

SCTE • ISBE[®]

S T A N D A R D S

Energy Management Subcommittee

SCTE STANDARD

SCTE 232 2019

**Key Performance Metrics:
Energy Efficiency & Functional Density of
CMTS, CCAP, and Time Server Equipment**

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1. Introduction

1.1. Executive Summary

This document is the second of multiple parts in a series that provides the cable operator with a standard reference to determine how well a piece of rack or shelf equipment performs in terms of minimizing the power required to do its particular job. In addition, this standard provides the means to quantify the amount of useful work the equipment provides per physical space. This part of the series focuses on the CMTS, CCAP, and other related cable operator critical facility equipment.

1.2. Scope

Cable operator networks are large expansive networks that involve hundreds if not thousands of miles of coaxial or fiber cable powered by power supplies in the outside plant and connecting customers to critical infrastructure facilities such as hubs, headends, data centers, regional, and national distribution datacenters. In these facilities is a vast array of equipment responsible for the production and support of the cable operator's products and services such as voice, video, data, home automation and security, and Wi-Fi. The importance of powering all of these devices in the critical facilities is ever increasing as the customer expectation is for 100% availability due to the critical nature of the services being provided to business and residential customers. This document defines how to use a standard methodology to measure the density of hardware to meet the needs of optimizing critical space, as well as measuring energy consumption for the various network element classes. This part of the series focuses on the CMTS, CCAP, and other related cable operator critical facility equipment.

1.2.1. *Applicability to Critical Facilities*

The energy efficiency and functional density metrics in this document apply to critical facilities used by cable operators. Critical facilities are defined in section 5.2.

1.2.2. *Hardware Service Feature Density Metrics*

This standard defines the method to calibrate product density, in terms of service features per amount of space utilized.

1.2.3. *Energy Consumption Metrics*

This standard defines the method to calibrate energy consumption based on service features such as Watts per Downstream Channel, Watts per Service Group, or similar for cable headend, hub, and cable subscriber access equipment.

1.2.4. *Applicable Equipment*

The energy efficiency and functional density metrics in this standard apply to all indoor equipment used in critical facilities that functions as one or more of the following:

- “Legacy” (i.e. pre-CCAP) CMTS broadband routing equipment - in particular, the Integrated Cable Modem Termination System (I-CMTS)
- Converged Cable Access Platform (CCAP) – including Integrated CCAP (I-CCAP) and Distributed CCAP Architecture (DCA) equipment
- PTP and NTP Time Servers

1.2.5. **Non-Applicable Equipment**

The energy efficiency and functional density metrics in this standard do NOT apply to the following equipment classes.

- Customer Premises Equipment (CPE)
- Outdoor Plant and associated powering equipment except for DCA modules that will be included in the energy efficiency metrics
- Facilities equipment covered by SCTE 184, such as
 - Generators and line-power back-up systems
 - Building HVAC control and monitoring equipment
 - Logistical and physical support such as lighting, fire alarming, and security systems, etc.

1.3. **Benefits**

This standard defines energy and functional density specific performance metrics based on service features that are inherent to the type of equipment. Standard metrics such as watts/QAM Channel and watts/Service Group for cable access equipment are identified. This standard will contribute to improve the overall energy footprint by enabling engineering driven decisions that reduce energy consumption at the source of power consumption.

1.4. **Intended Audience**

Cable operator headend and hub engineers, procurement teams, and operations staff.

1.5. **Areas for Further Investigation or to be Added in Future Versions**

Given the current CableLabs project: Flexible MAC Architecture (FMA) System Specification, CM-SP-FMA-SYS-I01, there could be minor revision to this publication. Addressing use of name plate data.

2. **Normative References**

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. **SCTE References**

- [ANSI/SCTE 210 2015] *Performance Metrics for Energy Efficiency & Functional Density of Cable Data Generation, Storage, Routing, and Transport Equipment*, <http://www.scte.org/SCTEDocs/Standards/SCTE%20210%202015.pdf>
- [SCTE_General_Test_Procedures] *ANSI/SCTE 231 2019, General Test Procedures for Evaluation of Energy Consumption Metrics and in Support of Functional Density Metrics*

2.2. **Standards from Other Organizations**

- [ATIS-0600015.2018] *Energy Efficiency for Telecommunication Equipment: Methodology for Measurement and Reporting – General Requirements*, May 2018.

- [ATIS-0600015.03.2009] *Energy Efficiency for Telecommunications Equipment: Methodology for Measurement and Reporting for Router and Ethernet Switch Products*, July 2009.
- [DOCSIS DRFI] *Downstream Radio Frequency Interface Specification*, CM-SP-DRFI-I14-131120, November 20, 2013, Cable Television Laboratories, Inc., <https://www.cablelabs.com/specification/downstream-rf-interface-specification/>
- [DOCSIS PHYv3.1] *DOCSIS 3.1, Physical Layer Specification*, CM-SP-PHYv3.1-I16-190121, December 10, 2015, Cable Television Laboratories, Inc., <https://www.cablelabs.com/specification/physical-layer-specification/>
- [DOCSIS PHYv4.0] *Data-Over-Cable Service Interface Specifications DOCSIS® 4.0*, CM-SP-PHYv4.0-I01-190815 August 15, 2019 <https://www.cablelabs.com/specification/docsis-4-0-physical-layer-specification/>
- [DOCSIS PHYv3.0] *DOCSIS 3.0, Physical Layer Specification*, CM-SP-PHYv3.0-I13-170111, December 7, 2017, Cable Television Laboratories, Inc., <https://www.cablelabs.com/specification/docsis-3-0-physical-layer-interface-specification/>
- [R-PHY] *Data-Over-Cable Service Interface Specifications DCA - MHA v2 Remote PHY Specification*, CM-SP-R-PHY-I10-180509, May 9, 2018, Cable Television Laboratories, Inc. <https://www.cablelabs.com/specification/CM-SP-R-PHY-I10-180509.pdf>
- [EN 300 429] *ETSI EN 300 429 V1.2.1: Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems*, April 1998.
- [ITU-T J.83-B] *Annex B to ITU-T Rec. J.83 (12/2007), Digital multi-program systems for television sound and data services for cable distribution*.

