

This Recommendation uses the following abbreviations:

ASCII	American Standard Code for Information Interchange
BSoD	Business Services over DOCSIS
CATV	Community Access Television, Cable Television
CM	Cable Modem
CMCI	Cable Modem to Customer Premises Equipment Interface
CMTS	Cable Modem Termination System

CVC	Code Verification Certificate
DHCP	Dynamic Host Configuration Protocol
DIX	Digital Intel Xerox
DNS	Domain Name Server
DOCSIS	Data-Over-Cable Service Interface Specifications
DSG	DOCSIS Set-top Gateway
eCM	embedded Cable Modem
eDOCSIS	embedded DOCSIS
eMTA	embedded Multimedia Terminal Adapter
ePS	embedded Portal Services Element
eSTB	embedded Set-Top Box
eSAFE	embedded Service/Application Functional Entity
eTEA	embedded T1/E1 TDM Emulation Adapter (TEA)
FCS	Frame Check Sequence
FQDN	Fully Qualified Domain Name
IP	Internet Protocol
LCI	Logical CPE Interface
LLC	Logical Link Control
MAC	Media Access Control
MIC	Message Integrity Check
MTA	Multimedia Terminal Adapter
OCAP	Open Cable Application Platform
PS	Portal Service
RF	Radio Frequency
ROM	Read-Only Memory
SAFE	Service/Application Functional Entity
SLED	Software Loopback for eDOCSIS
SNMP	Simple Network Management Protocol
SW	Software
SSD	Secure Software Download
TDM	Time Division Multiplexing
TFTP	Trivial File Transfer Protocol
TLV	Type/Length/Value
UDP	User Datagram Protocol
UPS	Uninterrupted Power Supply
USB	Universal Serial Bus
WAN	Wide Area Network

4.2 Conventions

Throughout this Recommendation, the words that are used to define the significance of particular requirements are capitalized. These words are:

MUST	This word or the adjective "REQUIRED" means that the item is an absolute requirement of this Recommendation.
MUST NOT	This phrase means that the item is an absolute prohibition of this Recommendation.
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 behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour 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.

5 Embedded cable modem

The goals for this Recommendation are:

- to preserve functional separation of the Cable Modem entity from eSAFEs within the eDOCSIS device, so that existing cable plant integrity, cable modem configuration, management and provisioning security are not compromised;
- to isolate Cable Modem functionality so that compliance can be tested for the eCM component independent of eSAFEs;
- to enable the service provider to enable or disable forwarding traffic between each eSAFE and the eCM within the eDOCSIS Device;
- to maximize compatibility with existing back-office management/provisioning infrastructure so that new services enabled by eDOCSIS devices can be deployed rapidly;
- to architect eDOCSIS devices in such a way as to scale to new services and applications, and to take advantage of technology innovations to achieve low cost and high functionalities.

5.1 Device interface reference model

As per Figure 5-1, an eDOCSIS device consists of an embedded cable modem (eCM) and one or more embedded service/application functional entities (eSAFEs). An eDOCSIS device may also have one or more physically exposed interfaces. In addition, only a single secured software image download is used for the entire eDOCSIS device.

eSAFEs include:

- ePS: embedded IPCable2Home portal services logical element [CH10].
- eMTA: embedded IPCablecom multimedia terminal adapter [PC10-MTA] and [PC10-MIB].

- eSTB: embedded set-top box: An eSAFE that is compliant with [DSG], providing video, audio and data services. An example OpenCable-compliant eSTB is further specified in [HOST2.0].
- eTEA: embedded T1/E1 TDM Emulation Adapter (eTEA) [TEI].
- eRouter: An eSAFE that is compliant with [eRouter], providing Internet Protocol data forwarding, address configuration, and Domain Name services.

Within an eDOCSIS device, each eSAFE interfaces to the eCM via a point-to-point logical CPE interface.

Figure 5-2 presents a typical IPcable2Home Home Access eDOCSIS Device reference model.

Figure 5-3 presents a logical view of protocol stacks for an eCM to ePS interface.

Figure 5-4 presents a typical IPcablecom E-MTA eDOCSIS Device reference model.

Figure 5-5 presents a logical view of protocol stacks for an eCM to eMTA interface.

Figure 5-6 presents a typical OpenCable Host 2.0 eDOCSIS Device reference model where the Host provides DSG Flow, Socket Flow and IP Flow support.

NOTE 1 – The POD module may support Socket Flow or IP Flow or both, but neither is supported simultaneously by the Host.

