openADR ALLIANCE

Introduction to OpenADR

June 23, 2020

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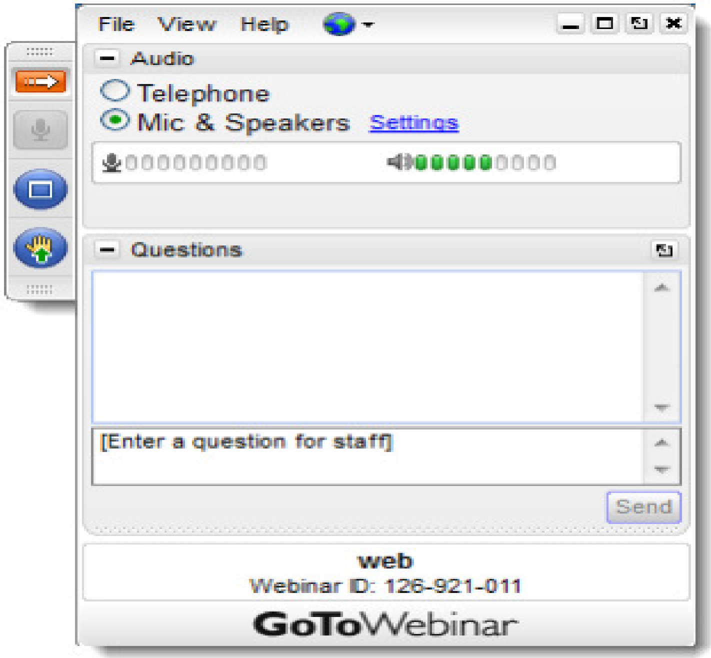

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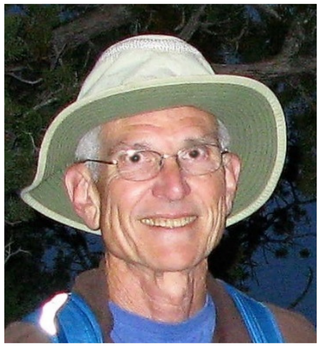
Introductions & Webinar Overview

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.

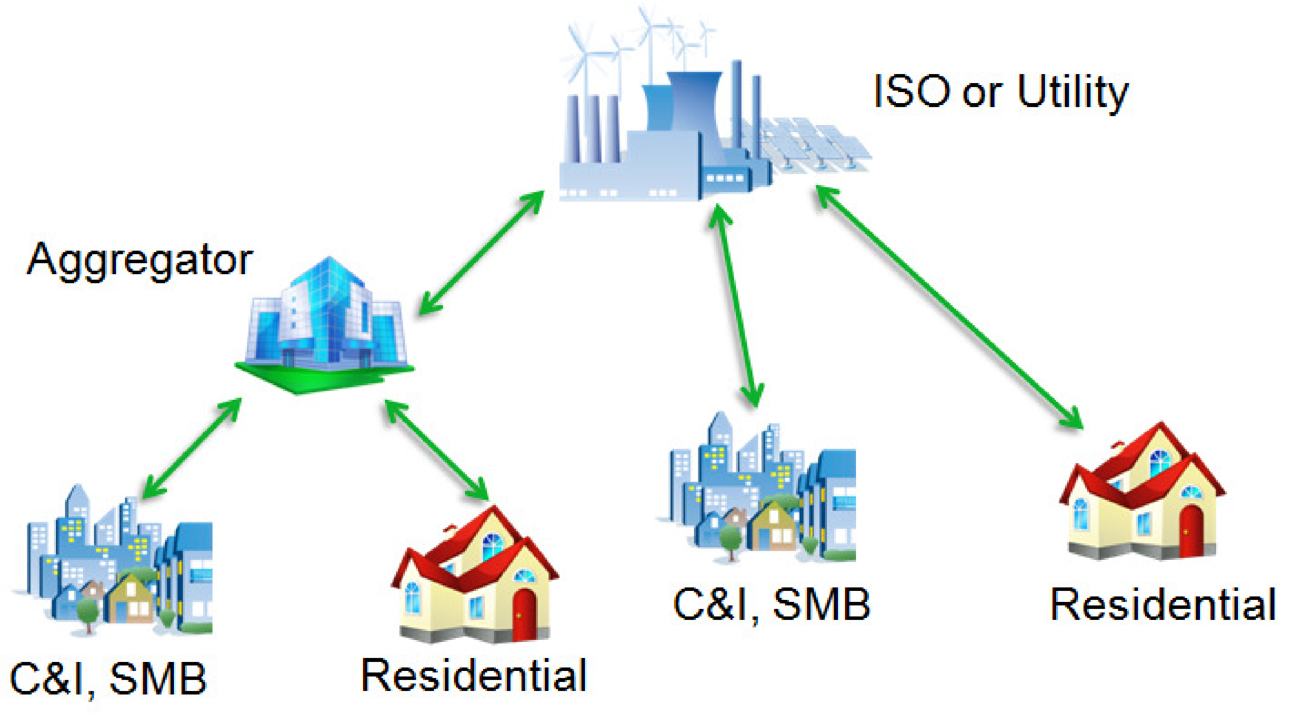
Our smart energy experts designed, developed, and maintain the OpenADR Test Harness, and we are intimately familiar with the OpenADR 2.0 specification. QualityLogic supported the OpenADR Alliance in the development of the "OpenADR Implementation Guide and we continue to be an active member of the alliance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

Topics

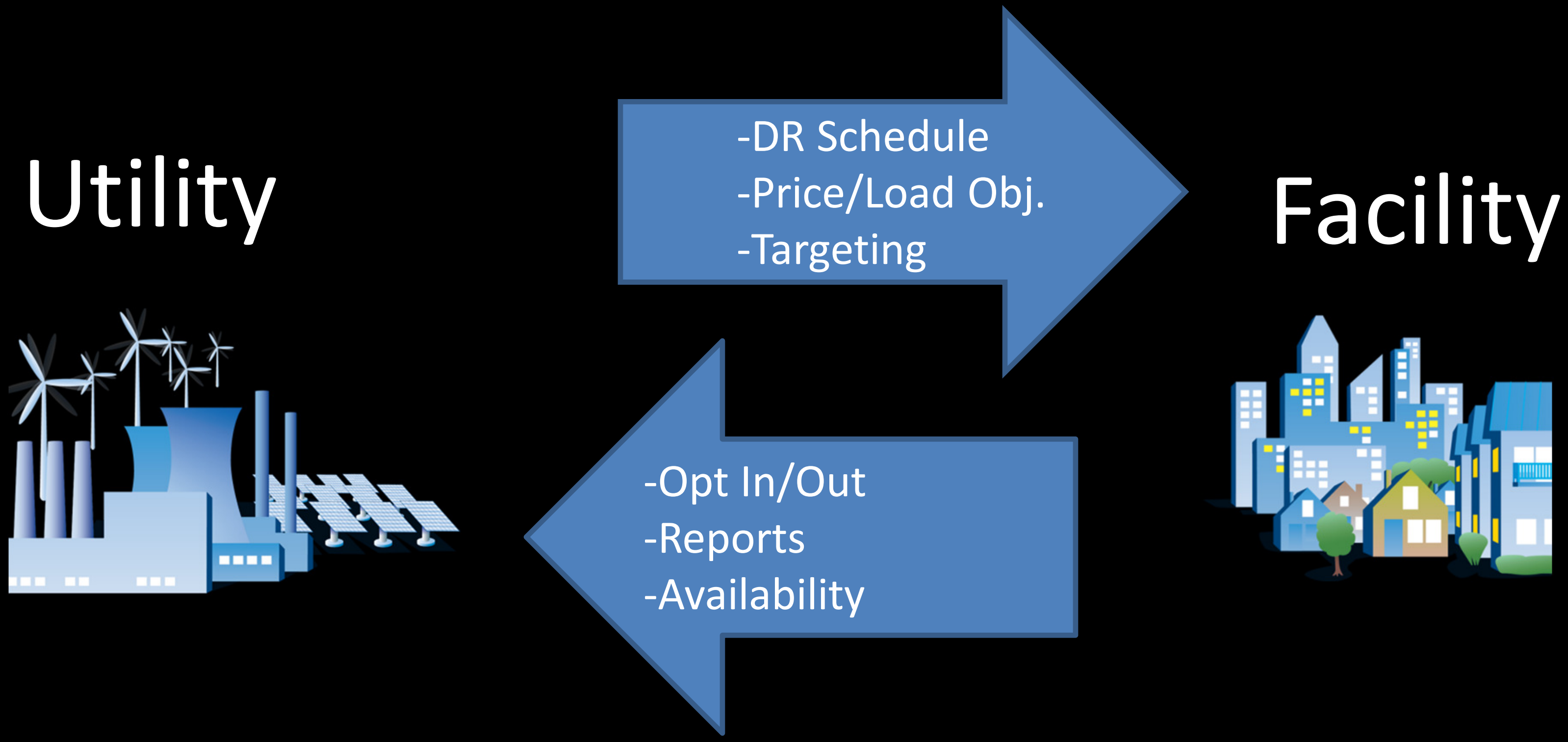
- Backstory
- VTNs and VENs
- Services
- Push vs. Pull
- Profiles
- Transports
- Security
- Feature Support
- Deployment Models