2.3. Published Materials

- No normative references are applicable.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- [ANSI/SCTE 226 2016] *Cable Facility Classification Definitions and Criteria*, https://www.scte.org/SCTEDocs/Standards/ANSI_SCTE%20226%202015.pdf.

3.2. Standards from Other Organizations

- [DOCSIS MULPIv3.0] *Media Access Control and Upper Layer Protocols Interface Specification*, CM-SP-MULPIv3.0-I26-150305, March 5, 2015, Cable Television Laboratories, Inc., <http://www.cablelabs.com/specification/docsis-3-0-mac-and-upper-layer-protocols-interface-specification/>
- [DOCSIS 3.1 MAC] *DOCSIS 3.1 MAC and Upper Layer Protocols Interface Specification* CM-SP-MULPIv3.1-I18-190422, April 22 2019, Cable Television Laboratories, Inc., <https://specification-search.cablelabs.com/CM-SP-MULPIv3.1>
- [DOCSIS DEPI] *Downstream External PHY Interface Specification*, CM-SP-DEPI-I08-100611, June 11, 2010, <http://www.cablelabs.com/specification/downstream-external-phy-interface-specification/>

- [DCA-Remote MACPHY] *Remote MAC-PHY Technical Report*, CM-TR-R-MACPHY-V01-150730, July 30, 2015, Cable Television Laboratories, Inc., <https://specification-search.cablelabs.com/remote-mac-phy-technical-report>
- [DOCSIS 4.0 MAC] *DOCSIS 4.0 MAC and Upper Layer Protocols Interface Specification*, CM-SP-MULPIv4.0-I01-190815, August 15, 2019, Cable Television Laboratories, Inc., <https://cablelabs.com/CM-SP-MULPIv4.0>

3.3. Published Materials

- [DOCSIS CCAP] *Converged Cable Access Platform Architecture Technical Report*, CM-TR-CCAP-V03-120511, May 11, 2012, <http://www.cablelabs.com/specification/ccap-architecture-technical-report/?v=3>
- [DOCSIS MHA] *Data-Over-Cable Service Interface Specifications Modular Headend Architecture - EQAM Architectural Overview Technical Report*, December 9, 2008, <http://www.cablelabs.com/wp-content/uploads/specdocs/CM-TR-MHA-V02-081209.pdf>
- [European Broadband CoC] *European Commission Joint Research Centre: Code of Conduct on Energy Consumption of Broadband Equipment*, Version 7.0, 2019, http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/files/documents/ICT_CoC/cocv5-broadband_final.pdf

4. Compliance Notation

<i>shall</i>	This word or the adjective “ required ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ <i>recommended</i> ” 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 weighted before choosing a different course.
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<i>deprecated</i>	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of this document. Implementations should avoid use of deprecated features.

5. Abbreviations and Definitions

5.1. Abbreviations

Abbreviation	Description
A-TDMA	Advanced Time Division Multiple Access

CCAP	Converged Cable Access Platform
CMTS	Cable Modem Termination System
DAA	Distributed Access Architecture
DCA	Distributed CCAP Architecture
DEPI	Downstream External PHY Interface
DOCSIS	Data Over Cable Service Interface Specifications
DPoE	DOCSIS Provisioning of EPON
DS	downstream
DTI	DOCSIS timing interface
EPON	Ethernet Passive Optical Network
EQAM (edge-QAM)	edge quadrature amplitude modulator
FDX	DOCSIS 3.1 Full Duplex
FEC	forward error correction
GBPS	Gigabits Per Second
GPS	Global Positioning System
HE	headend
I-CCAP	Integrated CCAP
I-CMTS	Integrated Cable Modem Termination System
IP	Internet Protocol
KPM	key performance metric
NC	narrowcast
NSI	Network Side Interface
NTP	Network Time Protocol
M-CMTS	Modular Cable Modem Termination System
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PIC	physical interface card
PTP	Precision Time Protocol
QAM	Quadrature Amplitude Modulation or Quadrature Amplitude Modulator
RF	radio frequency
RPD	Remote-PHY Device
RMD	Remote MAC-PHY Device
SC-QAM	Single Carrier Quadrature Amplitude Modulation or Single Carrier Quadrature Amplitude Modulator
SDV	switched digital video
US	upstream
VoD	video on demand

5.2. Definitions

Term	Definition
Critical facility	The network, facility, and/or building responsible for the reliable delivery of information services.
Key Performance Metric	A standard of measurement for the efficiency of use of energy or rack and space/volume for cable equipment in critical facilities