# OpenADR Introduction
# 12 September 2019 – European Webinar

Rolf Bienert, Technical & Managing Director
Don Dulchinos, Director Market Facilitation




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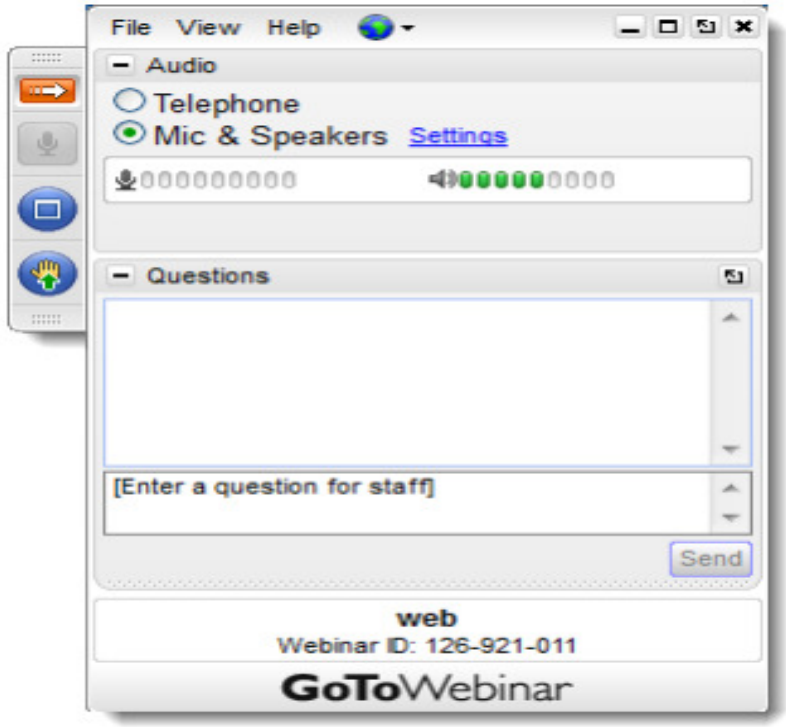

# Agenda

- Introductions – Rolf Bienert, Don Dulchinos
- OpenADR Alliance: roles, promotion, certification, standardization
- OpenADR 101: protocols, highly secure, flexible, web services-based.
- Extensions in scope to DER, storage, transactive energy
- Product Case Studies

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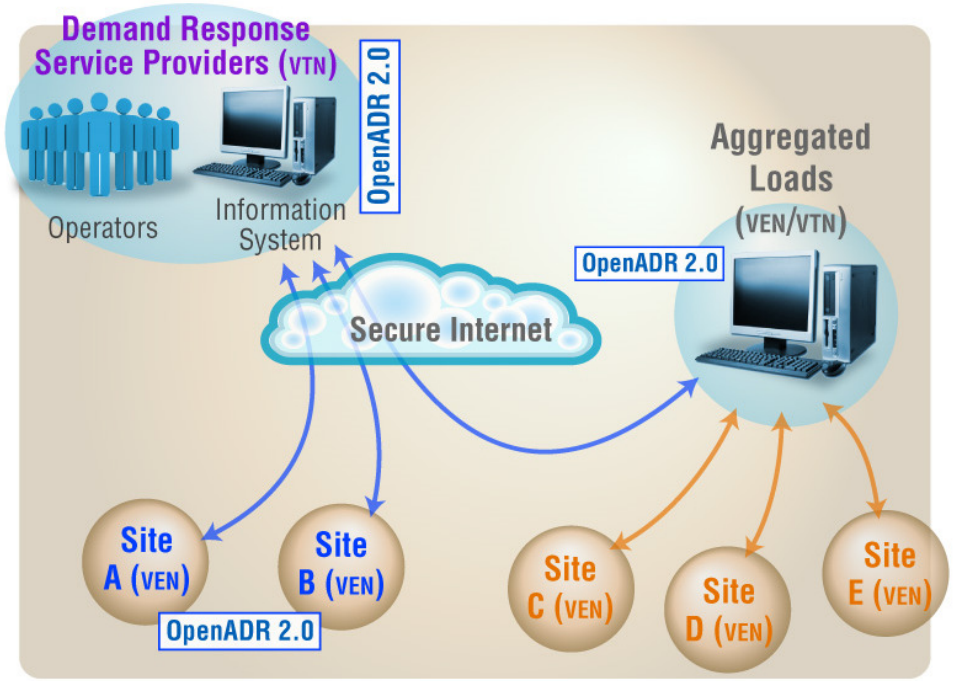
# OpenADR in a Nutshell

OpenADR provides a non-proprietary, open standardized DR & DER interface that allows DR service providers to communicate DR, DER, and TE (Transactive Energy) signals directly to existing customers using a common language and existing communications such as the Internet.



# What is the OpenADR Alliance?


**Vision: Facilitate the global deployment of OpenADR to reduce the cost of supplying and consuming electricity, while improving energy reliability and reducing environmental impact.**

- California based nonprofit 501(c)(6) corporation  comprised of 140 industry stakeholders
- Leverages Smart Grid related standards from OASIS, IEC, UCA and NAESB for OpenADR profiles
- Supports development, testing, certification, and deployment of commercial OpenADR
- Enables stakeholders to participate in automated DR, DER, dynamic pricing, transactive services, and electricity grid reliability

# Members

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**Adopter Members**

EDF R&D · ETC · ETRI Electronics and Telecommunications Research Institute · Hawaiian Electric Company · ISGF India Smart Grid Forum · Korea Electrotechnology Research Institute · KETI · London Hydro · NVEnergy

