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Technical Report

Access, Terminals, Transmission and Multiplexing (ATTM); Integrated Broadband Cable and Television Networks; Converged Cable Access Platform Architecture

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

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1 Scope

The present document is intended to provide an introduction to the Converged Cable Access Platform (CCAP) architecture. The CCAP architecture has been specified in an integrated and a modular implementation. The present document describes both the integrated and modular architectures and discusses the various specifications that contain normative requirements pertaining to the CCAP. In addition, the present document describes the architectural entities and interfaces that make up the integrated and modular implementations, as well as the protocols they support. For the modular implementation, the present document provides an overview of the operation of Packet Shelf and Access Shelf devices, as well as the interface between them.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

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- [i.3] DOCSIS Timing Interface Specification: "CM-SP-DTI", Cable Television Laboratories, Inc.
- [i.4] Edge QAM Video Stream Interface Specification: "CM-SP-EQAM-VSI", Cable Television Laboratories, Inc.
- [i.5] DOCSIS Edge Resource Manager Interface: "CM-SP-ERMI", Cable Television Laboratories, Inc.
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- [i.23] IETF RFC 4761: "Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signalling", January 2007.
- [i.24] IETF RFC 4874: "Exclude Routes - Extension to Resource Reservation Protocol-Traffic Engineering (RSVP-TE)", April 2007.
- [i.25] IETF RFC 5036: "LDP Specification", October 2007.
- [i.26] IETF RFC 5303: "Three-Way Handshake for IS-IS Point-to-Point Adjacencies", October 2008.
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- [i.45] IETF RFC 5120: "M-ISIS: Multi Topology (MT) Routing in Intermediate System to Intermediate Systems (IS-ISs)", February 2008.
- [i.46] 802.3ah-2004: "IEEE Standard for Information Technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Amendment: Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks".
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3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Access Shelf (AS): one of the two chassis that make up a Modular CCAP implementation. The Access Shelf is primarily responsible for MPEG processing and access functions (PHY, PON, etc.) normally associated with the CMTS and the Edge QAM

Cable Modem Termination System (CMTS): headend component that provides the operator network side termination for the DOCSIS link. A CMTS communicates with a number of Cable Modems to provide data services

Converged Cable Access Platform (CCAP): headend component that provides the functionality of a CMTS and an Edge QAM in a single architecture with greater QAM density and overall capacity

Edge QAM (EQAM): head-end or hub device that receives packets of digital video or data from the operator network. It re-packetizes the video or data into an MPEG transport stream and digitally modulates the transport stream onto a downstream RF carrier using QAM

Ethernet Passive Optical Network (EPON): point-to-multipoint, fibre to the premises network architecture in which unpowered optical splitters are used to enable a single optical fibre to serve multiple premises

hybrid fibre-coax System: broadband bidirectional shared-media transmission system using optical fibre trunks between the head-end and the fibre nodes, and coaxial cable distribution from the fibre nodes to the customer locations

NETCONF: IETF network management protocol that provides mechanisms to manipulate the configuration of a device. NETCONF executes YANG-based XML files containing configuration objects

Packet Shelf (PS): one of the two chassis that make up a Modular CCAP implementation. The Packet Shelf is responsible for the packet processing functions, such as subscriber management, service flow management, layer-3 routing and higher layer protocol manipulation, as well as Access Shelf command and control

RF combiner: headend equipment that accepts multiple input signals and delivers a single output that is equal in phase and amplitude

service group: set of channels for a given service (e.g. Video On Demand, High-Speed Internet) delivered via a number of fibre nodes to corresponding subscribers of that service to a single subscriber device

YANG: language used to model data for the NETCONF protocol. A YANG module defines a hierarchy of data which can be used for NETCONF-based operations, including configuration, state data, remote procedure calls (RPCs), and notifications

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AES	Advanced Encryption Standard
ANCP	Access Node Control Protocol
AS	Access Shelf
ASM	Any-Source Multicast
AWGN	Additive White Gaussian Noise
BGP	Border Gateway Protocol
CA	Conditional Access
CATV	Cable Television
CBR	Constant Bit Rate
CCAP	Converged Cable Access Platform
CLI	Command-Line Interface
CM	Cable Modem
CMTS	Cable Modem Termination System
CPE	Customer Premises Equipment
CSA	Common Scrambling Algorithm
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DLC	Downstream Line Card
DOCSIS	Data-Over-Cable Service Interface Specifications
DPIC	Downstream Physical Interface Card
DPoE	DOCSIS Provisioning of EPON (Ethernet Passive Optical Network)
DRFI	Downstream RF Interface
DSG	DOCSIS Set-top Gateway
DTI	DOCSIS Timing Interface
ECM	Encryption Control Message
ECMD	ECM Decoder
ECMG	ECM Generator
EoC	Ethernet over Coax
EPL	Ethernet Private Line