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



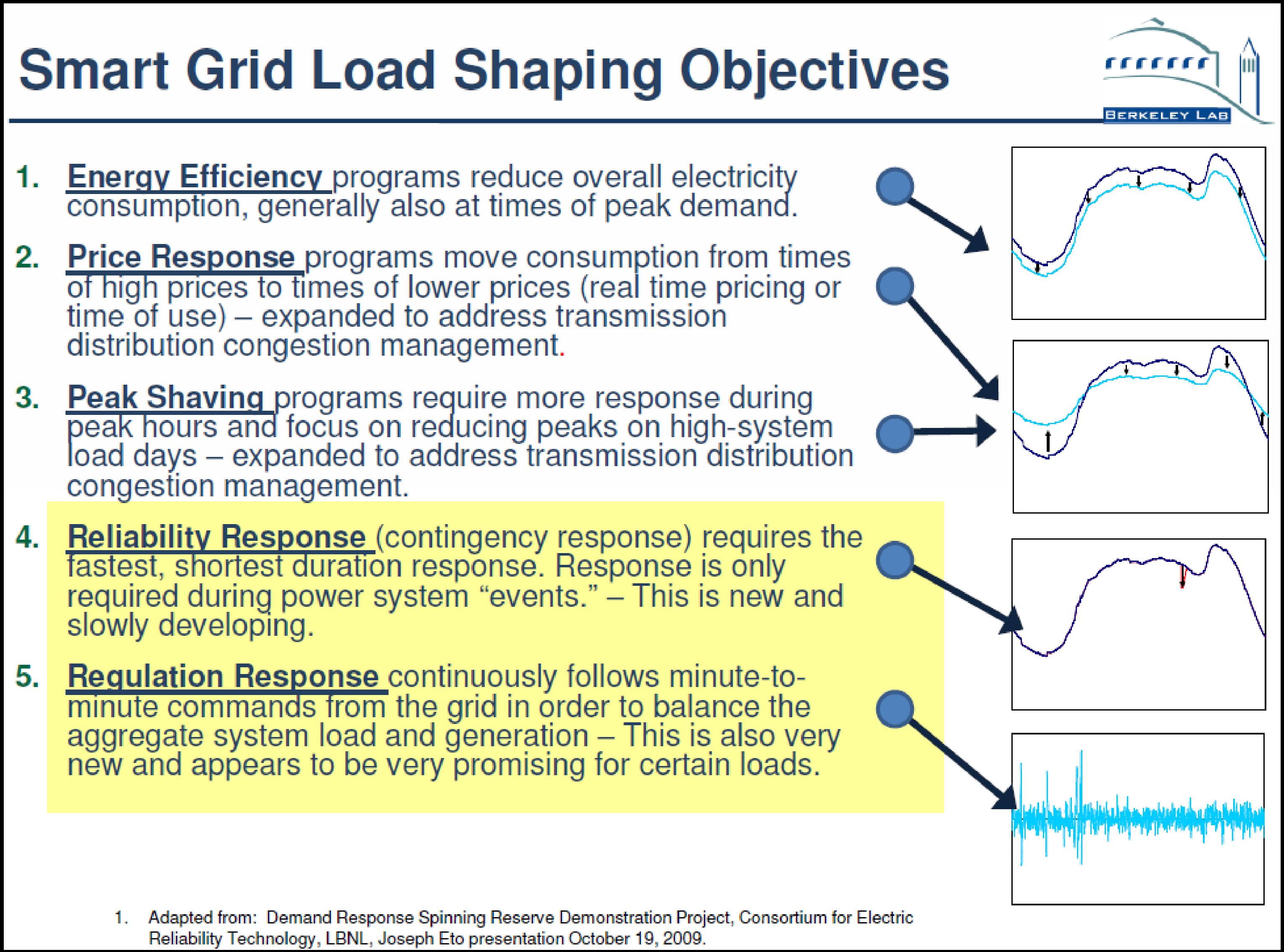
Utility

-DR Schedule
-Price/Load Obj.
-Targeting

Facility

-Opt In/Out
-Reports
-Availability

Load Shaping

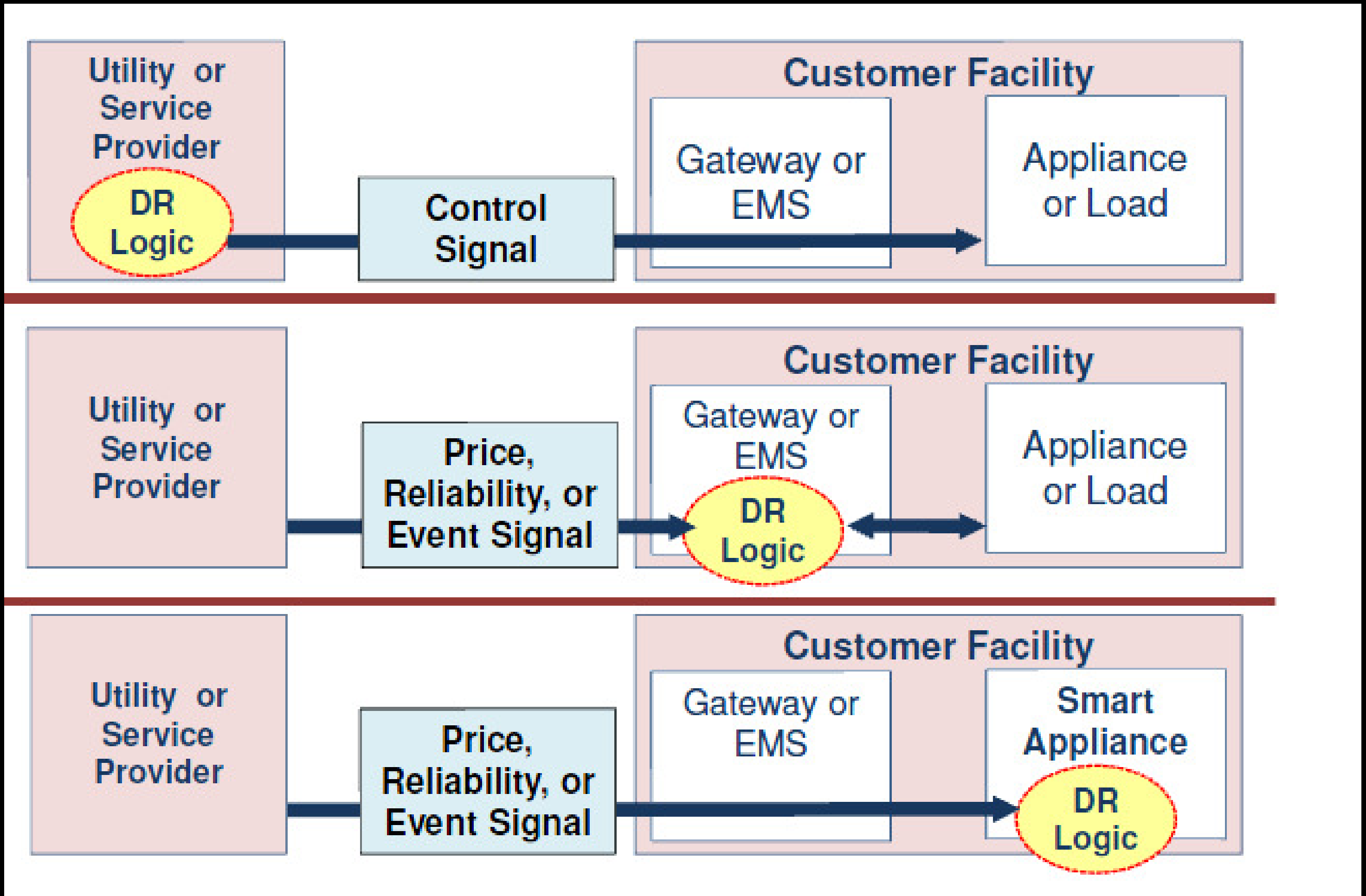


Smart Grid Load Shaping Objectives

1. **Energy Efficiency** programs reduce overall electricity consumption, generally also at times of peak demand.
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.
3. **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.
4. **Reliability Response** (contingency response) requires the fastest, shortest duration response. Response is only required during power system "events." – This is new and slowly developing.