Figure 5-7 presents a logical view of protocol stacks for an OpenCable Host 2.0 eCM to eSTB to POD module interface where the Host provides DSG Flow, Socket Flow and IP Flow support.

NOTE 2 – The POD module may support Socket Flow or IP Flow or both, but neither is supported simultaneously by the Host.

Figure 5-8 presents a typical embedded security STB eDOCSIS device reference model.

Figure 5-9 presents a logical view of protocol stacks for an eCM to eSTB interface (embedded security STB).

Figure 5-10 presents a typical T1/E1 TDM emulation adapter (TEA) eDOCSIS device reference model.

Figure 5-11 presents a logical view of protocol stacks for an eCM to eTEA interface (embedded TDM emulation adapter).

Figure 5-12 presents a typical DOCSIS eRouter eDOCSIS device reference model.

Figure 5-13 presents a logical view of protocol stacks for an eCM to IPv4 eRouter interface.

Figure 5-14 presents a logical view of protocol stacks for an eCM to IPv6 eRouter interface.

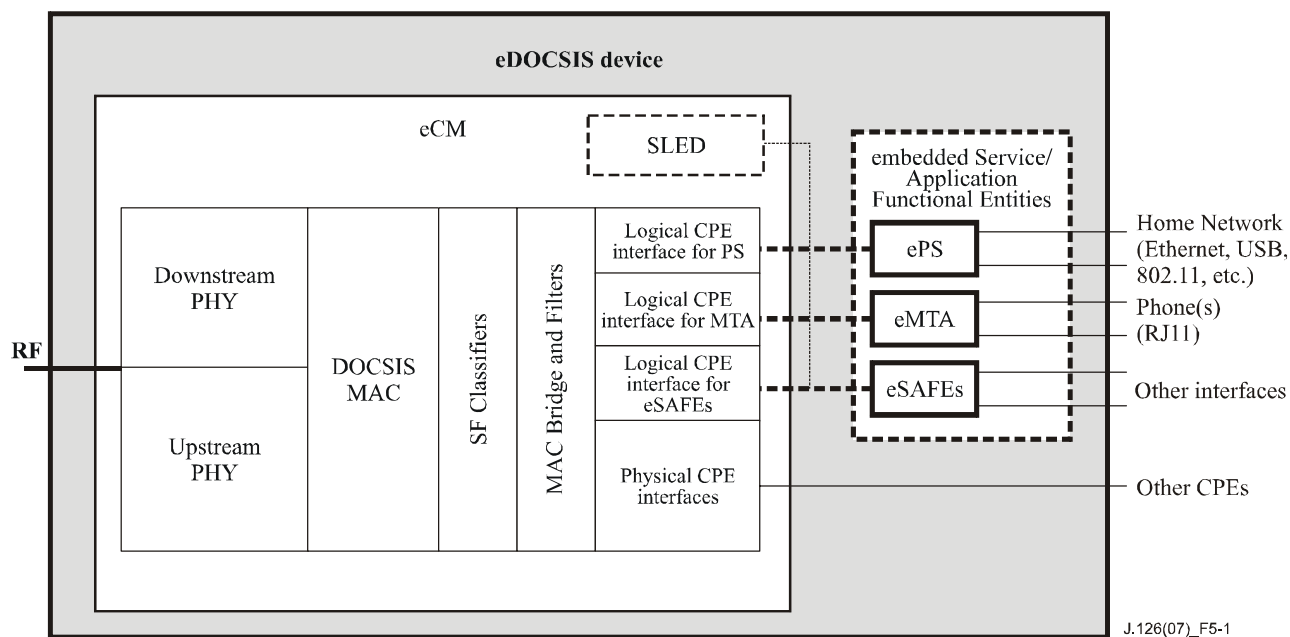


Figure 5-1 – eDOCSIS reference model

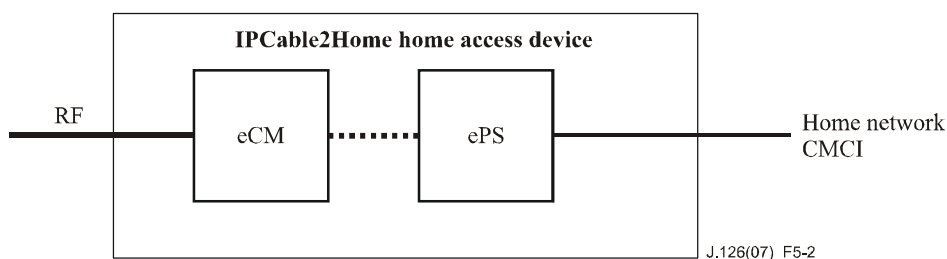


Figure 5-2 – IPCable2Home home access eDOCSIS device reference model

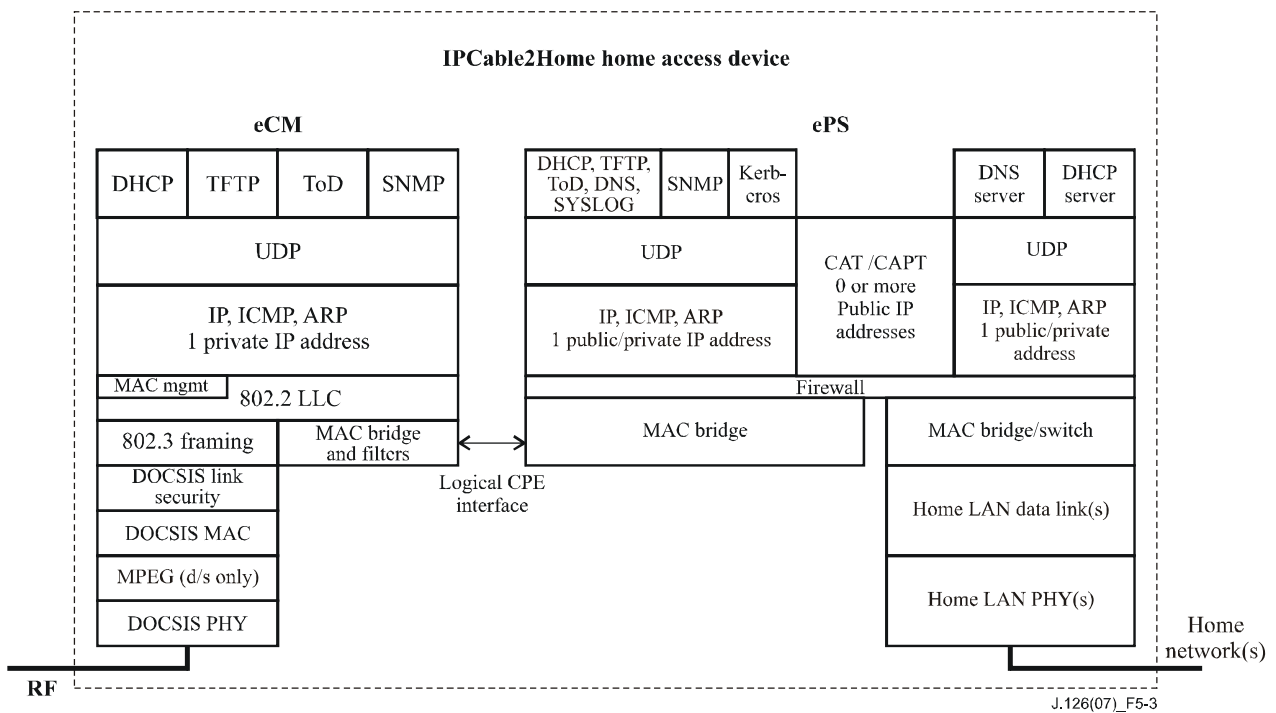