EPON	Ethernet Passive Optical Network
EQAM	Edge QAM
ERM	Edge Resource Manager
ERMI	Edge Resource Manager Interface
EVPL	Ethernet Virtual Private Line
EXP	Experimental
FFT	Fast Fourier Transform
Gbps	Gigabits per second
GigE	Gigabit Ethernet
GRE	Generic Routing Encapsulation
HFC	Hybrid Fibre/Coaxial
HSI	High-Speed Internet
I-CCAP	Integrated CCAP
ID	Identifier
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPDR	IP Detail Record
ISIS	Intermediate System to Intermediate System
IS-IS	Intermediate System To Intermediate System Protocol
L2VPN	Layer 2 Virtual Private Network
LAN	Local Area Network
LDP	Label Distribution Protocol
LSP	Label-Switched Path
MAC	Media Access Control
M-CCAP	Modular CCAP
M-CMTS	Modular CMTS
MCX	Micro Coaxial
MEF	Metro Ethernet Forum
MHA	Modular Headend Architecture
MHz	Megahertz
MIB	Management Information Base
MPEG	Moving Picture Experts Group
MPLS	Multiprotocol Label Switching
MPTS	Multi-Program Transport Stream
MT	Multi Topology
MULPI	MAC and Upper Layer Protocols Interface
MVPN	Multicast Virtual Private Network
NA	Not Applicable
NNI	Network to Network Interface
NSI	Network-Side Interface
OAM	Operations Administration and Maintenance
OLT	Optical Line Termination
ONU	Optical Network Unit
OOB	Out Of Band
OSPF	Open Shortest Path First protocol
OSS	Operations Support System
OSSI	Operations Support System Interface
OTT	Over-the-Top
P2MP	Point-to-Multipoint
PASI	Packet to Access Shelf Interface
PC	Physical Contact
PCR	Program Clock Reference
PE	Provider Edge
PE-CE	Provider-Edge - Customer-Edge
PEG	Public, Education, and Government channels
PHY	Physical Layer
PIC	Physical Interface Card
PIM-DM	Protocol Independent Multicast - Dense Mode
PIM-SM	Protocol Independent Multicast - Sparse Mode
PON	Passive Optical Network
PS	Packet Shelf

PSTN	Public Switched Telephone Network
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RFC	Request for Comments
RFoG	Radio Frequency over Glass
RIP	Routing Information Protocol
RSVP	Resource Reservation Protocol
RSVP-TE	RSVP - Traffic Engineering
SC	Subscriber Connector
SCTE	Society of Cable Telecommunications Engineers
SDV	Switched Digital Video
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
SPTS	Single Program Transport Stream
SRM	Session Resource Manager
SSM	Source-Specific Multicast
STB	Set-Top Box
TDM	Time-Division Multiplexing
TEI	TDM Emulation Interface
TLS	Transparent LAN Service
TTL	Time-To-Live
UCH	Universal Cable Holder
UDP	User Datagram Protocol
UML	Unified Modelling Language
VBR	Variable Bit Rate
VLAN	Virtual LAN
VOD	Video On Demand
VoIP	Voice over IP
VPLS	Virtual Private LAN Service
VPN	Virtual Private Network
VSI	Video Stream Interface
XML	Extensible Markup Language

4 VOID

5 CCAP Architecture Goals, Benefits and Overview

5.1 Fundamental Goals of the CCAP

The Converged Cable Access Platform (CCAP) is intended to provide a new equipment architecture option for manufacturers to achieve the Edge QAM and CMTS densities that cable operators require in order to address the costs and environmental challenges resulting from the success of narrowcast services. The CCAP leverages existing technologies, including DOCSIS 3.0, Modular Headend Architecture, and current HFC architectures; and also can include newer ones, such as Ethernet optics and EPON (Ethernet Passive Optical Network).

The CCAP provides an alternative approach to the implementation of converged video and data services described in the Modular Headend Architecture (MHA) Technical Report (i.e. Modular CMTS with Universal Edge QAM). Similar to MHA, the CCAP provides sharing of QAM channels for different narrowcast services, but adds the capability of sharing broadcast QAM channels.