

Introduction to OpenADR



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Introductions & Webinar Overview



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Jim Zuber Co-Founder, CTO, QualityLogic

Jim Zuber is QualityLogic's CTO and a co-founder of the company. He was the OpenADR profile and schema editor, developed the OpenADR Test Specification, and architected the official Alliance Test Harness. Jim has spent the last 5 years training and consulting with companies to help them with their OpenADR implementations.

Many of the testing products Jim architected for QualityLogic have become de facto testing standards in the smart grid, imaging, facsimile, and telephony industries. He was the principal architect of the testing methodologies that made QualityLogic's predecessor, Genoa Technology, one of the leading suppliers of test solutions to the computer and telecommunications industries. Before helping to establish Genoa, he was cofounder and chief technical officer of Blue Chip Software, where he wrote the official simulation of the American Stock Exchange, which was cobranded with the Amex.





About QualityLogic

QualityLogic was founded in 1986 to help solve compatibility problems between print systems and software applications. As a result, we developed the quality assurance test tools and test suites that quickly became the industry standard.

Our smart energy experts designed, developed, and maintain the OpenADR Test Harness, and we are intimately familiar with the OpenADR 2.0 specification. QualityLogic supported the OpenADR Alliance in the development of the "OpenADR Implementation Guide and we continue to be an active member of the alliance and other smart energy organizations.







OpenADR

An Introduction

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Topics

- Backstory
- VTNs and VENs
- Services
- Push vs. Pull
- Profiles
- Transports
- Security
- Feature Support
- Deployment Models

QualityLOGIC Putting Technology to the Test

Automated DR

- An information exchange model to facilitate communication of price and reliability signals
- Receipt of external signal (the "Event") initiates preprogrammed response strategies by end user



Demand Response Information Exchanged





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Smart Grid Load Shaping Objectives

Energy Efficiency programs reduce overall electricity consumption, generally also at times of peak demand. 1.

Load Shaping

- 2. **Price Response** programs move consumption from times of high prices to times of lower prices (real time pricing or time of use) – expanded to address transmission distribution congestion management.
- Peak Shaving programs require more response during peak hours and focus on reducing peaks on high-system load days - expanded to address transmission distribution congestion management.
- Reliability Response (contingency response) requires the 4. fastest, shortest duration response. Response is only required during power system "events." - This is new and slowly developing.
- 5. Regulation Response continuously follows minute-tominute commands from the grid in order to balance the aggregate system load and generation – This is also very new and appears to be very promising for certain loads.
 - 1. Adapted from: Demand Response Spinning Reserve Demonstration Project, Consortium for Electric







Auto DR Logic



DR Program Examples



- Critical Peak Pricing Program
 - Price program with rates increasing during critical peaks in energy consumption
 - Customers offered discounted energy prices during non-peak times as an incentive to participate
 - DR Event is notification that the peak pricing period is about to begin

DR Program Examples



Thermostat Program

- Customer grants permission for utility to modify behavior of thermostat in return for a free thermostat, discount, or stipend
- When utilities anticipate high market prices or emergency conditions, a DR Event is initiated that modifies the behavior of the customer's thermostat over a specified time period



OpenADR 2.0

- OpenADR Alliance formed in 2010 to evolve prior DR protocol efforts into a standard:
 - Non-proprietary, open standardized DR & DER interface
 - Allows electricity providers to communicate DR, DER, and TE signals directly to existing customers
 - Formal certification program for OpenADR devices



- Two actors in OpenADR communication exchanges
 - Virtual Top Nodes (VTN)
 - Transmit events other nodes
 - Virtual End Nodes (VEN)
 - Receive events and respond to them
 - Control demand side resources



- A VEN typically has one VTN in a relationship
- A VTN has one or more VENs in a relationship















Your Application Code



- OpenADR provides for DR message exchange, not DR application logic
- No constraints on how messages arriving at one node are translated into subsequent messages







- Web Service like logical request-response services
 - Event Service Send and Acknowledge DR Events
 - Opt Service Define temporary availability schedules
 - Report Service Request and deliver reports
 - Registration Service VEN Registration, device information exchange

