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**Adaptive Power System Interface Specification
(APSYS™)**

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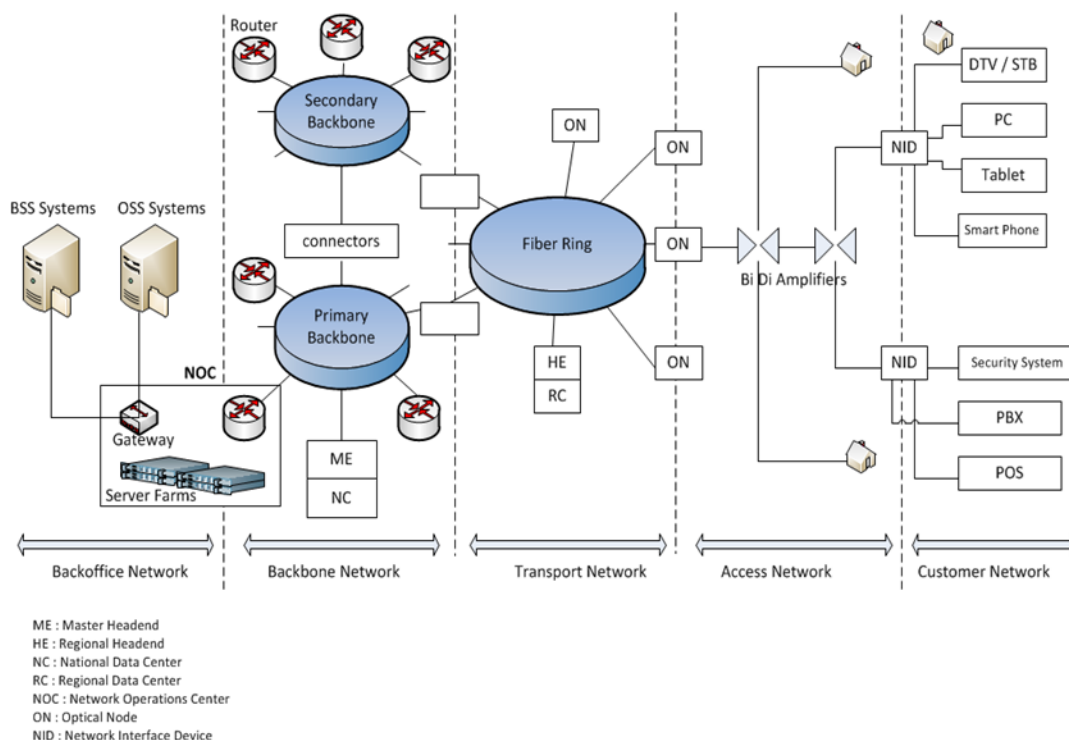
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1. Introduction

1.1. Executive Summary

The Adaptive Systems Interface Specification (APSIS™) is a method by which cable broadband providers can address and control energy management from an end to end perspective. The 2020 release contains updated references, reorganizes some content, and recognizes YANG data modeling as another device level protocol opportunity. The general idea behind APSIS is that power consumption should be reflective of demand. Figure 1 identifies the components of the network and systems architecture being addressed by APSIS.



The cable network architecture described here provides context to segment devices into logical categories for the purpose of understanding software interfaces and interaction between components. The cable network is generally implemented in a hub-spoke topology, where network segments become more regionalized and numerous as we travel from left to right in the diagram. Network segments include:

The Back Office Network includes Business Support Systems (BSS) used to run operations including billing, customer relationship management, trouble management, and new customer acquisition and Operational Support Systems (OSS) which include inventory, provisioning, configuration, performance and fault management. Adaptive Power Applications will typically be implemented within this logical network segment.

The Backbone Network is comprised of content access and distribution systems, data centers, and other enterprise wide service delivery functions.

The Transport Network provides video, voice, and data service to local markets and includes head-end and hub facilities.

The Access Network serves the ‘last mile’ connecting the cable network to individual homes and businesses.

The Customer Network demarcation point is at a single point of interface to a home or business or at a device or devices within a home or business at which the service termination point resides. Examples of such demarcation points are Set Top Boxes (STBs), Cable Modems (CMs), embedded Multimedia Terminal Adapters (eMTAs), Media Gateways (MGs), Private Branch Exchange (PBXs), Point of Sale (POS) or any other similar Network Interface Devices (NIDs). Requirements pertaining to equipment residing in the Customer Network are not within the scope of this document.

1.2. Scope

This document is part of the work being done in SCTE’s Standards Energy Management Subcommittee (EMS). The Adaptive Power System Interface Specification (APSIS) working group under the EMS is responsible for the creation and updates of this document. The document was developed for the benefit of the cable industry and includes contributions by cable operators, vendors and industry support organizations. While the initial intent of this document is to support the cable industry, the process, methodology and results of this effort may be applicable to other telecommunications networks.

Today’s cable systems include broadband telecommunications infrastructure, including high-speed data services, digital telephony and other applications, and multi-channel video program distribution systems composed of highly specialized television distribution technology. This document specifies software interfaces to cable systems enabling a broad set of energy monitoring and management applications. Interfaces may be defined at the level of individual devices, collections of devices including an entire facility, and networks spanning multiple facilities.

Applications that influence service delivery in order to attenuate energy consumption are called adaptive power applications. The set of device and system level interfaces that support such applications are Adaptive Power System Interfaces.