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# Membership Examples

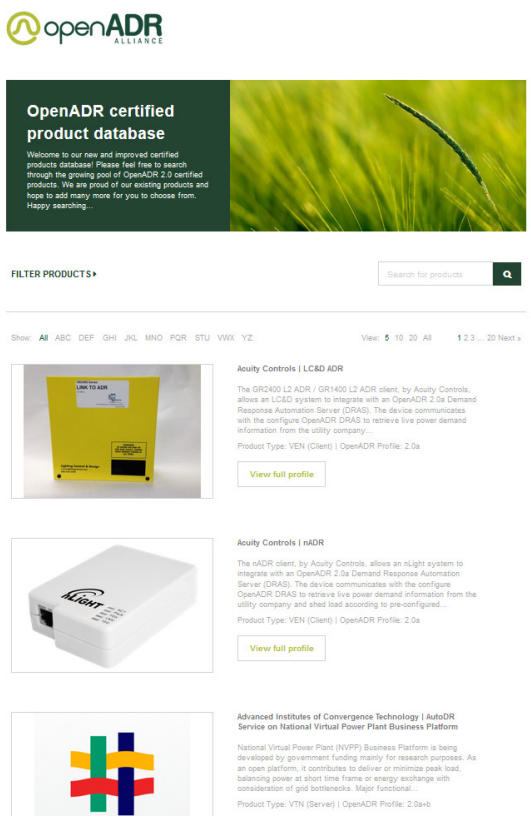

- *Metering*
  - Itron
  - Fujitsu
- *Controls/Systems*
  - Auto-Grid
  - Siemens
  - AO Smith
  - Quality Logic
  - Many more
- *Adopters*
  - Hawaii Electric
  - NV Energy
  - London Hydro
  - PG&E
  - SCE
  - Austin Energy
  - Many more
- *Consumer Devices*
  - Chargepoint
  - Ecobee
  - evconnect

## Standards Interoperability *Lifecycle* Process

**An iterative development process for a standard to be deployed In markets**

1. Research and development
2. Pilots and field trials
3. Interoperability standards development
4. Deployment and market facilitation

# Where are we today?




- Two completed specifications
  - >7 years for 2.0a
  - >6 years for 2.0b
- 8 test houses validated
- ~ 170 certified systems
- ~ 145 member companies

# International Standardization

- **2014**
  - International Electrotechnical Commission (IEC) approved the OpenADR 2.0b Profile Specification as a Publicly Available Specification (PAS) IEC/PAS 62746-10-1 as a basis for a new commission standard to be developed.
  - The level of international support for the PAS validates the global importance of the OpenADR smart grid specification.
- **2018**
  - The IEC Project Committee 118 (PC118) together with TC57 WG21 advanced the PAS to become an international standard.
  - OpenADR 2.0b is now published as IEC 62746-10-1 Ed.1 as of November 19, 2018. https://webstore.iec.ch/publication/26267
  - The technical requirements and functions are unchanged from OpenADR 2.0b.

# Certified Products - Examples

- VTN
  - DERMS
  - DR Optimization System
  - Building Energy Management System
  - Virtual Power Plant
  - Load Balancing System


- VEN
  - HVAC Controls
  - EV Charging Stations
  - Smart Thermostats
  - DR Client Software
  - Energy Storage System
  - Building Gateway Software

# OpenADR Alliance Can Provide Support

The OpenADR Technical Implementation Guide addresses these issues:

- Defines OpenADR best practices
- Defines deployment scenarios
- Defines DR program templates
- Provides guidance to utilities in selecting templates and deployment scenarios

ps://www.openadr.org/dr-program-guide

# Program Templates in the Guide – Models of Typical Programs

- Critical Peak Pricing
  - Prices raised during peaks, lower prices non-peak
- Capacity Bidding Program
  - Pre-committed day of/day ahead load shed capacity
- Residential Thermostat Program
  - Allow changes to PCT, free PCT/Discount/Rebate
- Fast DR Dispatch (Ancillary Services)
  - Pre-committed large real time load shed capacity
- Residential Electric Vehicle TOU Program
  - TOU pricing with day ahead price notification
- Public Station EV RTP Program
  - RTP influences customer charge decision
- Distributed Energy Resources (DER) Program
  - Uses harvested energy and load shed to offset high prices

European Utility Week

12 - 14 November 2019
Paris Expo Porte de Versailles
Paris, France

## Be sure to visit us at booth G180 - More than Demand Response

- Learn more about the OpenADR standard, certified products and why is important for utilities and system operators to adopt.

- Hear how the OpenADR 2.0 standard, recently established as an International Electrotechnical Commission (IEC) standard, is being implemented for DER programs worldwide.

- To schedule a meeting email rolf@openadr.org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European Utility Week

12 - 14 November 2019
Paris Expo Porte de Versailles
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# OpenADR Alliance Global Members Exhibiting

- Enbala
- Enel Foundation (Enel X)
- Honeywell
- Itron
- Nuri Telecom
- OSI
- Panasonic
- Siemens
- Trilliant
- TUV Rheinland

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# How it Works and Common Services