5. **Regulation Response** continuously follows minute-to-minute 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 Reliability Technology, LBNL, Joseph Eto presentation October 19, 2009.

Auto DR Logic



Source: "Direct versus Facility Centric Load Control for Automated Demand Response, Grid Interop 2008, Koch,E., Piette, M"

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

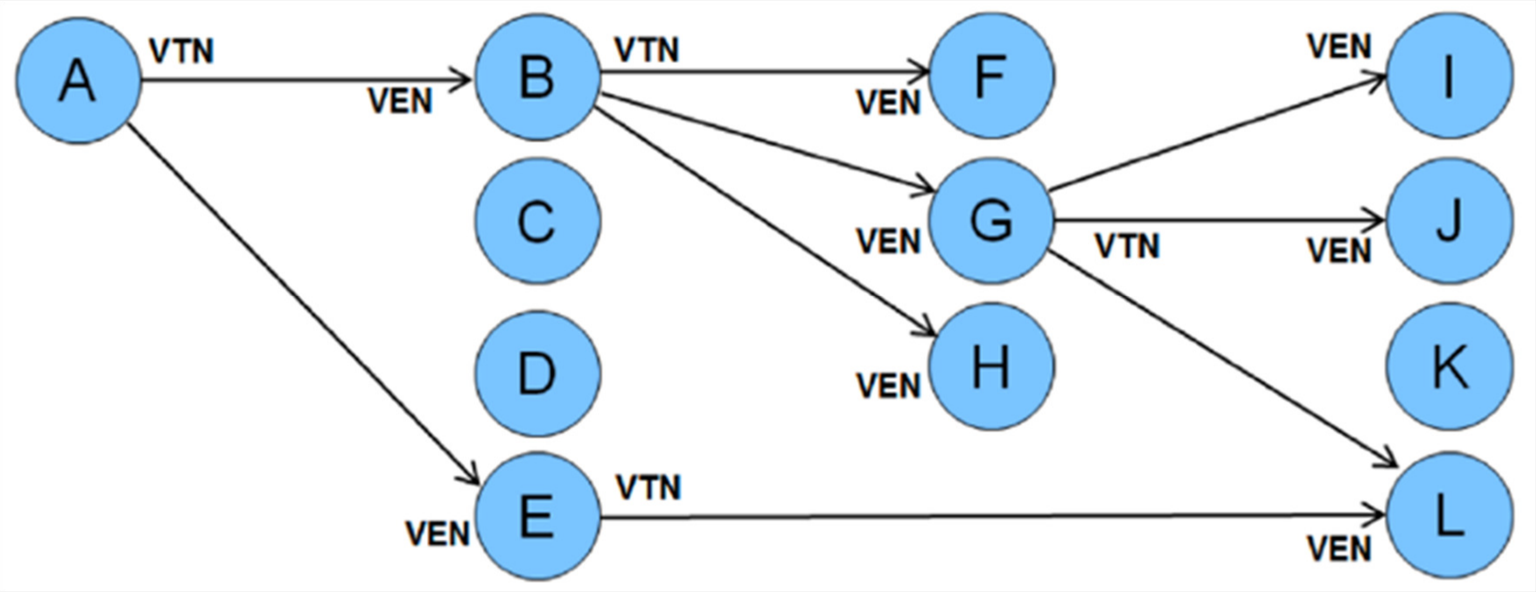
- OpenADR Alliance formed in 2010 to evolve prior DR protocol efforts into a standard:
  - Non-proprietary, open standardized DR & DER interface
  - Allows electricity providers to communicate DR, DER, and TE signals directly to existing customers
  - Formal certification program for OpenADR devices

