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BSI Standards Publication

Systems interface between customer energy management system and the power management system

Part 10-1: Open Automated Demand Response (OpenADR 2.0b Profile Specification)

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Systems interface between customer energy management system and the power management system –
Part 10-1: Open Automated Demand Response (OpenADR 2.0b Profile Specification)

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FOREWORD

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A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 62746-10-1, submitted by Open ADR Alliance, has been processed by IEC project committee 118: Smart grid user interface. It is based on Open Automated Demand Response Communications Specification, also called OpenADR 2.0 Specification B Profile. The structure and editorial rules used in this PAS reflect the practice of the organization which submitted it.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
118/29/DPAS	118/32/RVD

Following publication of this PAS, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

One of the tasks of PC 118 is to develop IEC standards on Demand Response.

This document has been approved as an IEC Publicly Available Specification (PAS) following the decision made by PC 118 at its second plenary meeting (March 2013).

It has been submitted by the OpenADR Alliance which has a category D liaison with PC 118 working groups.

The intent of this publication is to present a widely used technical solution for Demand Response and a promising trend of the industry. It has a large but partial compatibility with IEC CIM (IEC 61970 and IEC 61968). Considering the urgent need of industry that is starting to move ahead and cannot wait, the PAS can temporarily be used as a reference, and gives time for IEC to develop a formal technical specification (TS) or an international standard (IS) on Demand Response based on OpenADR 2.0b, fully compatible with IEC CIM which will then replace this IEC PAS.

The content of this document is based on the Open Automated Demand Response Communications Specification also called OpenADR 2.0 Specification B Profile. OpenADR is designed to facilitate automated DR actions at the customer location and has been field tested and deployed for several years in a number of DR programs in the world.

This standard contains attached Profile B Schema files. These files are intended to be used as a complement and do not form an integral part of the PAS.

A bilingual version of this publication may be issued at a later date.

Original introductory material

FOREWORD

The development of the **Open Automated Demand Response Communications Specification**, also called OpenADR, began in 2002 following the California electricity crisis. The California Energy Commission Public Interest Energy Research Program funded an OpenADR research program through the Demand Response Research Center (DRRC) at Lawrence Berkeley National Laboratory (LBNL). OpenADR development began in 2002 to support California's energy policy objectives to move toward dynamic pricing to improve the economics and reliability of the electric grid. Initial field tests focused on automating a number of event-based DR utility programs for commercial and industrial (C&I) customers. The DRCC research set out to determine if today's communications and information technologies could be used to automate Demand Response (DR) operations using standardized electricity price and reliability signals. This research, development, and deployment have led to commercial adoption of OpenADR. Today, utilities and governments worldwide are using OpenADR to manage the growing demand for electricity and peak capacity of the electric systems. This low cost communications infrastructure is used to improve the reliability, repeatability, robustness, and cost-effectiveness of DR.

OpenADR is a fundamental element of U.S. Smart Grid interoperability standards being developed to improve optimization between electric supply and demand. OpenADR is designed to facilitate automated DR actions at the customer location, whether it involves electric load shedding or shifting. OpenADR is also designed to provide continuous dynamic price signals such as hourly day-ahead or day-of real time pricing. OpenADR has been field tested and deployed in a number of DR programs in U.S and worldwide. While the scope of OpenADR focuses on signals for DR events and prices, significant work focuses on DR strategies and techniques to automate DR within facilities. OpenADR interacts with facility control systems that are pre-programmed to take action based on a DR signal, enabling a response to a DR event or a price to be fully automated, with no manual intervention.

The DRCC OpenADR 1.0 specification was donated to the Organization of Structured Information Standards (OASIS) to create a national standard for OpenADR. The OASIS' Energy Interoperation (EI) Technical Committee (TC) developed a standard to describe "an information model and a communication model to enable collaborative and transactive use of energy, service definitions consistent with the OASIS SOA Reference Model [SOA-RM], and XML vocabularies for the interoperable and standard exchange of dynamic price signals, reliability signals, emergency signals, communication of market participation information such as bids, load predictability and generation information." Considering that the goal of OASIS EI TC was more than DR and Distributed Energy Resources (DER), the EI TC created profiles within the EI Version 1.0 standard for specific applications within the Smart Grid. The OpenADR Alliance used the EI OpenADR profile as the basis for the OpenADR 2.0 Profile Specification defined in this document. OpenADR 2.0 defines profiles for DR and Distributed Energy Resources (DER), while keeping in mind the requirements of the diverse market and stakeholder needs.