# The ‘Entities’ of OpenADR

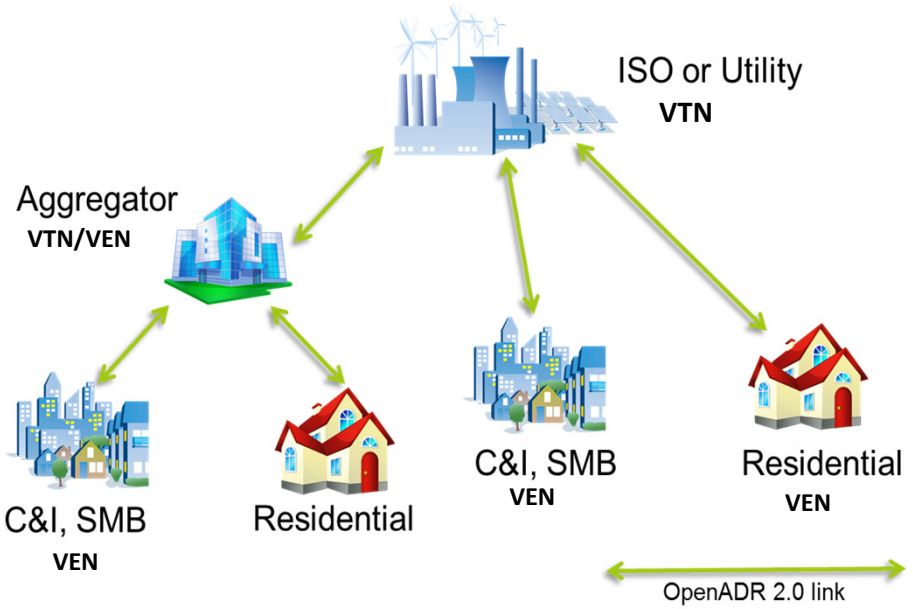
OpenADR is a message exchange protocol with two primary actors aka ‘entities’

**Virtual Top Nodes** (VTN)

- Manages Resources
- Creates/Transmit events
- Request Reports

**Virtual End Nodes** (VEN)

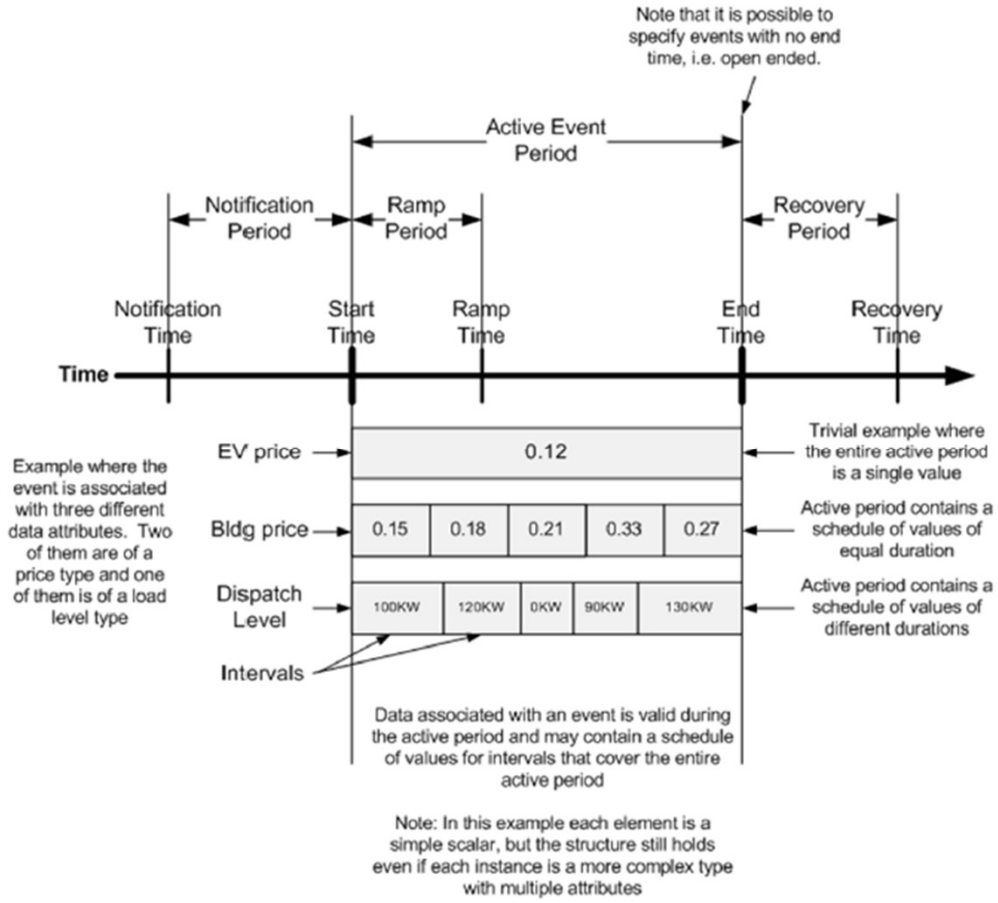
- Receive events and respond to them
- Generate reports
- Control demand side resources



# The ‘Services’ of OpenADR

- 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
  - RegisterParty Service – VEN Registration, device information exchange
- XML Payloads
- Communication through broadband or dedicated internet connection