VENs and VTNs

- 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

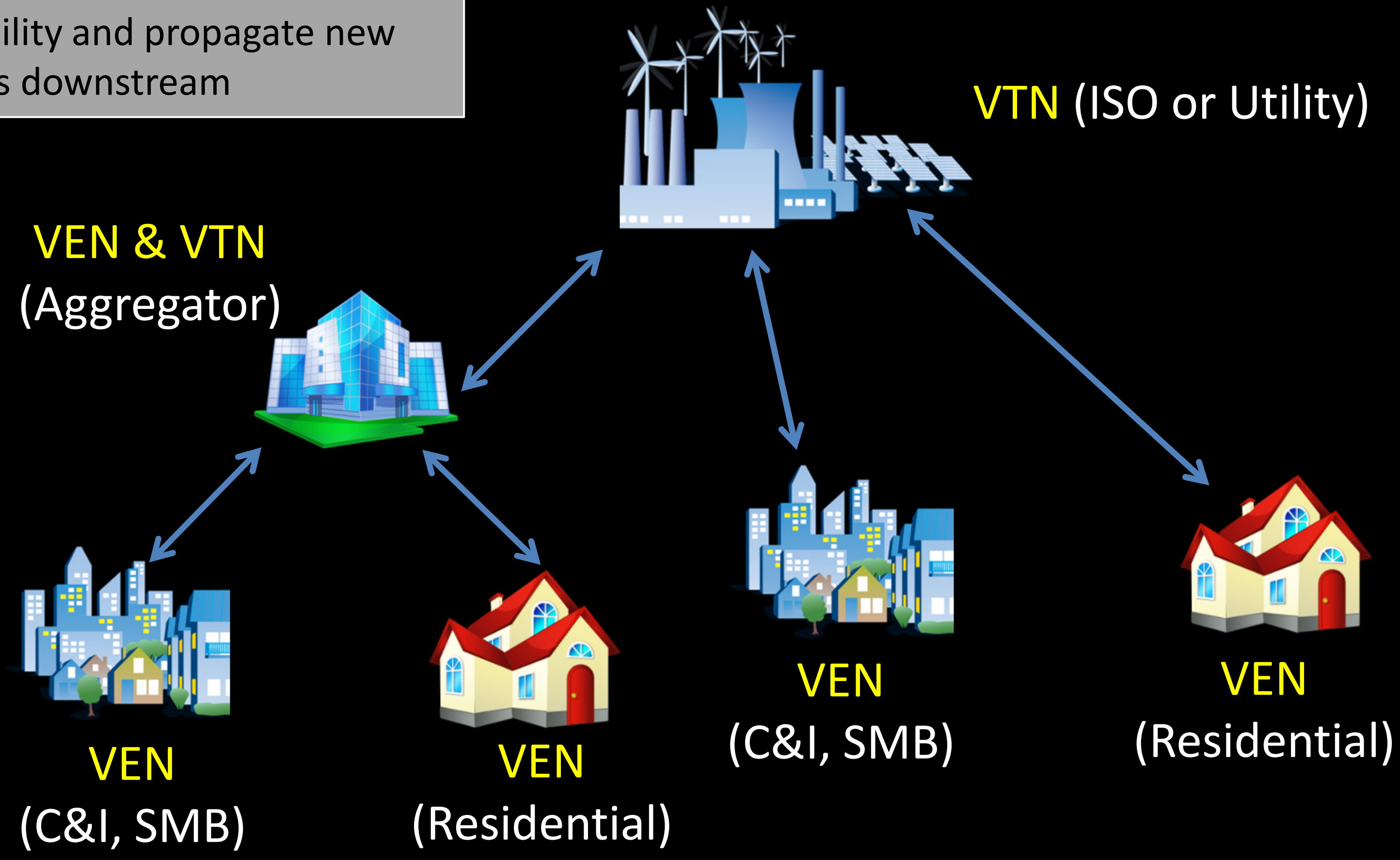
VENs and VTNs

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

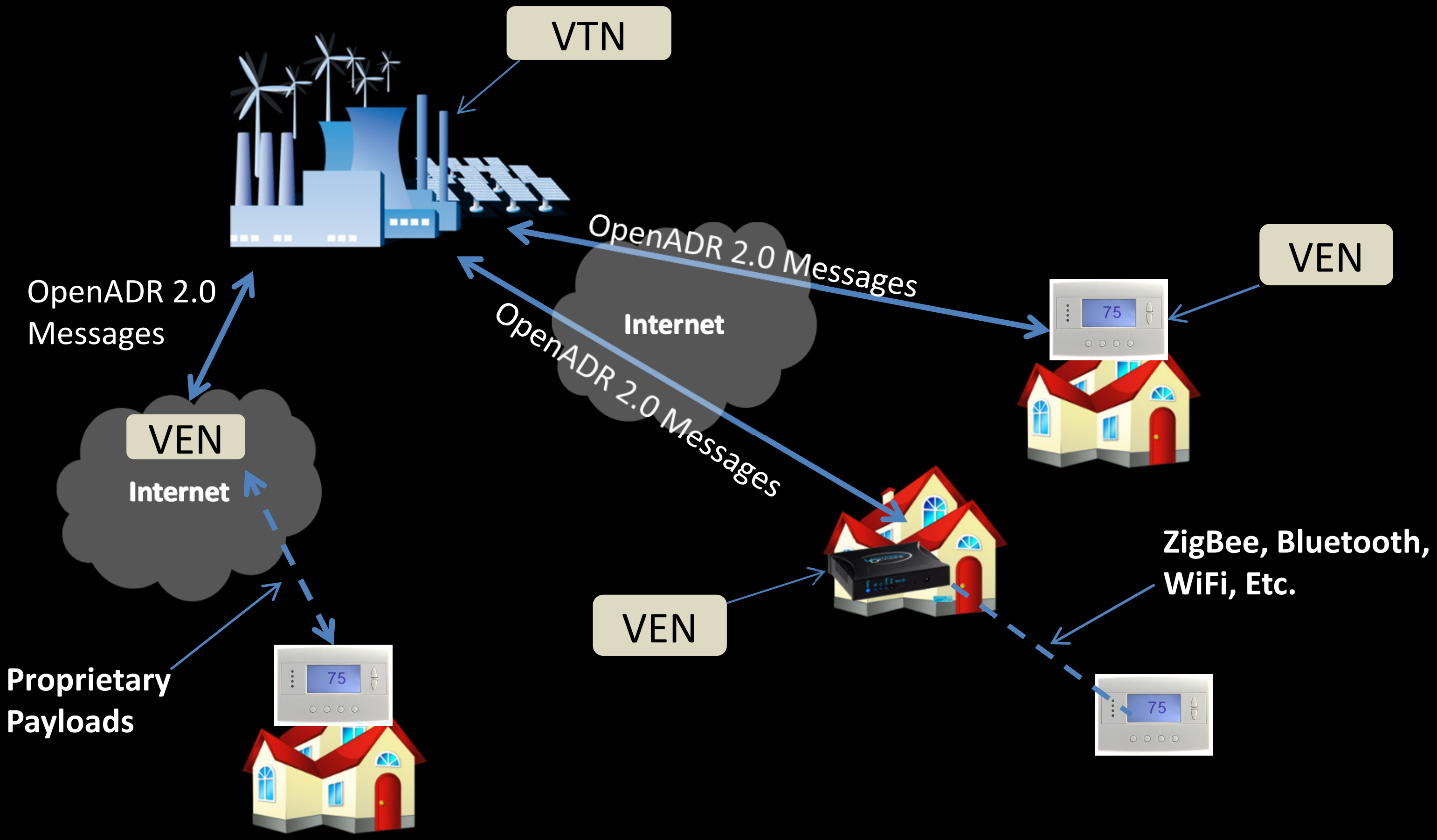


VENs and VTNs

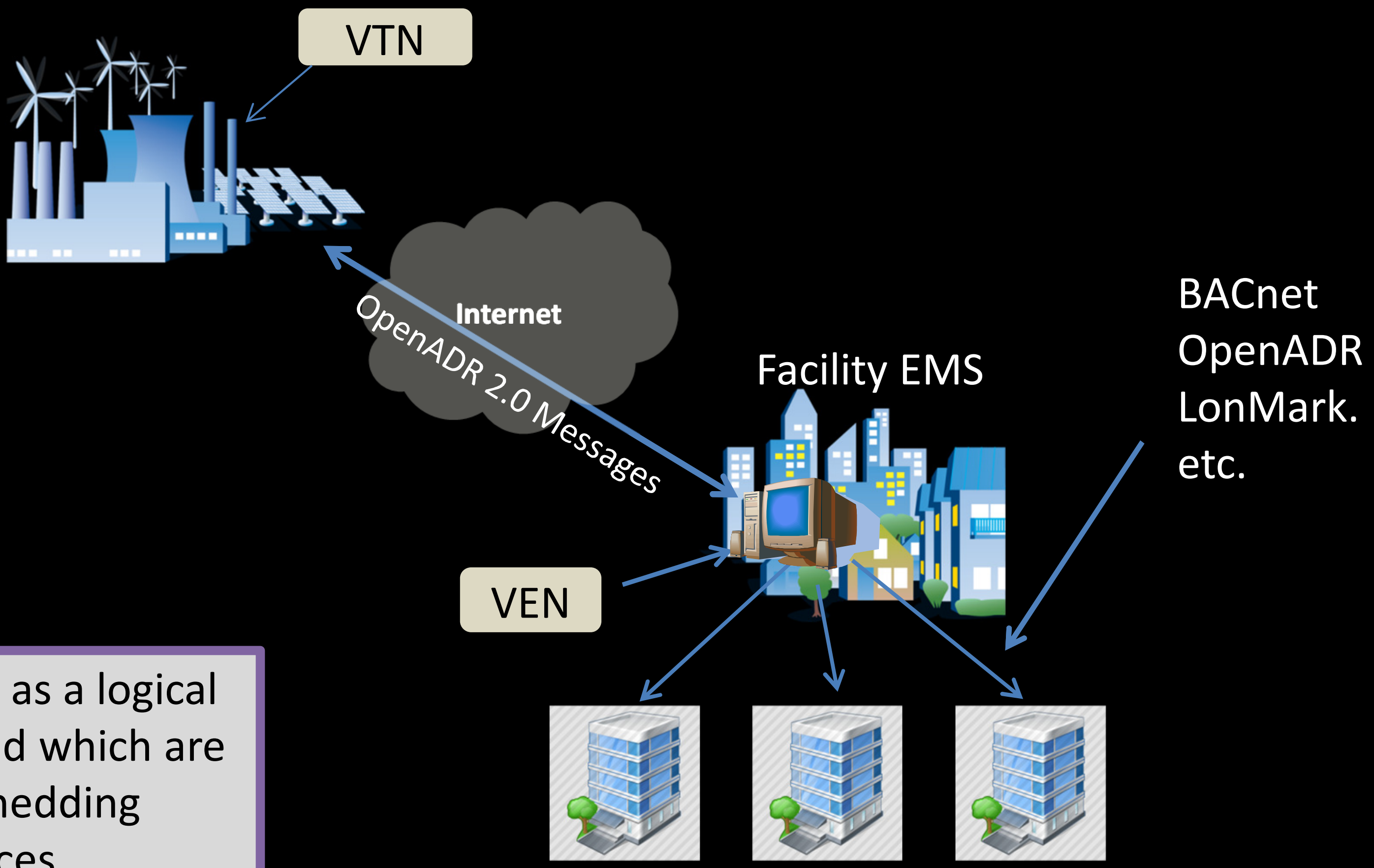
The aggregator in this diagram would receive the event from the utility and propagate new events downstream