Figure 5-3 – eCM-ePS protocol stacks

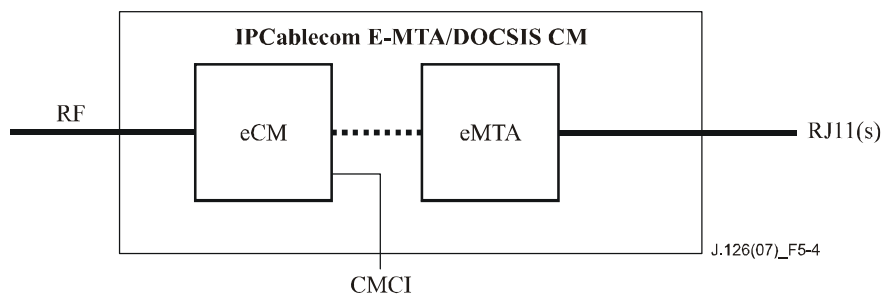


**Figure 5-4 – IPCablecom E-MTA (with DOCSIS CM)
eDOCSIS reference model**

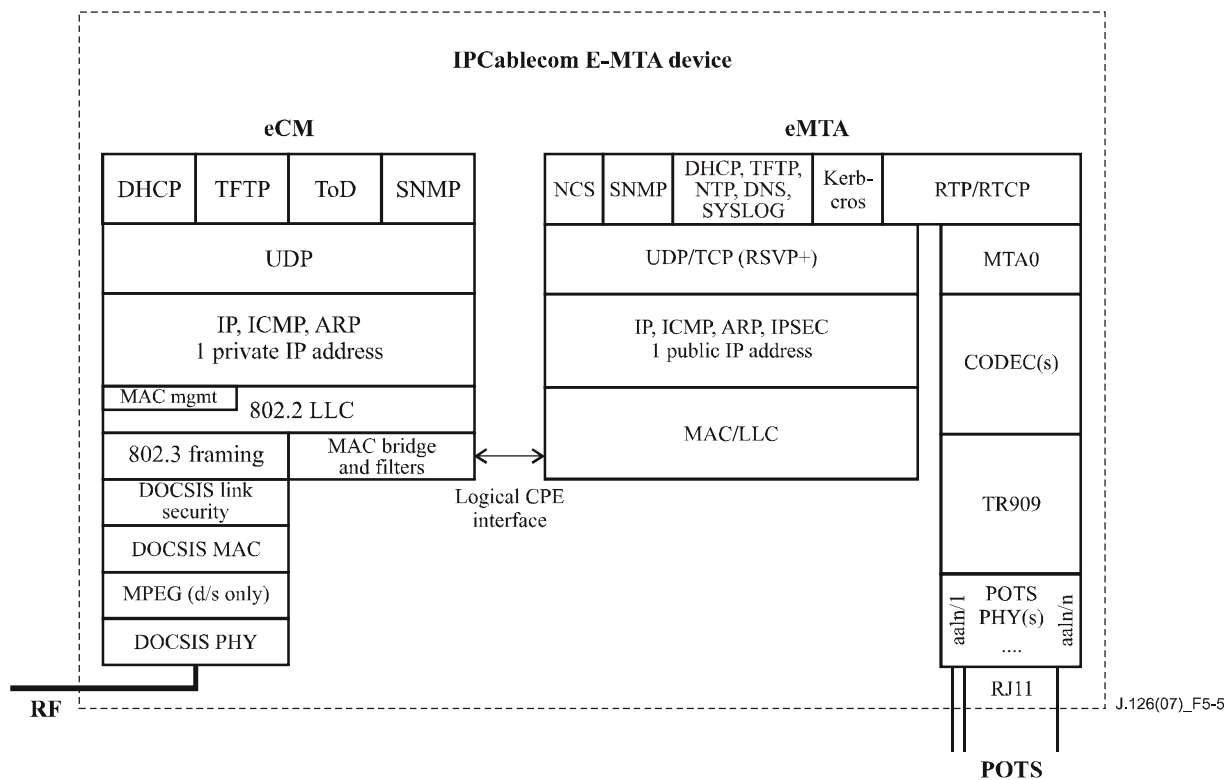


Figure 5-5 – eCM-eMTA protocol stacks

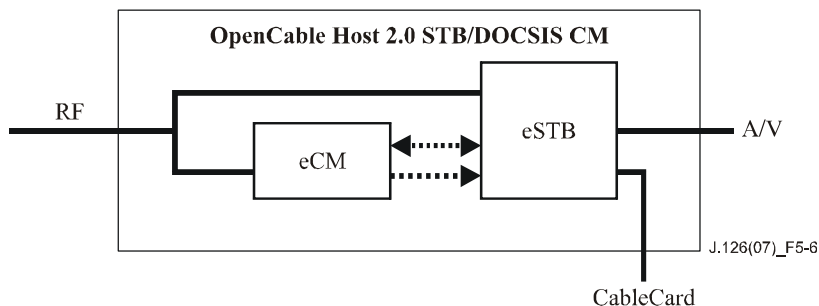


Figure 5-6 – OpenCable Host 2.0 eDOCSIS reference model

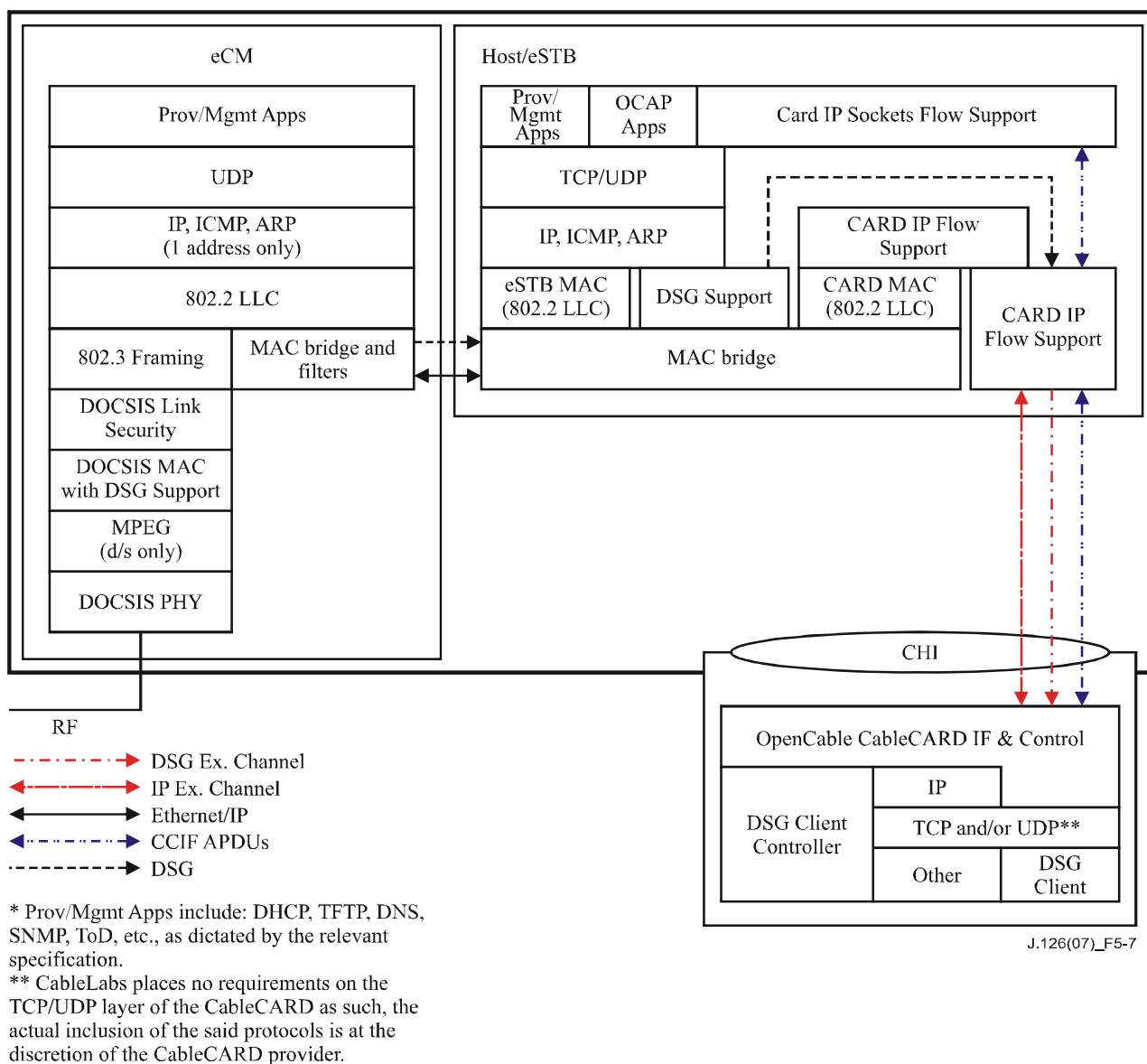