# OpenADR 2.0 Event - Example



# Cyber Security Certifications are Critical

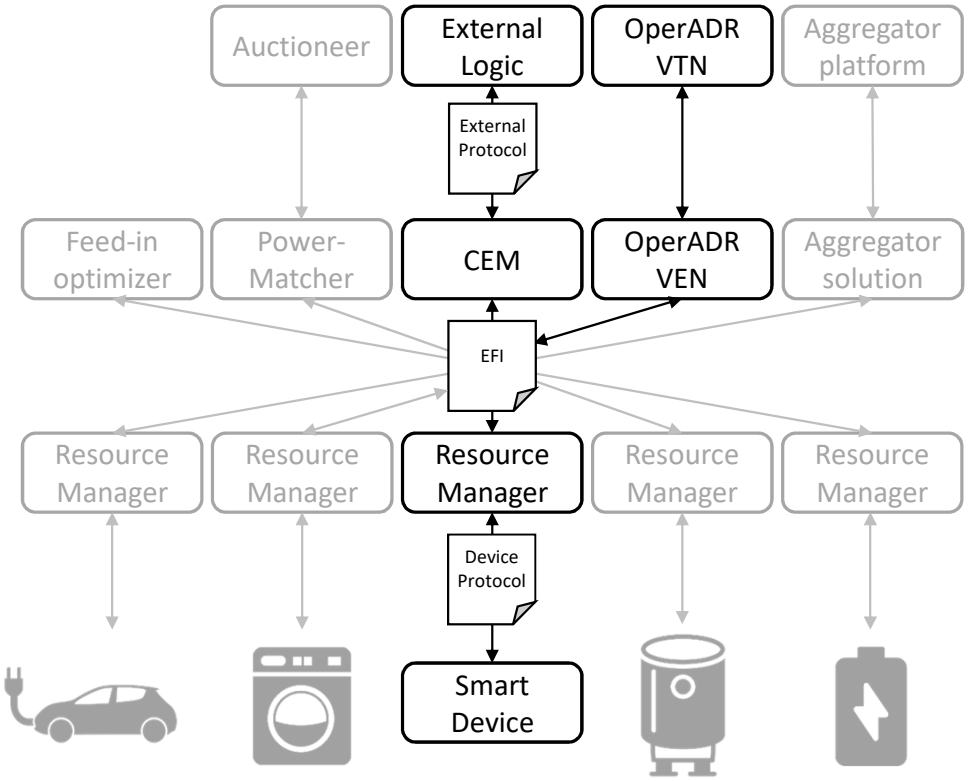
- OpenADR security section went through NIST, SGIP, and IEC Cyber Security reviews
- Alliance had to implement server AND client certificates
- Usage of TLS1.2 is mandatory for certification
- Additional security (XML wrappers) are optional
- Alliance has established a Certificate Authority (DigiCert – formerly Symantec)

# Coexistence with other Standards

- Due to the nature of OpenADR – Inform & Motivate – it is easy to connect OpenADR enabled systems to other standards
- Any building management and control protocol can be connected to gateways
- Some examples
  - OCPP – Open Charge Point Protocol
  - EFI - Energy Flexibility Interface

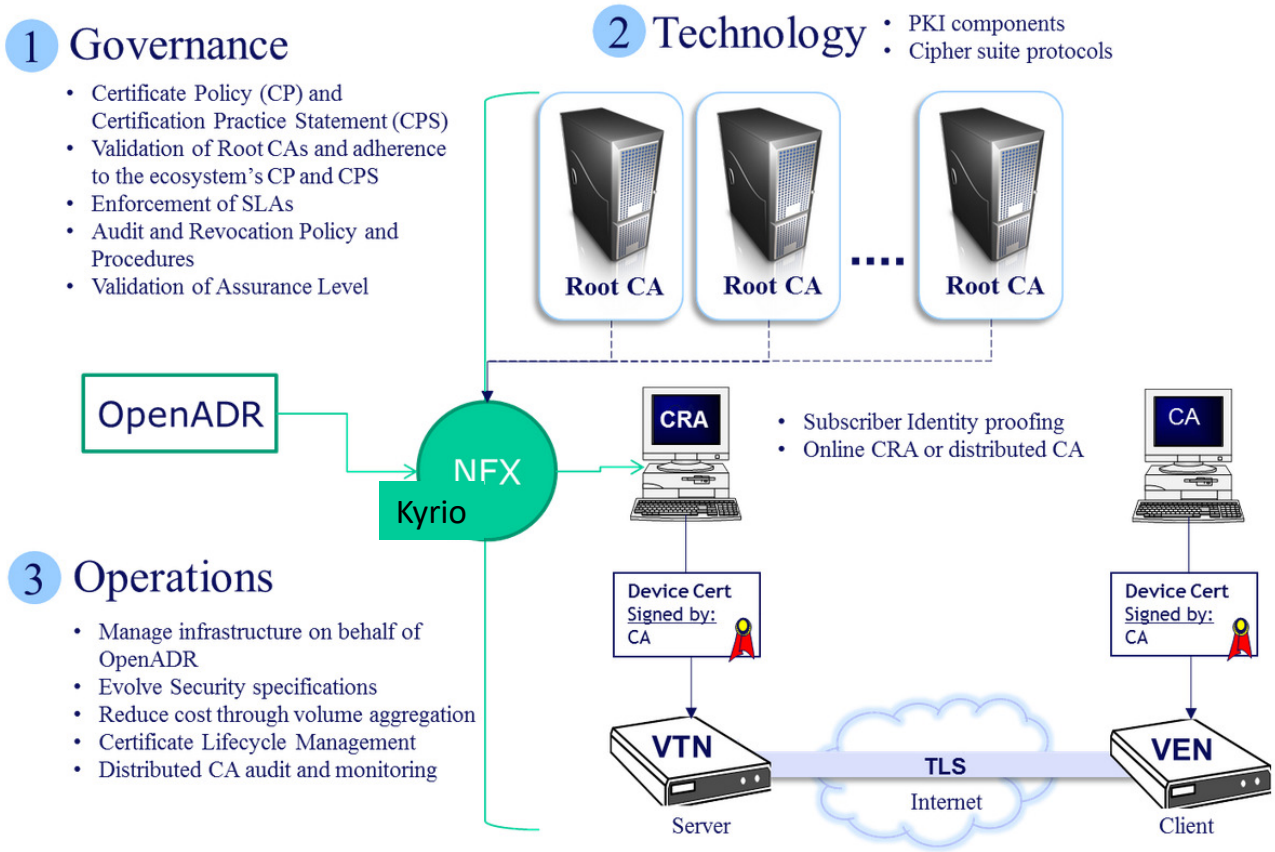
# Coexistence with other Standards – Example EFI