Services Usage Scenario





Event Service Payloads



- Payloads are XML messages exchanged between VENs and VTNs
 - oadrRequestEvent or oadrPoll VEN requests its DR events from VTN
 - oadrDistributeEvent VTN sends DR events to VEN
 - oadrCreatedEvent VEN tells VTN whether it will particupate in the event (optIn or OptOut)
 - oadrResponse VTN acknowledges VENs optIn/optOut message
- Typical Signals: Simple, Price, Load_Dispatch

Exchange Patterns



- Pull VEN polls VTN for DR events
- Pull avoids firewall security issues



Exchange Patterns



- Push VTN pushes DR events to VEN
- VEN can still request events





Registration Service

- VEN registers with VTN, VEN and VTN exchange capabilities
- Service patterns...
 - VEN requests registration and sends its capabilities, VTN responds with registration ID and its capabilities
 - VEN or VTN requests cancellation of registration, other side acknowledges cancelation
- Typically the venID, polling rate, and push/pull model are determined as part of registration

Report Service Payloads



- Service Patterns...
 - Declare (register) available reports, acknowledge receipt of available reports
 - Request specific report, acknowledge receipt of request
 - Deliver requested report, acknowledge receipt of report
 - Cancel requested report, acknowledge cancellation request
- Reports can be one-shot or periodic
- Typical reports: Telemetry Usage, Telemetry Status

Opt Service Payloads



- Communicate temporary availability schedule
- Service Patterns...
 - VEN sends opt schedule to VTN, VTN acknowledges receipt of schedule
 - VEN cancels opt schedule, VTN acknowledges cancellation
- Qualify resources participating in event
 - VENs must initially make an all-or-nothing decision about event participation
 - The Opt Service can be used to subsequently qualify what resources will participate in events

OpenADR 2.0 Profiles



- "A" profile is targeted at limited resource devices and simple DR applications
- "B" profile is targeted at robust devices and sophisticated DR applications





Transports

Simple HTTP

- Request Response pattern using HTTP
- Uses an HTTP Post for all request payloads
- Payload root element indicates action
- XMPP
 - A bidirectional XML streaming protocol
 - Persistent connection, low overhead
 - Push model



Security

- Client and Server x.509v3 certificates
- TLS 1.2 with specified SHA256 ECC or RSA ciphers
- Optional XML payload signatures
- Requirements above are "out of box", deployment security may differ

Feature Support



		B VTN	B VEN	A VEN
Services	EiEvent - Simple	М	Μ	Μ
	EiEvent – Full	Μ	Μ	NA
	EiOpt	Μ	Μ	NA
	EiRegistraton	Μ	Μ	NA
	EiReport	Μ	Μ	NA
Security	RSA and ECC Ciphers	Μ	One(1)	One(1)
	XML Signatures	0	0	NA
Transport	SimpleHTTP Only	NA	NA	Μ
	XMPP and SimpleHTTP	Μ	One(1)	NA
Exchange Model	Pull - SimpleHTTP	Μ	М	Μ
	Push - SimpleHTTP	М	0	0
Profile	B support for A profile	М	NA	NA

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O=Optional M=Mandatory

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Deployment Scenarios





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Deployment Scenarios





Direct 2

Deployment Scenarios



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OpenADR Key Concepts



- VTN plays the role of a server, VEN a client
- 4 services: Event, Report, Opt, and Registration
- Key payloads in Event service: oadrRequestEvent or oadrPoll, oadrDistributeEvent, oadrCreatedEvent, oadrResponse
- Two profiles A and B
- Two transports Simple HTTP and XMPP
- Security: TLS, RSA and ECC ciphers, and x.509 certificates
- Receipt of Event triggers preprogrammed strategy

Questions & Answers



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Thank You

Contact Information

Jim Zuber – jimzuber@qualitylogic.com

Survey

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Continue Your OpenADR Training Online With Our Fundamentals of OpenADR Course

The course expands on today's introductory material on the OpenADR protocol, then takes a deep dive into the technical details of OpenADR.

qualitylogic.thinkific.com/fundamentals-of-openadr



