Society of Cable Telecommunications Engineers

ENGINEERING COMMITTEE
Energy Management Subcommittee

SCTE STANDARD

SCTE 237 2017

Implementation Steps for Adaptive Power Systems Interface Specification (APSIS™)

NOTICE

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1. Introduction

1.1. Executive Summary

The intent of this document is to outline the high-level implementation steps necessary for cable operators to enable/implement ANSI SCTE 216 2015: Adaptive Power Systems Interface Specification (APSIS™).

1.2. Scope

SCTE 216 addresses the end to end network; therefore, an implementation of APSIS can touch back office networks, backbone networks, transport networks, access networks and customer premise equipment. The primary focus of APSIS has been the access network including critical facilities and outside plant.

1.3. Benefits

Implementation Steps for Adaptive Power Systems Interface Specification (APSIS) provides the high-level overview to help identify essential steps necessary and a logical order of approaching the necessary steps to enable end-to-end energy control.

1.4. Intended Audience

This document is intended to be referenced by network architects, engineers and implementers at cable operator organizations.

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

Definitive use cases that would apply when a condition would warrant APSIS to ramp up or down the power being consumed.

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

- SCTE 216 Adaptive Power System Interface Specification (APSIS) http://www.scte.org/SCTEDocs/Standards/ANSI_SCTE%20216%202015.pdf

2.2. Standards from Other Organizations

- IETF EMAN (Energy Management. https://datatracker.ietf.org/wg/eman/charter/

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 2015: Cable Facility Classification Definitions and Requirements

3.2. Standards from Other Organizations

- No informative references are applicable.

3.3. Published Materials

- ARRIS diurnal adaptation demo: http://www.scte.org/SCTEDocs/Standards/Arris%20CCAP%20-%202015%20APSIS%20Demo.pdf
- Cisco diurnal adaptation demo: https://cisco.webex.com/cmp3200/webcomponents/jsp/docshow/closewindow.jsp
- OpenDaylight EMAN (energy management) plug-in: https://wiki.opendaylight.org/view/EMAN:Main

4. Compliance Notation

shall	This word or the adjective "***required***" means that the item is an absolute requirement of this document.
shall not	This phrase means that the item is an absolute prohibition of this document.
forbidden	This word means the value specified shall never be used.
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 weighted 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.
deprecated	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	**Definition**
APSIS	Adaptive Power Systems Interface Specification
ANSI	American National Standards Institute
API	Application Programming Interface
CCAP	Converged Cable Access Platform
EMAN	Energy Management
HTTP	HyperText Transport Protocol
IETF	Internet Engineering Task Force
IPDR	Internet Protocol Detail Record
KPI	Key Performance Indicator
ODL	OpenDaylight open source SDN project
RI	Reference Implementation - a working implementation of a specification
SCTE	Society of Cable Telecommunications Engineers
SDN	Software Defined Network
SNMP	Simple Network Management Protocol

5.2. Definition

Term	**Definition**
controller	the set of functions that can be offloaded to a centralized set of components to relieve individual applications of the low-level details of building a network topology and interfacing directly with devices

6. APSIS™ High Level Plan

An APSIS™ enabled platform is composed of a device domain and an application domain.

The device domain includes the physical and logical components of a telecommunications system that support the APSIS™ standard or a functional equivalent. A functional equivalent is an alternate or proprietary means of communicating energy measures and controls that are logically equivalent to APSIS™ definitions but are encoded in a different protocol. A software adapter can translate such definitions into an APSIS™ format in the application layer.

The application domain encodes logic to collect and process energy measures and issue energy controls. The application layer may be composed of many independent processes executing simultaneously, and may include heavyweight 'big data' applications and lightweight alarm processors, and many other functions. Applications may input other data sources such as measures of service level in order to perform its tasks.

The application domain may include a middleware layer to offer basic device discovery and connectivity services on behalf of all applications, greatly reducing the complexity for each energy specific application. One such middleware is the open-source OpenDaylight Software Defined Networking controller with the EMAN (Energy Management) plug-in.

Annex A includes a diagram of a layered software model.

6.1. Steps to Enabling APSIS™

Implementers of APSIS shall read SCTE 216 2015 and familiarize themselves with the detailed ANSI/SCTE standard that normatively recognizes IETF's EMAN reference as the energy management framework.