- EFI is a Communications protocol to control multiple smart appliances (dish washers, heating, airco, solar panels, car charging)
- Managed by the FlexiblePower Alliance Network



# Cyber Security (2)

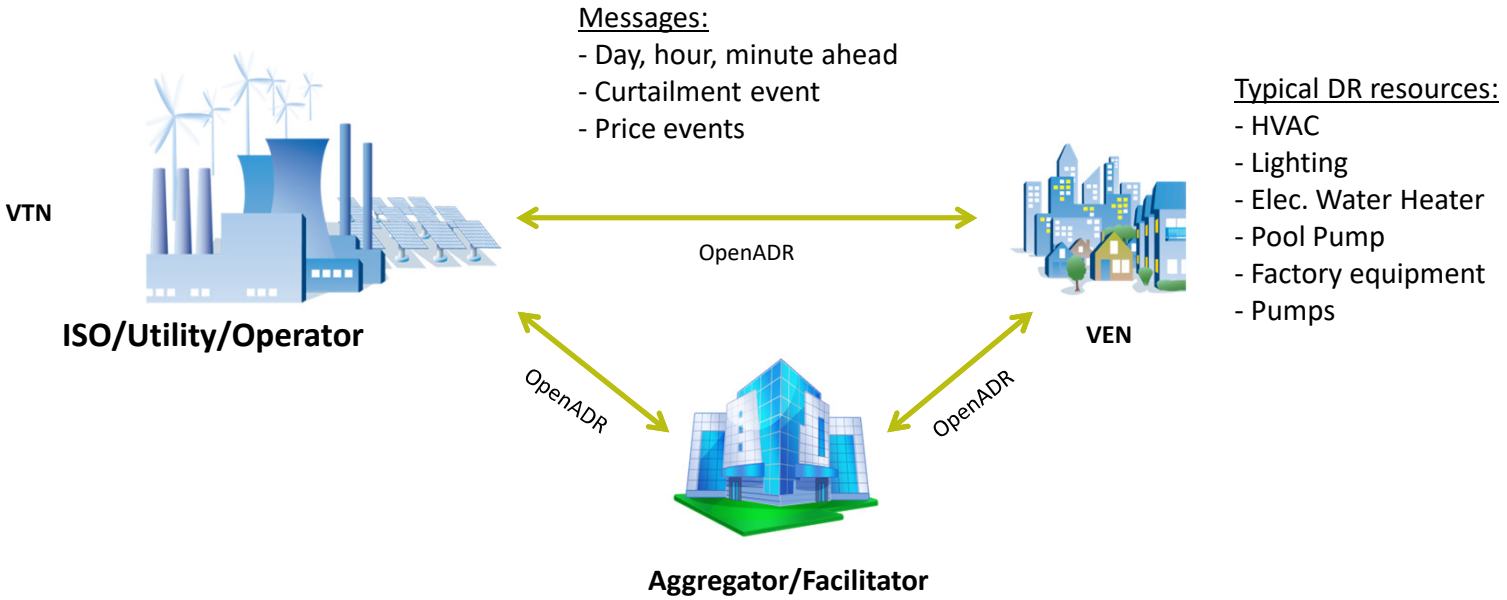
CA Overview



# Transition from DR to DER

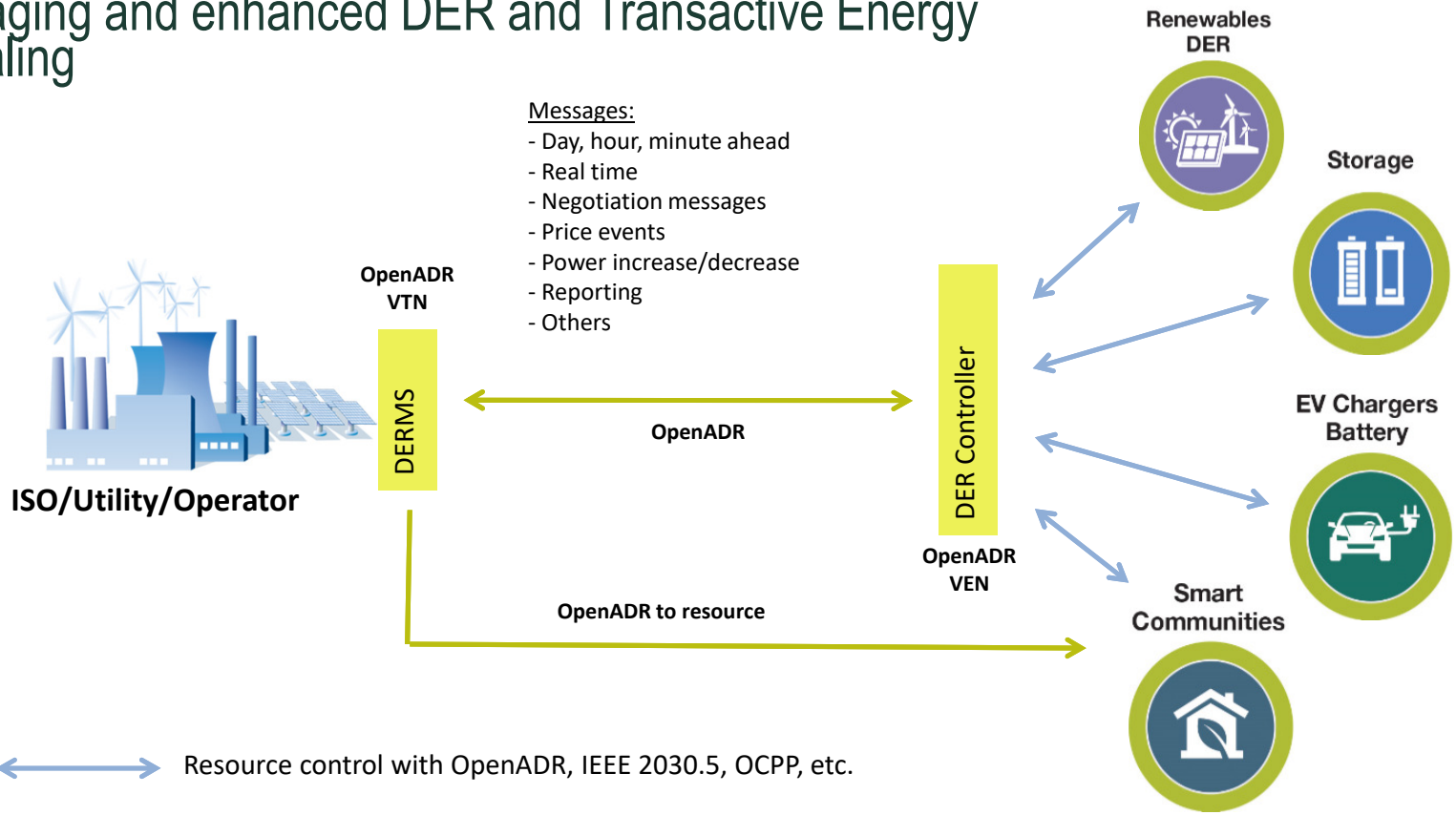
# Traditional DR with OpenADR

Original Demand Response (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" (FERC 2007)



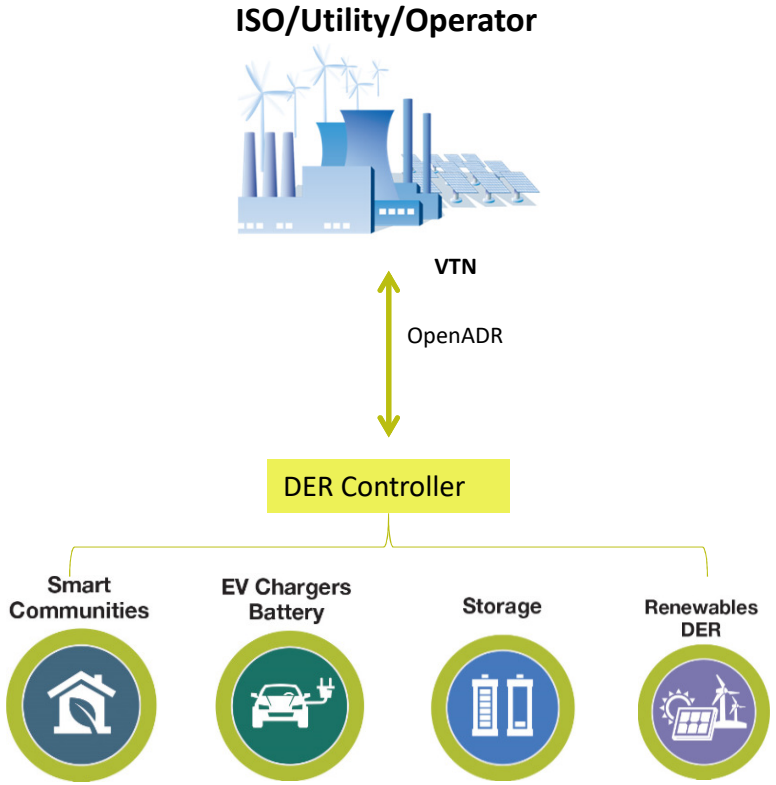
# DER Control Made Easy

OpenADR is capable of managing resources using classical DR messaging and enhanced DER and Transactive Energy (TE) signaling



# Advantages of OpenADR for DERs

- Provide targeted price and energy information
  - Target by area, zip code, resource ID, etc.
  - Bi-directional comms
- Receive reports (telemetry) from resources
- Exchange inverter specific requirements for a specific area
  - Volt/Var expectations etc (new signal types and report types planned)
- Transactive control
  - Include quotes, tender, delivery services



# DER Control Strategies

- Large resource
  - Solar farm
  - Wind
  - Etc.
- Need for tight control
  - Direct control
  - Modify parameters
  - Owned, or managed by utility/ISO
- SCADA

ISO/Utility/Operator

DER direct Management

Distributed Decisions

- Small(er) resources