VENs and VTNs



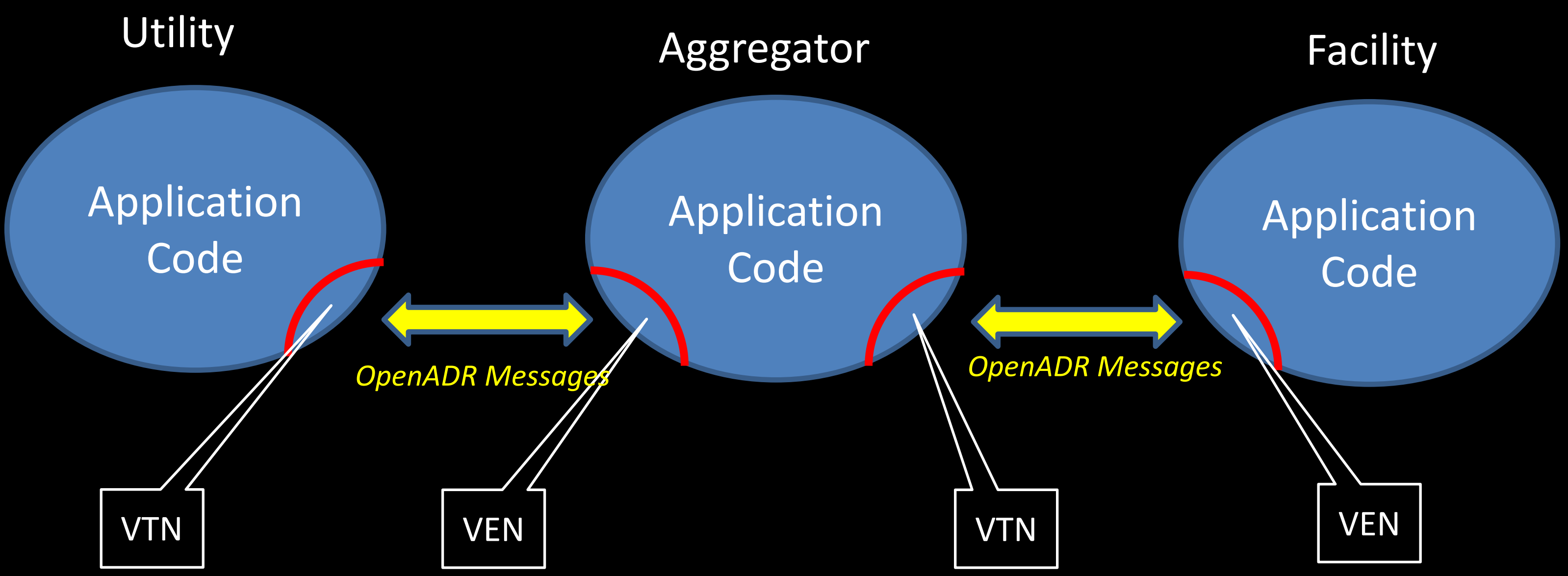
VENs and VTNs



Think of a VEN as a logical interface behind which are the load shedding resources.

Your Application Code

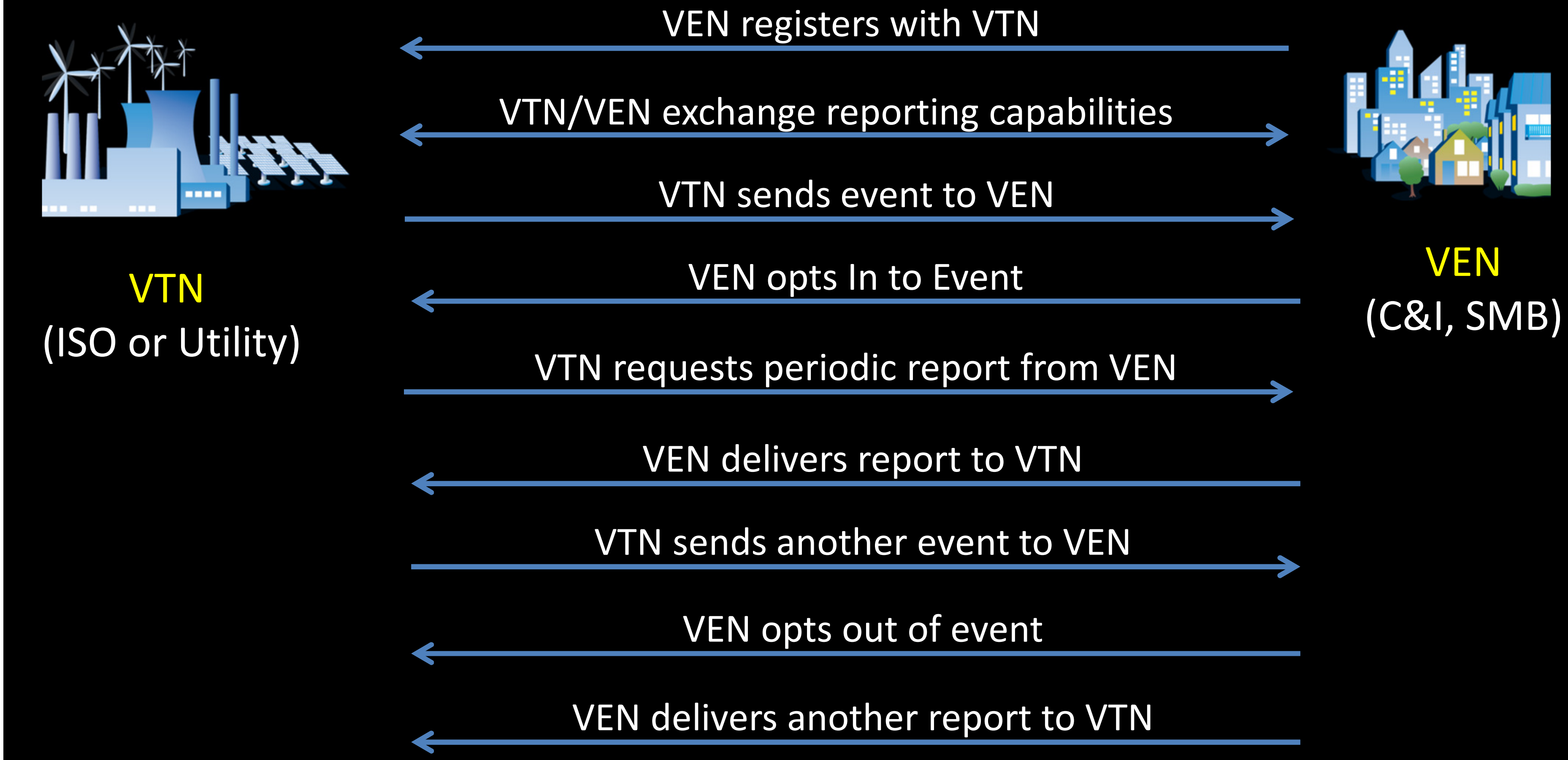
- OpenADR provides for DR message exchange, not DR application logic
- No constraints on how messages arriving at one node are translated into subsequent messages