INTRODUCTION

Development of the Demand Response (DR) market has resulted in a transition from manual DR to OpenADR in Automated DR (Auto-DR) programs. As of 2013, over 250 MW was enrolled in California commercial and industrial customers Auto-DR programs using OpenADR 1.0.[1] DR is defined as "…action taken to reduce electricity demand in response to price, monetary incentives, or utility directives so as to maintain reliable electric service or avoid high electricity prices."[2] OpenADR 1.0 was developed to support Auto-DR programs and California's energy policy objectives to move toward dynamic pricing to improve the economics and reliability of the electric grid. The recent developments have expanded the use of OpenADR to meet diverse market needs such as ancillary services (Fast DR), dynamic prices, intermittent renewable resources, supplement grid-scale storage, electric vehicles, and load as generation. For example, with real-time price information, an automated client within the customer facility can be designed to continuously monitor these prices and translate this information into continuous automated control and response strategies. This rationale is a fundamental element of the United States (U.S.) Smart Grid interoperability standards which are developed to improve dynamic optimization of electric supply and demand.

OpenADR Communications have the following defining features:

- **Continuous, Secure, and Reliable** - Provides continuous, secure, and reliable two-way communications infrastructures where the end points at the end-use site receive and acknowledge the receipt of DR signals from the energy service providers.
- **Translation** - Translates DR event information to continuous Internet signals to facilitate DR automation. These signals are designed to interoperate with energy management and control systems, lighting, or other end-use controls.
- **Automation** - Receipt of the external signals designed to initiate automation through the use of pre-programmed demand response strategies determined and controlled by the end-use participant.
- **Opt-Out** - Provides opt-out or override function to any participants for a DR event if the event comes at a time when changes in end-use services are not desirable.
- **Complete Data Model** - Describes a rich data model and architecture to communicate price, reliability, and other DR activation signals.
- **Scalable Architecture** - Provides scalable communications architecture to different forms of DR programs, end-use buildings, and dynamic pricing.
- **Open Standards** - Uses standards-based technology such as Internet Protocol (IP) and web services form the basis of the communications model.

OpenADR is a communications data model, along with transport and security mechanisms, which facilitate information exchange between two end-points, the electricity service provider and the customer. It is not a protocol that specifies "bit-structures" as some communications protocols do, but instead relies upon existing open standards such as eXtensible Mark-up Language (XML) and Internet Protocol (IP) as the framework for exchanging DR signals. In some references the term "system," "technology," or "service" is used to refer to the features of OpenADR.

OpenADR is designed to facilitate automation of DR actions at the customer location, whether it involves electric load shedding or load shifting. We are often asked if the communications data model can be used for continuous operations. The answer is **yes**. Many emergency or

[1] Piette, Mary Ann, Girish Ghatikar, Sila Kiliccote, Ed Koch, Dan Hennage, Peter Palensky, and Charles McParland. 2009. Open Automated Demand Response Communications Specification (Version 1.0). California Energy Commission, PIER Program. CEC- 500- 2009- 063.

[2] U.S. Federal Energy Regulatory Commission (FERC), 2007 Assessment of Demand Response and Advanced Metering, Staff Report, available: http://www.ferc.gov/legal/staff-reports/09-07-demand-response.pdf

reliability DR events occur at specific times when the electric grid is strained. The OpenADR communications are designed to coordinate such signals with facility control systems (commercial, industrial, and residential). OpenADR is also designed to provide continuous dynamic price signals such as hourly day-ahead or day-of real time pricing. With such price information an automated client can be configured to continuously monitor these prices and translate this information into continuous automated control and response strategies within a facility. Several reports present the history of OpenADR 1.0 research.[3] This OpenADR 2.0 profile specification covers the signaling data models for price and reliability signals to both wholesale and retail markets in the U.S.

OpenADR provides the following benefits:

- **Open Specification**–Provides a standardized DR communications and signaling infrastructure using open, non-proprietary, industry-approved data models that can be implemented for both dynamic prices and DR emergency or reliability events.
- **Flexibility**–Provides open communications interfaces and protocols that are flexible, platform-independent, interoperable, and transparent to end-to-end technologies and software systems.
- **Innovation and Interoperability**–Encourages open innovation and interoperability, and allows controls and communications within a facility or enterprise to build on existing strategies to reduce technology operation and maintenance costs, stranded assets, and obsolesce in technology.
- **Ease of Integration**–Facilitates integration of common Energy Management and Control Systems (EMCS), centralized lighting, and other end-use devices that can receive Internet signals (such as XML).
- **Supports Wide Range of Information Complexity –** Can express the information in the DR signals in a variety of ways to allow for systems ranging from simple end devices (e.g., thermostats) to sophisticated intermediaries (e.g., aggregators) to receive the DR information that is best suited for its operations.
- **Remote Access**– Facilitates opt-out or override functions for participants to manage standardized DR-related operation modes to DR strategies and control systems.