6.1.1. Step one: Inventory

Inventory of devices that are able to: one) - report energy conditions via software interfaces, and two) – be controlled via these software interfaces for the amount of energy consumed in the process of enabling APSIS™ on the network. Without a solid understanding and inventory of current network-to-power awareness, unnecessary programming or missed opportunities could occur.

Because few devices support APSIS™ today, this process is not programmatically supported by the APSIS™ platform and step one must be performed in an operator defined way.

6.1.2. Step two: Measurement

Energy measurement is step two in the process of enabling APSIS™ on the network. Collecting a good understanding of how much power the end-to-end network consumes should help the cable operator prioritize where to target the rollout of APSIS™ based on greatest opportunity.

While APSIS™ supports detailed, programmatic energy measurement, step two must be performed in an operator defined way.

6.1.3. Step three: Controller Middleware

An end-to-end energy system benefits from a centralized method of device discovery, connectivity, security, and APSIS™ policy enforcement. This software layer could be custom built, integrated into an existing entity management system or an off-the-shelf package such as the open-source OpenDaylight Software Defined Networking (SDN) controller. The term 'controller' is used simply to refer to the set of functions that can be offloaded to a centralized set of components to relieve individual applications of the low-level details of building a network topology and interfacing directly with devices.

The controller should be located at a hardened facility that can reach the furthest points on the operator's production network. For example, a data center that meets ANSI SCTE 226 2015 Class A definition would be a logical first consideration. A controller platform should be redundant and provide high-availability, be secure, and offer reasonable performance.

6.1.4. Step four: Enablement

Energy Management applications may take many forms, from offering web accessible front-ends for operational or business intelligence visualizations, to alarming, to reporting, and others. Applications receive energy measurements from devices via a controller platform or other data ingest/repository/access framework, and issue commands through controller APIs or other framework. Many applications may integrate with other service operator defined data sets, such as real-time service level metrics.

6.2. Example Scenario

The following steps outline details that represent one opportunity for implementing network energy control.

1. Set of access network devices are configured to provide energy measures and expose control functions to a centralized controller.
2. Controller establishes connections to network devices and collects energy measures, either temporarily reposing data in controller data domain or providing the measures in near real-time to application layer.
3. Energy management application collects energy measures from controller and stores data in semi-permanent repository.
4. Energy management application enforces energy policies via interactions with controller, which forwards control messages to devices.
5. Energy management application continuously monitors service delivery metrics to ensure energy policies do not disrupt services.
6. Energy management technician utilizes energy measurement application to view visualizations and generate reports of energy measurements.

6.3. Use Cases

The SCTE APSIS™ working group has identified a number of use cases that may be addressed by the APSIS™ platform. Documentation of these use cases will be made publicly available at some point. The current set of use cases fall into the following categories:

* Measurement- Baseline energy measurement to support energy KPIs (Key Performance Indicators)
* Adaptation- Match energy usage to service delivery levels
* Demand Response- Capture favorable pricing for utilities
* Energy Supply- Improve reliability by actively managing power supply issues such as brown-out, power quality issues and others
* Energy Service- Utilize network intelligence to optimize energy usage in customer premises

6.4. Use Case Example - Diurnal Adaptation

A representative use case for APSIS is the adaptation of energy usage to correspond to daily fluctuations in service delivery levels. It’s well known that network services increase the amount of data at prime time versus the wee hours of the morning. Significant efficiencies can be gained by actively measuring service levels, modifying configurations, and powering down unneeded resources during off-peak loads.

ARRIS has demonstrated this use case with the E6000 CCAP device. They found a 40% reduction in energy usage during periods of low service delivery levels, with a daily efficiency gain of ~%15. Cisco has demonstrated similar results.

6.5. OpenDaylight APSIS™ Reference Implementation

OpenDaylight (ODL) is a Linux Foundation open source project that supports many features that manage and control networks. An energy management extension is being developed to provide a Reference Implementation (RI) of the APSIS™ standard. When deployed, an ODL controller with EMAN plug-in can provide a way to expose virtual and real APSIS™ compliant devices, and develop interoperable APSIS™ applications.

Note that many operational APSIS™ applications will necessarily integrate with APIs, data sets, and interfaces outside the scope of APSIS™, e.g. service delivery metrics, service quality metrics, utility interfaces, and so on as a specific case requires.