Figure 5-7 – eCM-eSTB protocol stacks – OpenCable Host 2.0 – Unicast IP flow

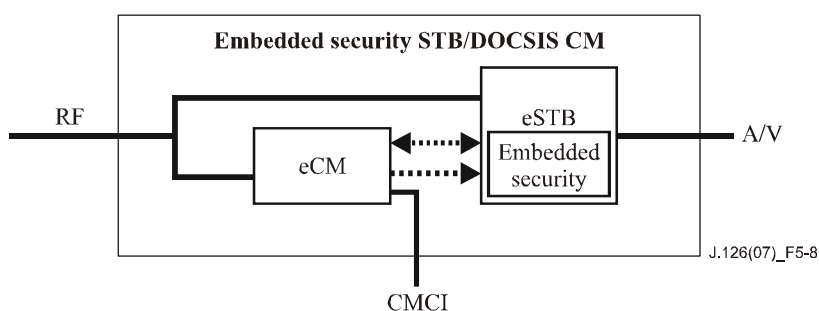


Figure 5-8 – Embedded security STB eDOCSIS reference model

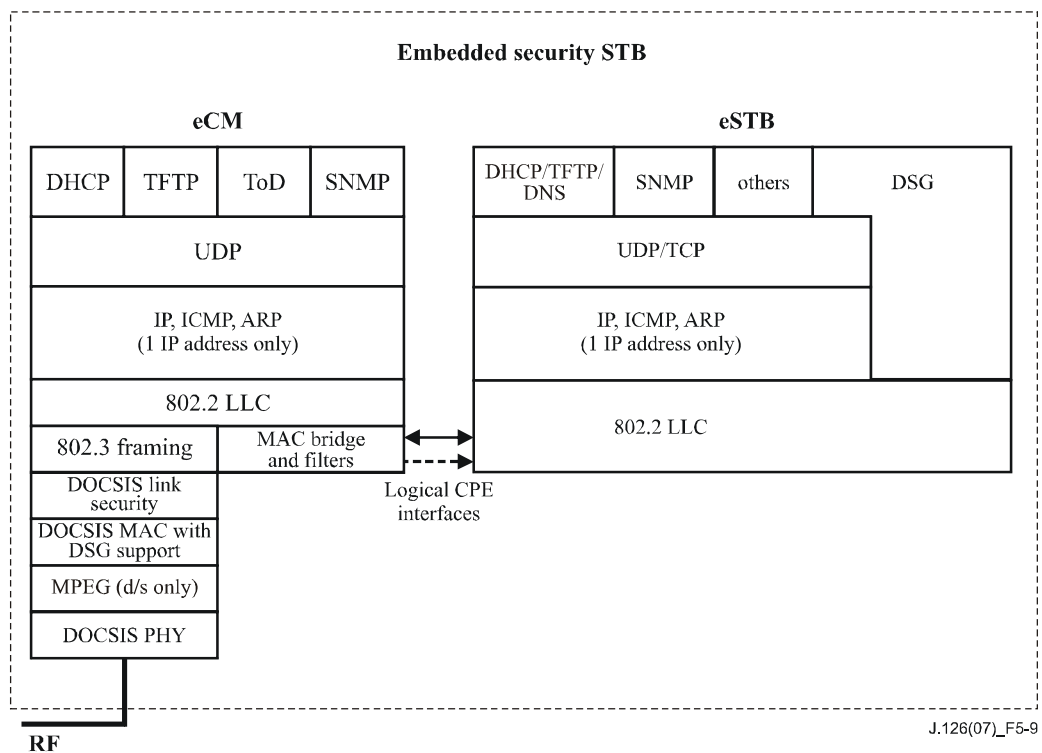


Figure 5-9 – eCM-eSTB protocol stacks – Embedded security STB

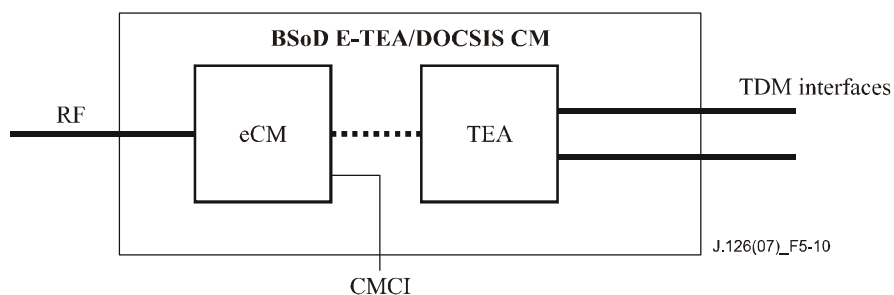


Figure 5-10 – BSoD eTEA (with DOCSIS CM) eDOCSIS reference model