The OpenADR Alliance is the primary authority for the development and adoption of OpenADR, leveraging the OpenADR 1.0 activities and OASIS Energy Interoperation (EI) Technical Committee's Version 1.0 standard.[4] The OpenADR profile within OASIS EI Version 1.0 standard is the basis for the OpenADR 2.0 profile specification and is referenced as appropriate in this document.

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[3] These reports are available at http://drrc.lbl.gov/drrc-pubsall.html:

Piette, M.A., S. Kiliccote, G. Ghatikar, Design and Implementation of an Open, Interoperable Automated Demand Response Infrastructure, Proceedings of the Grid-Interop Forum, October 2007, LBNL-63665.

Koch, E., M.A. Piette, Architecture Concepts and Technical Issues for an Open, Interoperable Automated Demand Response Infrastructure. Proceedings of the Grid-Interop Forum, October 2007. LBNL-63664.

Piette, M.A, D. Watson, N. Motegi, S. Kiliccote Automated Critical Peak Pricing Field Tests: 2006 Pilot Program Description and Results, August, 2007. LBNL-62218.

Motegi, N., M.A. Piette, D.S. Watson, S. Kiliccote, P. Xu. Introduction to Commercial Building Control Strategies and Techniques for Demand Response, May 2007. LBNL-59975.

[4] Energy Interoperation OASIS Committee Specification, Energy Interoperation Version 1.0, December 2011. http://www.oasis-open.org/committees/download.php/44364/energyinterop-v1.0-csprd03.zip

1 Scope

The OpenADR 2.0 profile specification is a flexible data model to facilitate common information exchange between electricity service providers, aggregators, and end users. The concept of an open specification is intended to allow anyone to implement the two-way signaling systems, providing the servers, which publish information (Virtual Top Nodes or VTNs) to the automated clients, which subscribe the information (Virtual End Nodes, or VENs).

This OpenADR 2.0 profile specification covers the signaling data models between VTN and VEN (or VTN/VEN pairs) and does include information related to specific DR electric reduction or shifting strategies, which are taken at the facility. In particular, OpenADR 2.0 supports the following services from OASIS EI Version 1.0 standard or subset thereof. Extensions to these services are included to meet the DR stakeholder and market requirements:

1. **Registration (EiRegisterParty)**: Register is used to identify entities such as VEN's and parties. This is necessary in advance of an actor interacting with other parties in various roles such as VEN, VTN, tenderer, and so forth.
2. **Enrollment (EiEnroll)**: Used to enroll a Resource for participation in DR programs. This establishes a relationship between two actors as a basis for further interactions. (Planned for future releases)
3. **Market Contexts (EiMarketContext)**: Used to discover program rules, standard reports, etc. Market contexts are used to express market information that rarely changes, and thereafter need not be communicated with each message. (Planned for future releases)
4. **Event (EiEvent)**: The core DR event functions and information models for price-responsive DR. This service is used to call for performance under a transaction. The service parameters and event information distinguish different types of events. Event types include reliability events, emergency events, and more – and events MAY be defined for other actions under a transaction.
5. **Quote or Dynamic Prices (EiQuote)**: EiDistributeQuote for distributing complex dynamic prices such as block and tier tariff communication. These are sometimes referred to as *price signals*; such signals are indications of a possible tender price – they are not themselves actionable. Such services can be used to implement the functionality for energy market interactions or transactional energy. (Planned for future releases)
6. **Reporting or Feedback (EiReport)**: The ability to set periodic or one-time information on the state of a Resource (response).
7. **Availability (EiAvail)**: Constraints on the availability of Resources. This information is set by the end node and indicates when an event may or may not be accepted and executed by the VEN with respect to a Market Context. Knowing the Availability and Opt information for its VENs improves the ability of the VTN to estimate response to an event or request. (Planned for future releases)
8. **Opt or Override (EiOpt)**: Overrides the EiAvail; addresses short-term changes in availability to create and communicate Opt-in and Opt-out schedules from the VEN to the VTN.

These OpenADR 2.0 services in this specification provide information that is pertinent to DR, pricing, and DER communication requirements. These services make no assumption on specific DR electric load control strategies within the resource or market-specific contractual or business agreements between electricity service providers and their customers.

OpenADR uses an application-level data model, which is independent of transport mechanisms. For the purposes of interoperability, OpenADR 2.0 provides basic transport mechanisms and their relevant interaction patterns (e.g., PUSH information vs. PULL information) to address different stakeholder needs.

OpenADR 2.0 specifies the necessary level of security that is essential to meet the U.S. Cyber Security requirements for such purposes as data confidentiality, integrity, authentication and message-level security. Such security requirements are essential for non-repudiation and to mitigate any resulting Cyber Security risks.

OpenADR 2.0 provides a clear set of mandatory and optional attributes within each of the services to meet the broader interoperability, testing and certification requirements, while creating feature-sets with different product profiles to address today's market needs as well