  - Resi/small commercial solar
  - Generators
  - Batteries/cars
- Need for decoupled control
  - "Inform and motivate"
  - Incentive based control
  - Owned by customer or by aggregator/facilitator
- Information-based comms

IEC 61850

OpenADR

DNP3

IEEE 2030.5

# Enhanced DER control messaging

- Alliance is preparing a straw man proposal
- Goal is to provide a message framework that can be an alternative use case to CA Rule 21 / CSIP
  - Supported requirements: Define how to best use OpenADR for these functions
  - Requirements that need minor changes: Add necessary reports, signals, etc. to accommodate
  - Requirements out of scope of OpenADR: List functions not supported by OpenADR and refer to other standards
  - High level outline on IEC 61968-5 grouping support

# California CSIP Requirements Example

- Grid Support Functions

| Grid Support DER Functions | |
|---|---|
| **Autonomous Functions** | **Advanced Function** |
| Anti-Islanding | Connect/Disconnect |
| Low/High Voltage Ride Through | Limit Maximum Active Power Mode |
| Low/High Frequency Ride Through | Scheduling Power Values and Modes |
| Ramp Rate Setting | Monitor Key Data including Alarms, DER Status and Output |
| Dynamic Volt-Var | Volt-Watt Control |
| Fixed Power Factor Control | Frequency-Watt Control |
| | Set Active Power Mode |