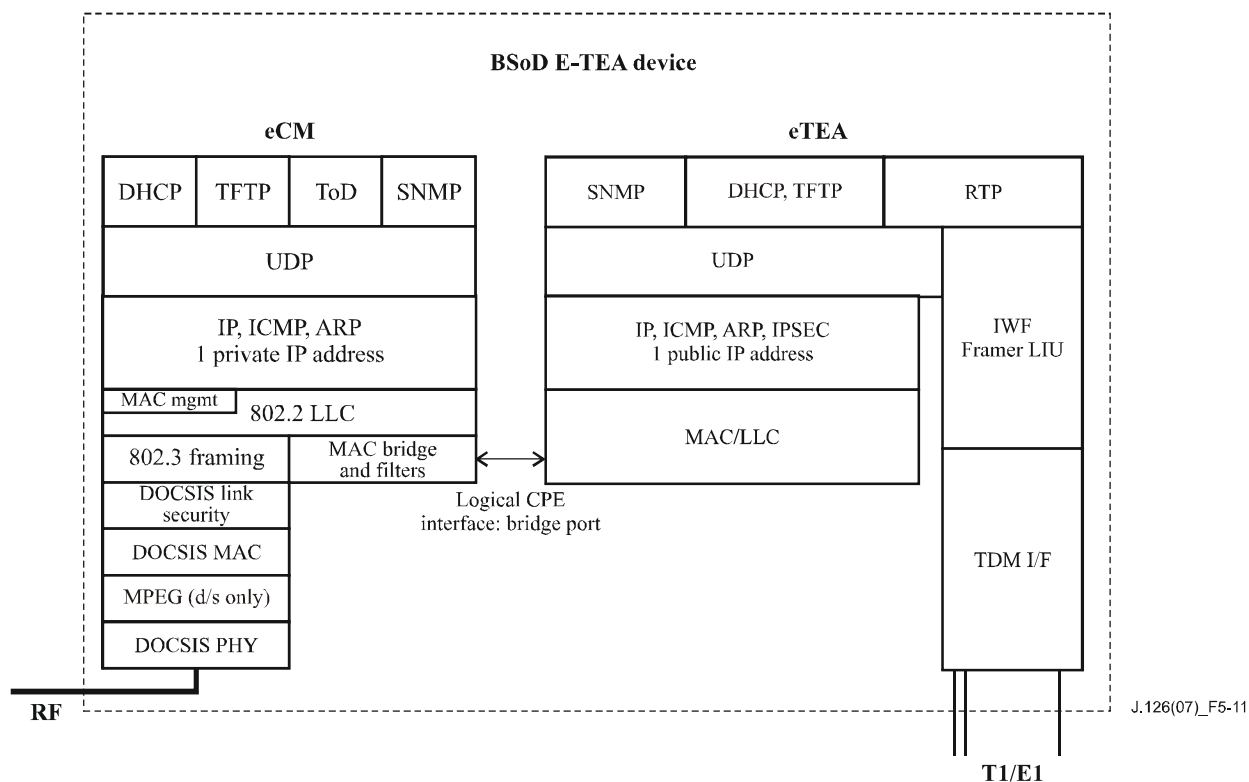


Figure 5-11 – eCM-eTEA protocol stacks

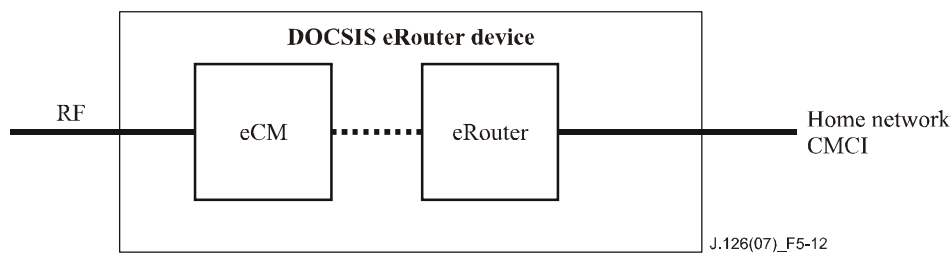


Figure 5-12 – DOCSIS eRouter eDOCSIS device reference model

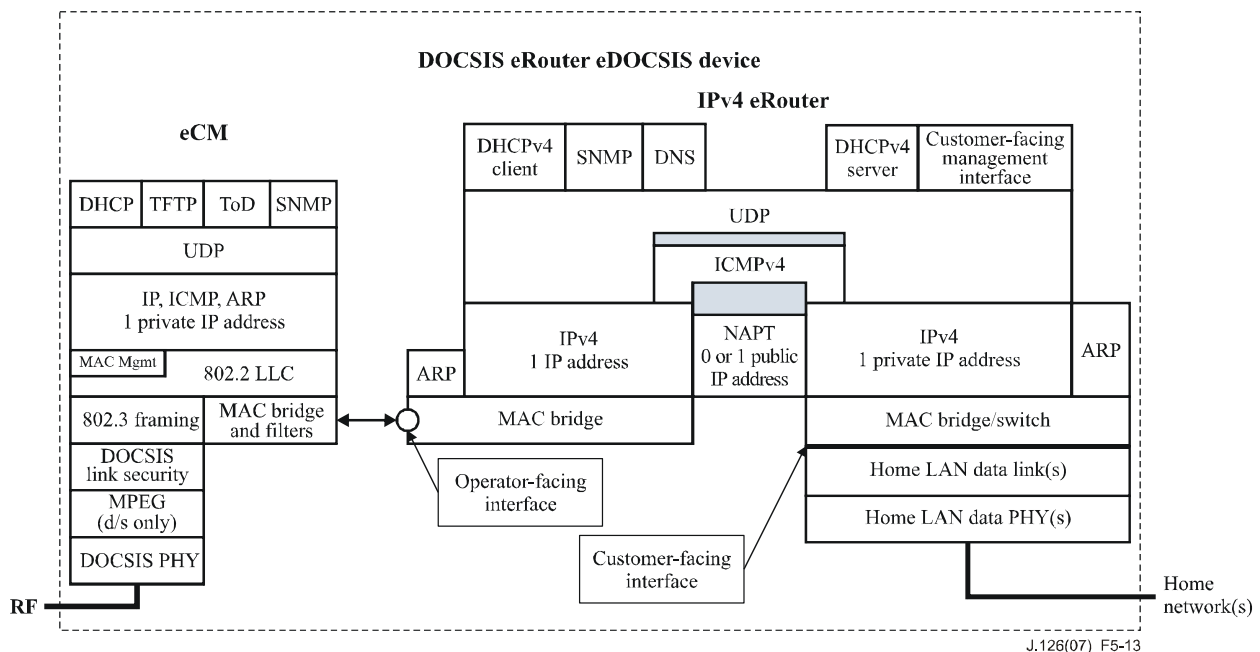


Figure 5-13 – DOCSIS IPv4 eRouter eDOCSIS device reference model

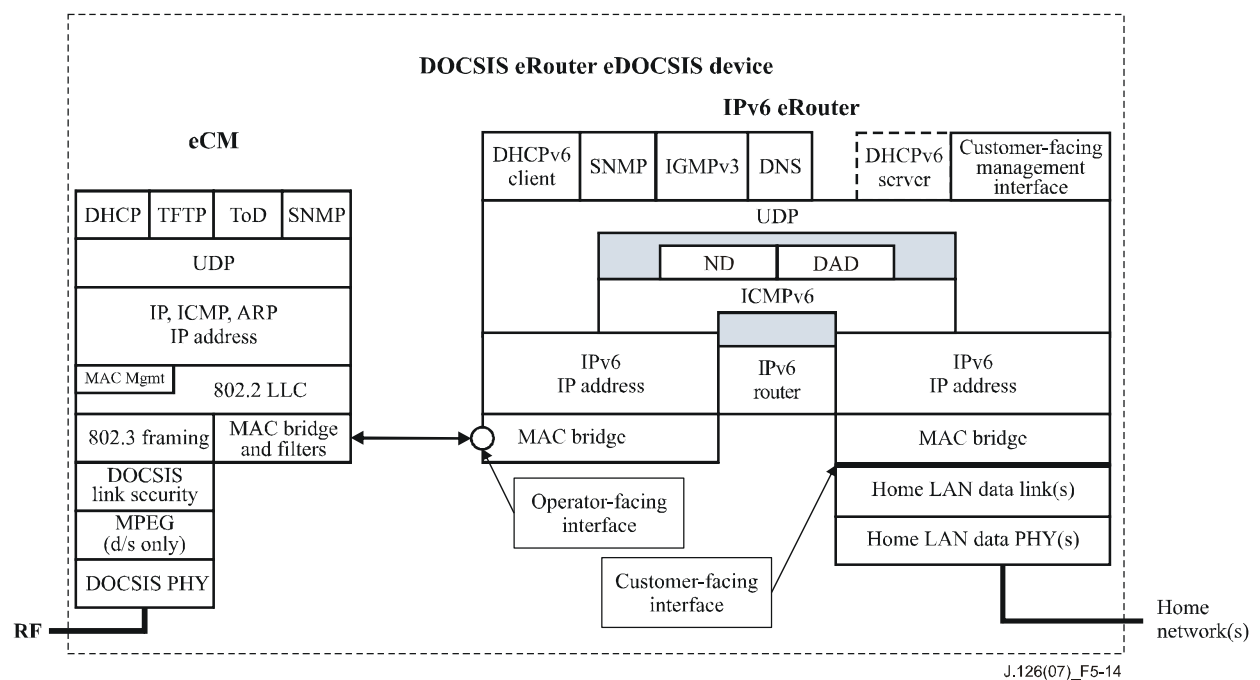


Figure 5-14 – DOCSIS IPv6 eRouter eDOCSIS device reference model

5.2 eDOCSIS requirements

5.2.1 General requirements

The eCM will provide an SNMP agent which is logically separated from any SNMP agent provided by an eSAFE.

Except for MIB objects that are explicitly allowed to be shared, the CableModem-specified MIBs MUST only be accessible through the Management IP address of the eCM. The eSAFE-specified MIBs MUST NOT be accessible through the Management IP address of the eCM.