The focus of this specification is to define interfaces within the domain of cable service delivery networks, including the cable ‘plant’, data centers, digital voice platforms, wireless platforms, and other communications and distribution electronics. An abstract information model is provided that defines a hierarchical structure for representing power related data and controls. The information model can be expressed in any number of specific protocols suitable for a specific environments Where the encoding format of information differs among protocols, the semantic definition is consistent. Interfaces will be defined for some number of device-level protocols, such as SNMP, YANG, or others. These interfaces are intended to complement definitions provided elsewhere that could allow a cable operator to obtain comprehensive visibility and control over their entire operations, including:

- The owned business enterprise networks (e.g., internal business networks, LANs, etc.)
- Operator facilities (e.g., HVAC, lighting, etc.)
- Interfaces to third parties (e.g., energy suppliers, other providers, demand-response managers, etc.)
- Interfaces to operator owned Customer Premises Equipment (CPE) (e.g., cable modem, set-top box, eMTA, etc.)
- Interfaces to energy consuming equipment owned by and located at a customer’s and consumer’s location (e.g., LCD TV, Wi-Fi Router, etc.)

Consumer Premise Equipment (CPE) are devices that deliver services within a customer's home or place of business and do not draw power from the service provider. APSIS does not directly address requirements of such equipment. However, a truly end-to-end energy management framework considers

the impact of these devices on the service provider energy systems; for example, service provider applications on CPE can work in concert with logic within the network to optimize energy utilization within the network. Interface definitions between CPE and components within the service provider network may prove valuable in the future, although none are planned at this time.

The intent of this document is to identify the appropriate energy related data necessary to measure and manage energy consumption and define protocols used for the data exchange. This specification is intended to enhance business continuity and disaster recovery by optimizing the performance, availability, and reliability of cable networks, optimize expenditure on energy, and improve the Mean Time Between Failures (MTBF) and extend the useful life of components and equipment.

1.3. Benefits

Cable network operators continue to add customers to their broadband telecommunications networks and provide more services and data over those networks. These factors increase demand for power, and forecasts for utility power availability and cost show that energy management will become an important element in cost-effectively delivering services. Service provider goals addressed by energy management include higher customer satisfaction, more cost-efficient operations, lower energy costs, and rapid product deployment.

The supporting SCTE 245: Use Cases for Adaptive Power Using APSIS can be downloaded at the SCTE website.

1.4. Intended Audience

Cable broadband provider network engineers, power managers, cable provider network equipment manufacturers and procurement managers.

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

None at the time of 2020 publication.

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

- [EMAN YANG] Energy Management YANG model, <https://www.scte.org/download-scte-isbe-standards/>

2.2. Standards from Other Organizations

- [IETF-EMAN-IM] Energy Management Framework, RFC 7326
https://datatracker.ietf.org/doc/draft-ietf-eman-framework/?include_text=1
- [IETF-EMAN-Object-MIB] Energy Object Context MIB, RFC 7461
<http://datatracker.ietf.org/doc/draft-ietf-eman-energy-aware-mib/>

- [IETF-EMAN-Power-MIB] Power, Energy Monitoring and Control MIB, RFC 7460
<http://datatracker.ietf.org/doc/draft-ietf-eman-energy-monitoring-mib/>

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

- SCTE 245 2018: Use Cases for Adaptive Power Using APSIS™
<https://scte-cms-resource-storage.s3.amazonaws.com/Standards/SCTE%20245%202018.pdf>
- SCTE 237 2017 Implementation Steps for Adaptive Power Systems Interface Specification (APSI™)
https://scte-cms-resource-storage.s3.amazonaws.com/Standards/ANSI_SCTE%20237%202017.pdf

3.2. Standards from Other Organizations

- [GR-3160-CORE] GR-3160-CORE, Generic Requirements for Telecommunications Data Center Equipment and Spaces
<http://telecom-info.telcordia.com/site-cgi/ido/docs.cgi?ID=SEARCH&DOCUMENT=GR-3160>
- [GR-2930, NEBS] Telcordia GR-2930, NEBS: Raised Floor Generic Requirements for Network and Data Centers
<http://telecom-info.telcordia.com/site-cgi/ido/docs.cgi?ID=SEARCH&DOCUMENT=GR-2930&>
- [TIA-942] TIA-942 Telecommunications Infrastructure Standard for Data Centers
https://global.ihs.com/doc_detail.cfm?&item_s_key=00414811&item_key_date=860905&input_doc_number=tia%20942&input_doc_title=
- [ITU M.3010] ITU-T M.3010 Principles for a telecommunications management network
<http://www.itu.int/rec/T-REC-M.3010>
- [IETF-EMAN] Energy Management Framework draft-ietf-eman-framework-16,
https://datatracker.ietf.org/doc/draft-ietf-eman-framework/?include_text=1

3.3. Published Materials

- No informative references are applicable.

4. Compliance Notation

<i>shall</i>	This word or the adjective “ <i>required</i> ” 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.
<i>should not</i>	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.
<i>may</i>	This word or the adjective “ <i>optional</i> ” 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.
<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

APSYS	Adaptive Power System Interface Specification	An end-to-end energy management standard and specification for cable telecommunications networks and associated interfaces.
API	Application Programming Interface	A programmatic interface used by business logic applications.
BSS	Business Support Systems	Systems that telecommunications providers use to run the operations of their business from a customer’s perspective. Typical support systems include product management, order management, revenue assurance and management as well as customer management.
CAPWAP	Control and Provisioning of Wireless Access Networks	Standard, interoperable networking protocol that enables a central wireless LAN Access Controller (AC) to manage a collection of Wireless Termination Points (WTPs), more commonly known as Wireless Access Points.
CCAP	Converged Cable Access Platform	An access-side networking element or set of elements that combines the functionality of a CMTS with that of an Edge QAM, providing high-density services to cable subscribers.