# Transactive Energy Pilot:
# Retail Automated Transactive Energy System

- The California Energy Commission (CEC) awarded a Grant in March 2016 for the RATES pilot to Universal Devices inc. as prime contractor and TeMix Inc. as subcontractor, with Dr. Edward Cazalet of TeMix as principal investigator.
  - GFO 15-311 - Advancing Solutions That Allow Customers To Manage Their Energy Demand – Group 2
  - Load Management Systems that Facilitate Participation as Demand-side Resources
  - Evaluate customer response to Transactive Signals

FUNDING PROVIDED BY THE CALIFORNIA ENERGY COMMISSION

UNIVERSAL DEVICES

TeMix™ Transactive Energy Services

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# RATES 2-Way Subscription Tariff

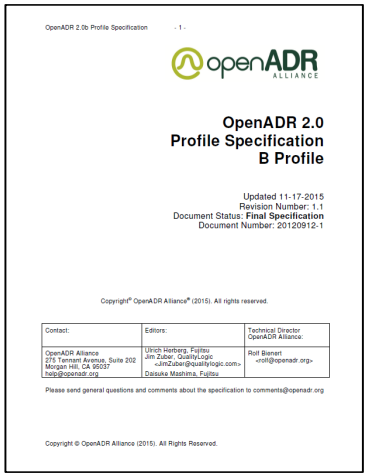
## Forward Subscriptions with *Spot* Transactions

- Subscribe at specific *costs* and *quantity* for each *interval*
  - Energy or Reactive Power (as needed)
  - Automated using subscriptions, positions, and preferences
  - Buy more at spot tenders prices or sell at spot prices if desired
  - Shed/shift load and/or DER
- Scarcity pricing used to recover more fixed cost when the delivery or generation system is more heavily loaded (in either direction)
- Addresses
  - Bill, revenue, and grid volatility
  - Recovery of both fixed and variable costs for all parties with settlement calculations
  - Forward transactions support better forecasting of operations

# Transactive Energy - Challenges to Overcome

- Transactive energy is most optimal with real-time metering info
  - Some meters had to be replaced
  - About 10% of meters have intermittent connectivity issues
    - Most recover within half an hour
    - 2% recover after 4 hours
    - 1% recover after 24 hours
  - Can partly be solved by back filling using Green Button but not as granular
- Existing equipment
  - Customers Do not want to replace their existing equipment
    - Especially Nest and EcoBee thermostats and Zodiac Pool Controllers
  - Some Inverters have to be replaced so that we can communicate with them

# Specification structure


OpenADR 2.0b Profile Specification - 1 -

OpenADR 2.0
Profile Specification
B Profile

Updated 11-17-2015
Revision Number: 1.1
Document Status: **Final Specification**
Document Number: 20120912-1

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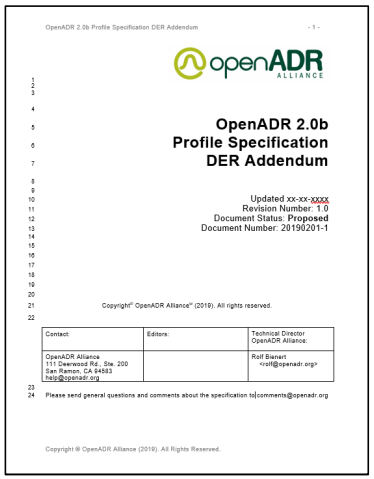
OpenADR 2.0b (IEC 62746-10-1)
Will remain unchanged


OpenADR 2.0b Profile Specification DER Addendum - 1 -

OpenADR 2.0b
Profile Specification
DER Addendum

Updated xx-xx-xxxx
Revision Number: 1.0
Document Status: **Proposed**
Document Number: 20190201-1

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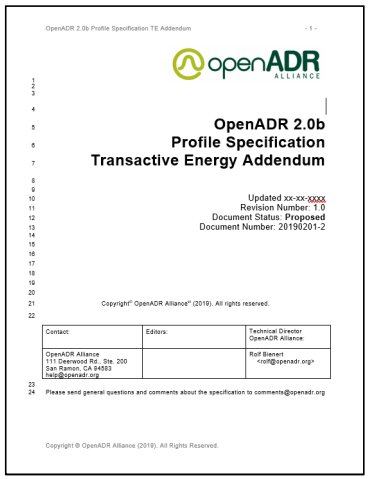
Addendum specifications for enhanced DER and TE functions – name and branding TBD
(See R.A.T.E.S program example)


OpenADR 2.0b Profile Specification TE Addendum - 1 -

OpenADR 2.0b
Profile Specification
Transactive Energy Addendum

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# Regulatory Requirements – U.S.

- California Energy Code (California Code of Regulations Title 24, Part 6) that specify OpenADR 2.0 as the required default demand response communication protocol for new construction in the state
- Other USA states have embraced innovative and progressive energy regulation in energy sustainability or flexibility
  - Illinois and Midwestern states
  - New York
  - Mid-Atlantic states
- Many states increasing percent of renewables portfolio