7. Conclusion

This document has been drafted to simplify the concept of rollout to help people unfamiliar with ANSI SCTE 216 2015: Adaptive Power Systems Interface Specification (APSIS™) to promote the investigation of its full deployment in either laboratory or production networks.

8. Annex A: Software Model

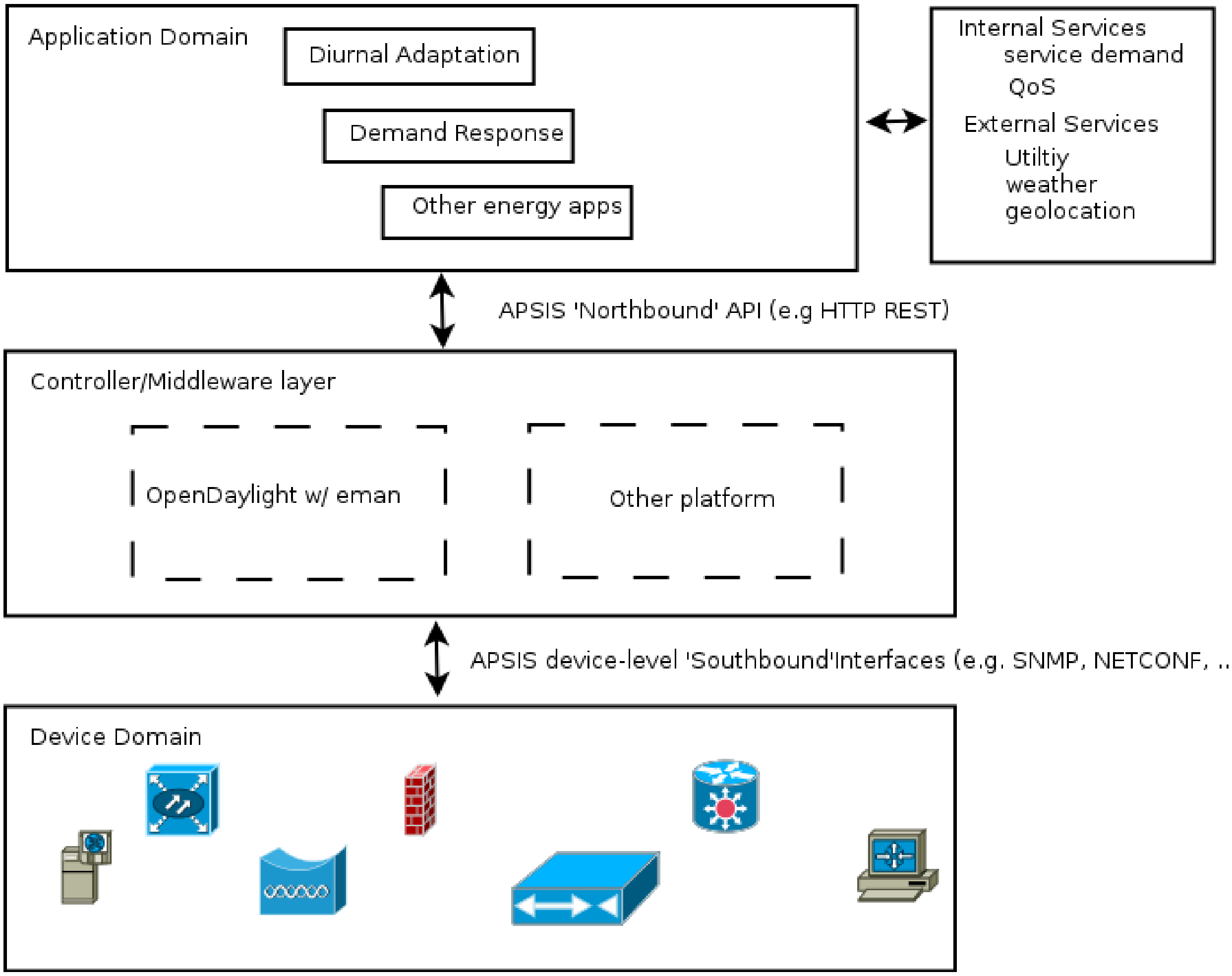

Figure 1 – APSIS™ Software Model