Services

- 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



VTN
(ISO or Utility)

VEN
(C&I, SMB)

VEN registers with VTN

VTN/VEN exchange reporting capabilities

VTN sends event to VEN

VEN opts In to Event

VTN requests periodic report from VEN

VEN delivers report to VTN

VTN sends another event to VEN

VEN opts out of event

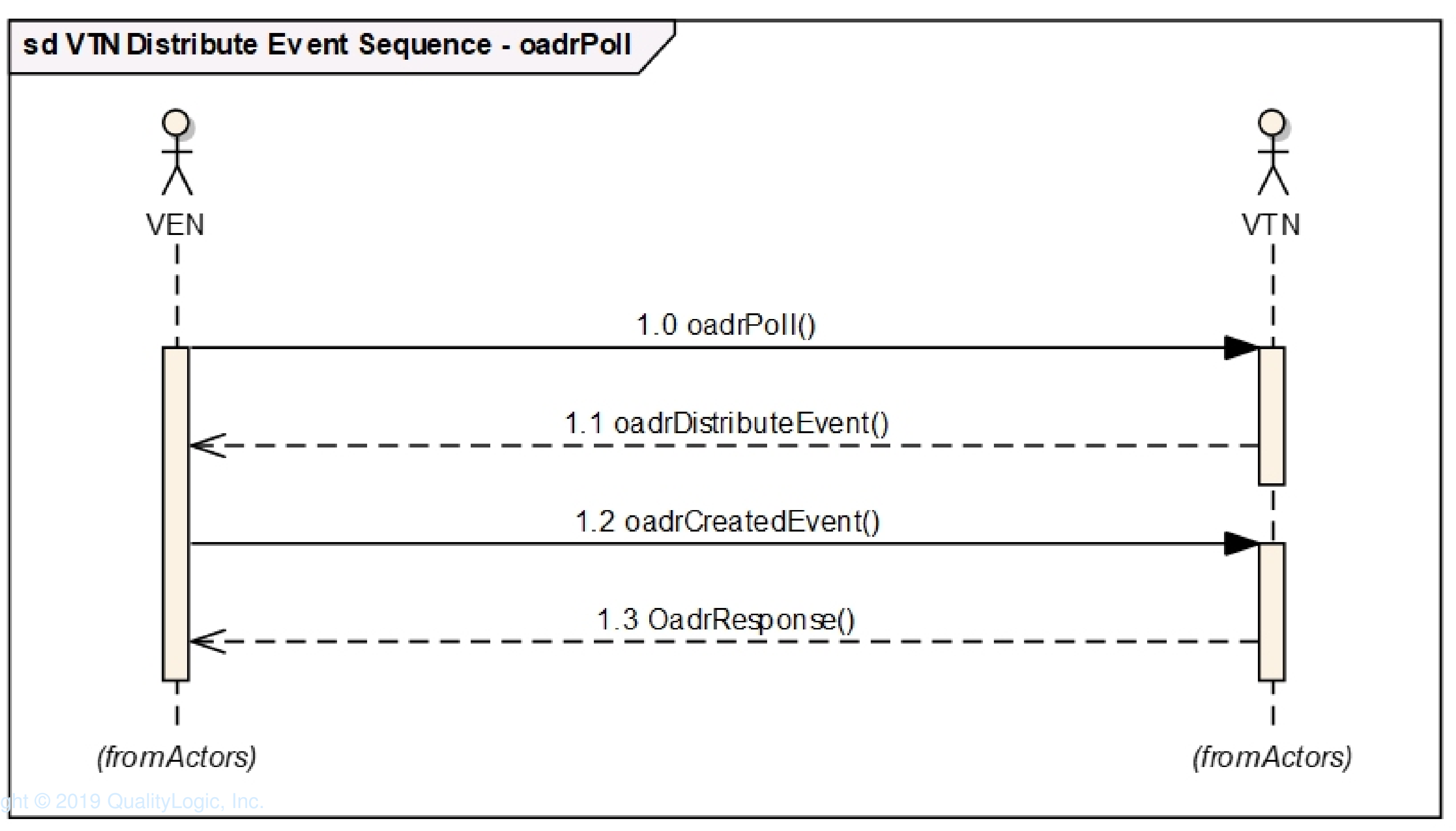
VEN delivers another report to VTN

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

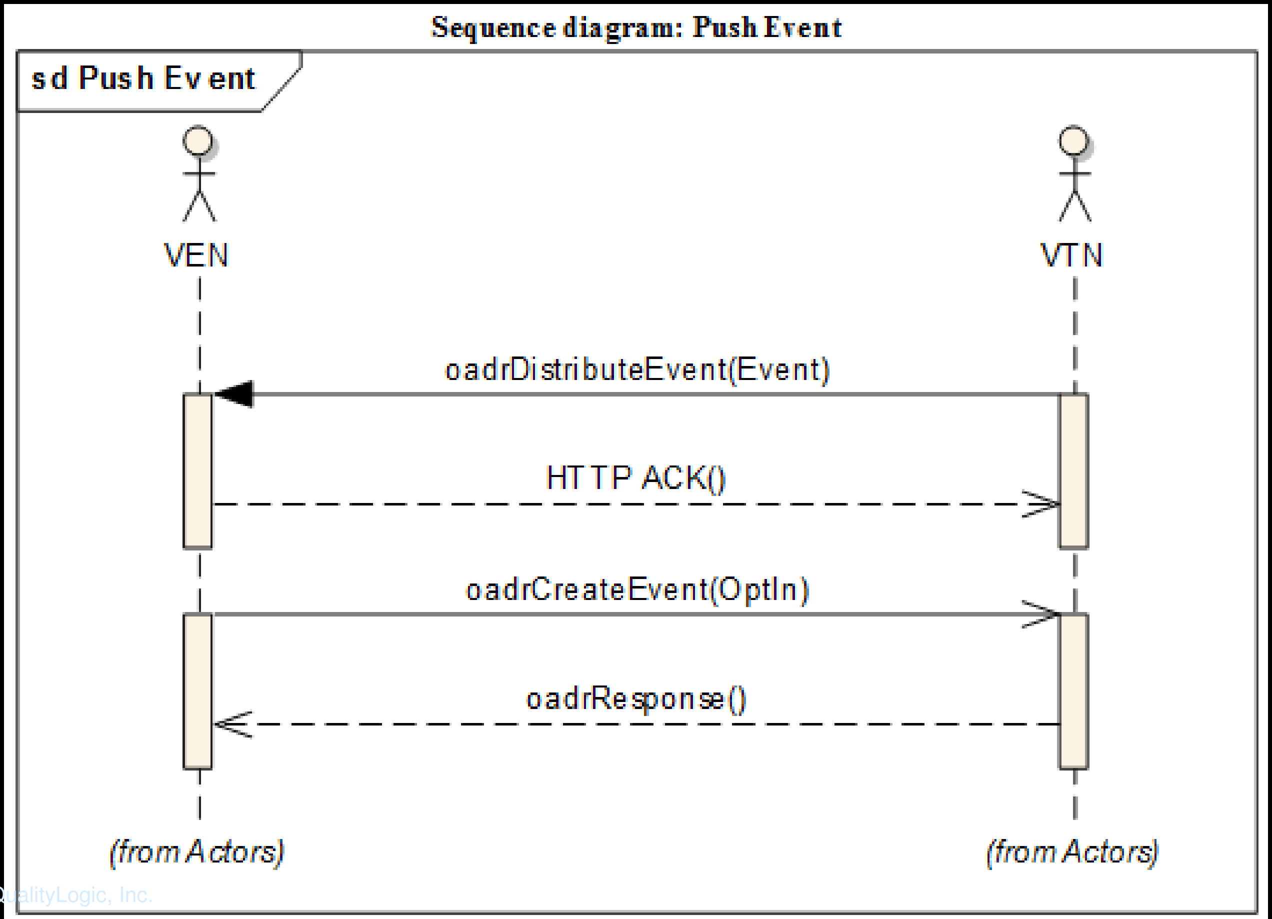
Exchange Patterns

- 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

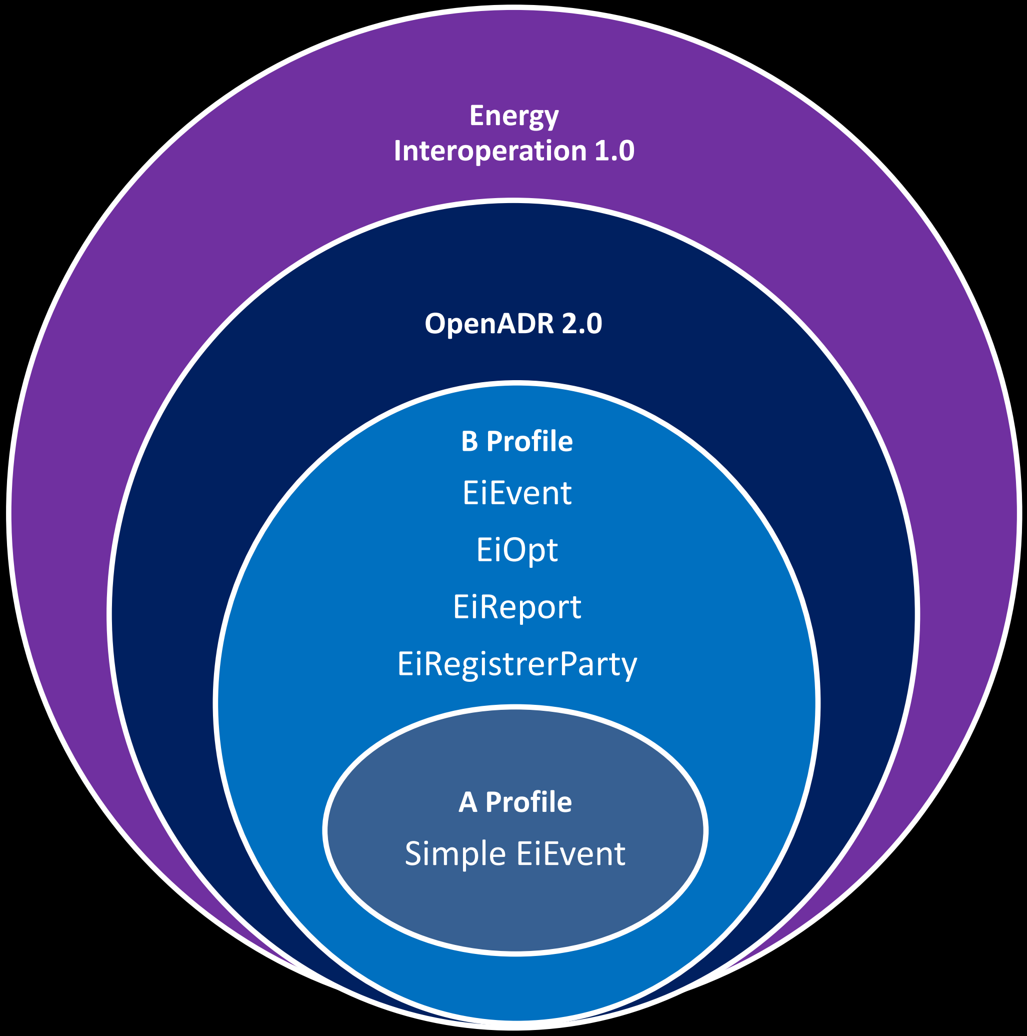
Opt Service Payloads

- 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

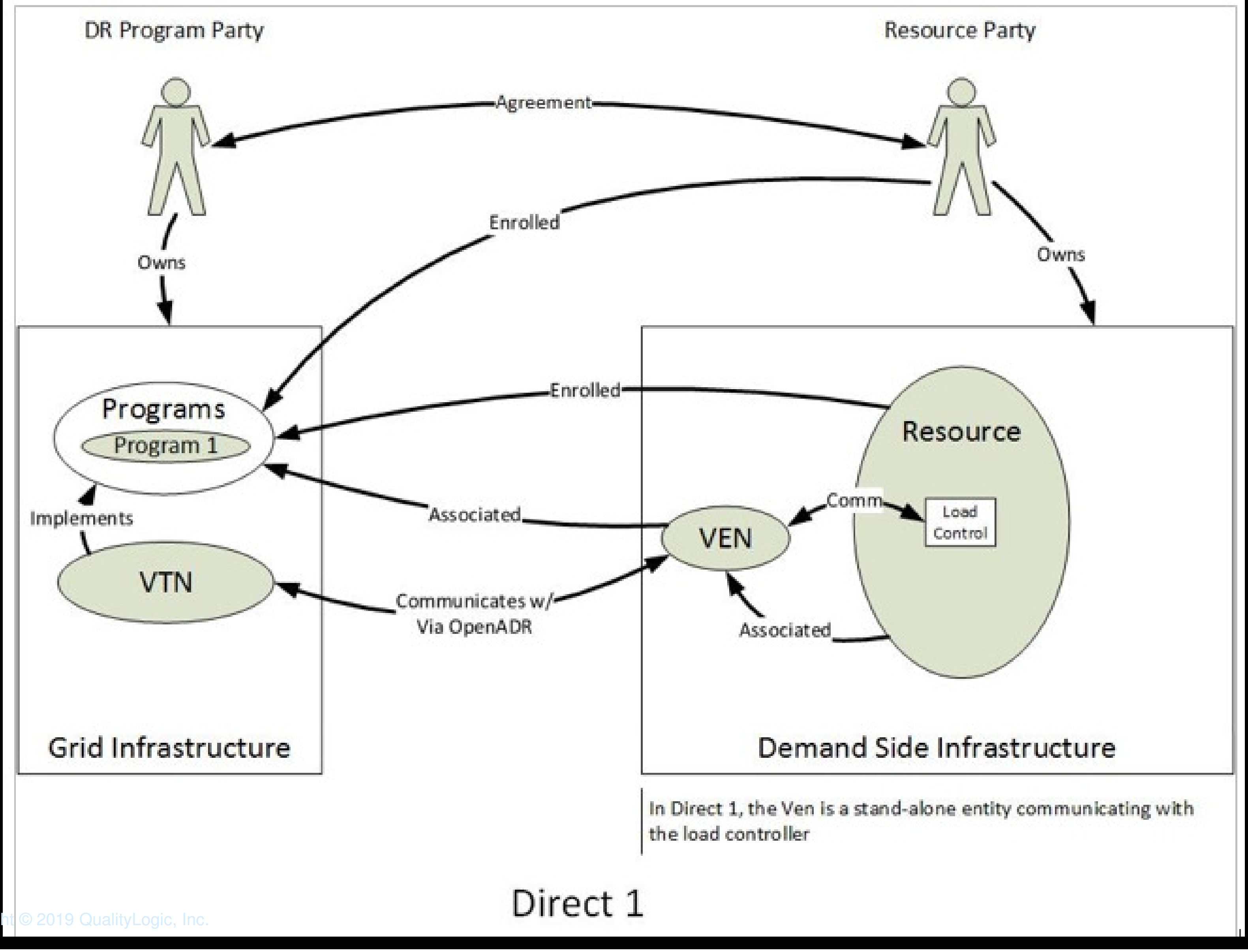
		B	B		A
		VTN	VEN		VEN
Services	EiEvent - Simple	M	M		M
	EiEvent – Full	M	M		NA
	EiOpt	M	M		NA
	EiRegistraton	M	M		NA
	EiReport	M	M		NA
Security	RSA and ECC Ciphers	M	One(1)		One(1)
	XML Signatures	O	O		NA
Transport	SimpleHTTP Only	NA	NA		M
	XMPP and SimpleHTTP	M	One(1)		NA
Exchange Model	Pull - SimpleHTTP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

(1) Must support at least one , but can support both.

O=Optional M=Mandatory

Deployment Scenarios

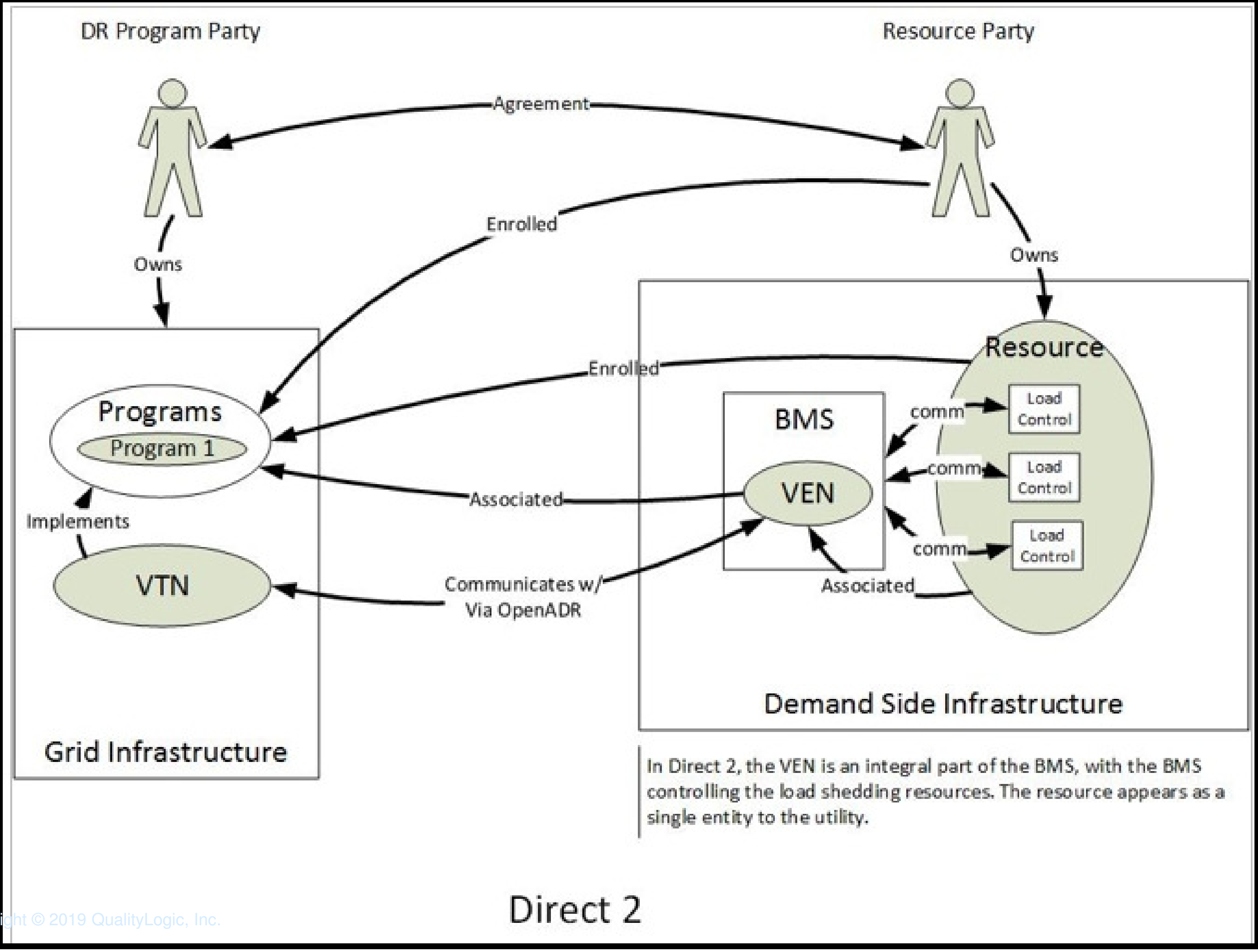
QualityLogic
Putting Technology to the Test



In Direct 1, the Ven is a stand-alone entity communicating with the load controller

Direct 1

Deployment Scenarios



In Direct 2, the VEN is an integral part of the BMS, with the BMS controlling the load shedding resources. The resource appears as a single entity to the utility.

Direct 2

Deployment Scenarios

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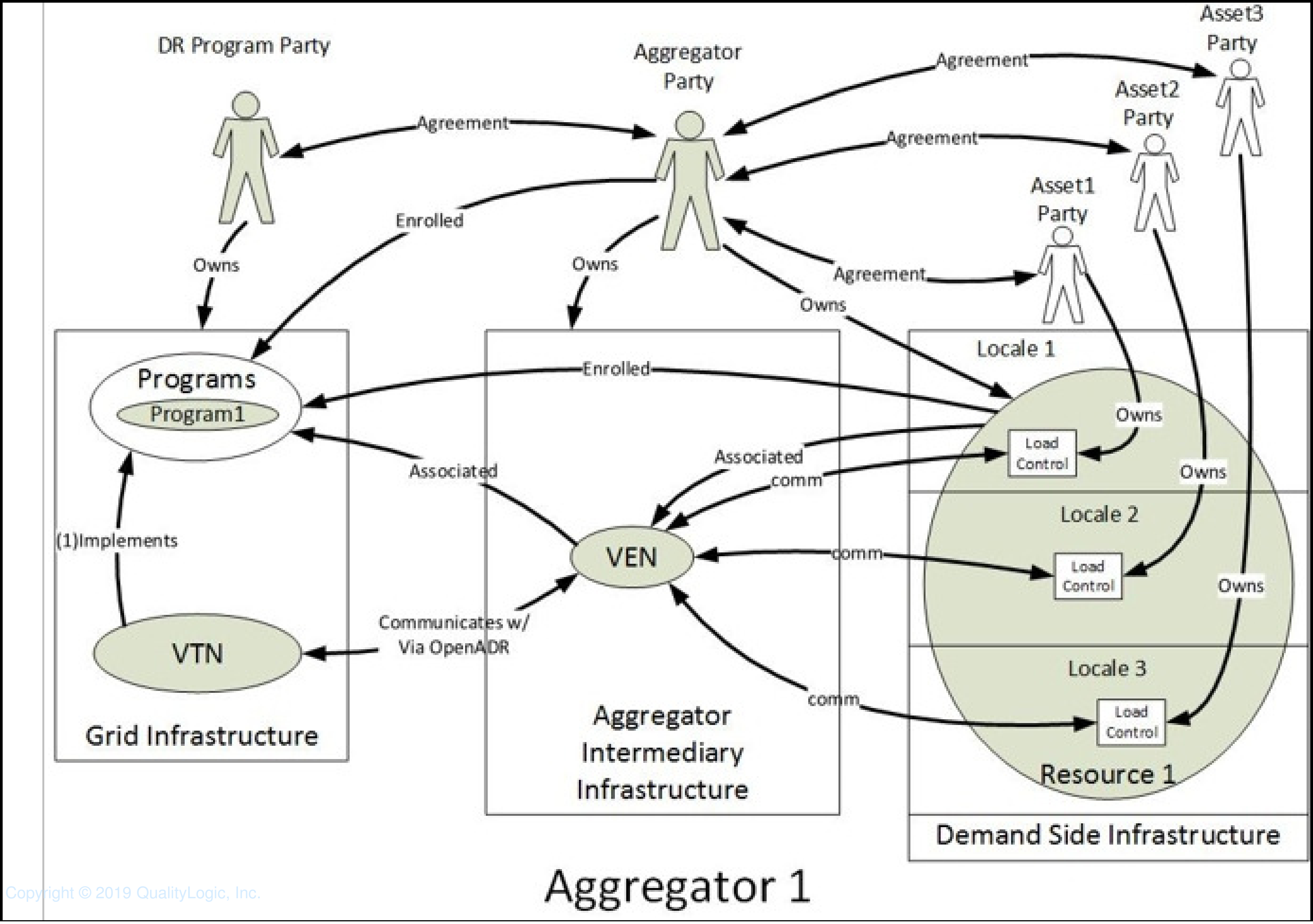

OpenADR Key Concepts

- 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

Thank You

Contact Information

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