# OpenADR in Europe

September 12, 2019

Pierre Mullin, Siemens AG
Nuremberg, Germany

# OpenADR Deployments

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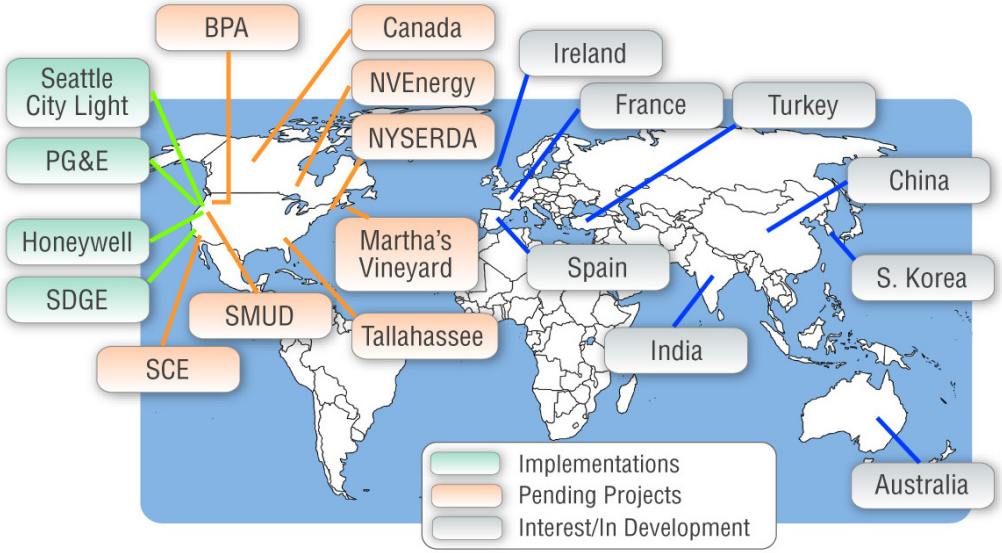
Ingenuity for life

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# European Market

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- Largely unbundled, as per EU regulation
  - Generation
  - Transmission System Operators
  - Distribution Network Operators
  - Retailers
  - Independent Aggregators
- Uneven access of DR to market mechanisms
  - Varies by country, much as it does by RTO in the US
  - Technical requirements are often still aligned with traditional generators
  - Stronger focus on aggregation for TSO markets

# DR in Europe

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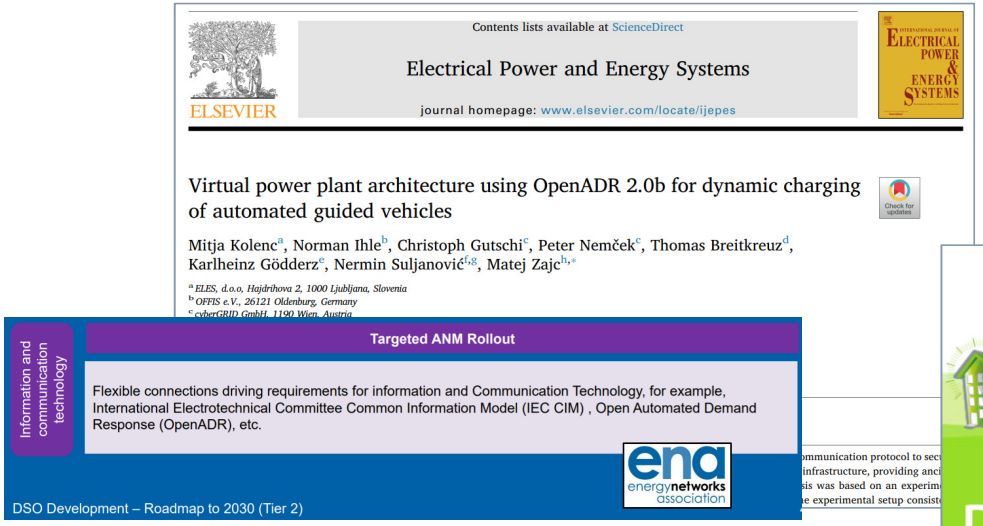
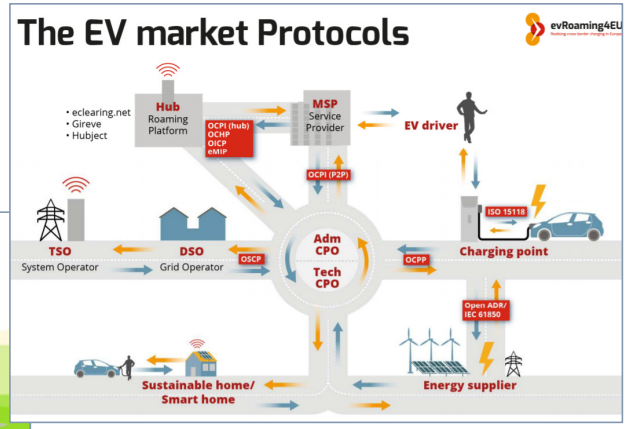
- The Good
  - Improved recognition at the policy level
  - Some good advocacy
  - PV penetration opening up thinking towards the need for controlling “around-the-meter” assets
- The Flip Side
  - Not yet ingrained in the utility DNA
  - District/building heating/cooling models do lend themselves to DR, esp. when directly fueled by natural gas
  - Smart meter rollout uneven

# Standards

- IEC standards dominant is most countries
- OpenADR now approved as IEC 62746-10-1 ED1
- OpenADR recognition is improving and has been used in research and pilot projects
- UK ENA mentions OpenADR in their DSO Roadmap
- European vendors  seeing need to support OpenADR to enter US market







# The Evolution of DERs on the Grid

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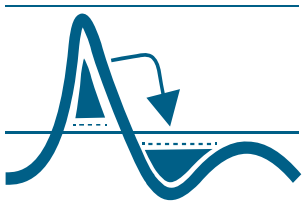
## Traditional Demand-side Management

- Traditionally event-based alignment of demand and generation using customer owned assets, primarily controllable loads
- Economic energy supply/demand balancing to minimize energy supply costs and transmission demand charges

**“How can we leverage the demand side of the grid to balance energy consumption and mitigate costs?”**



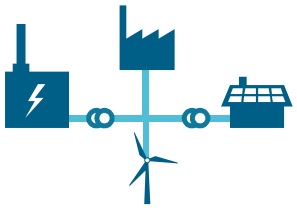
1

**USA+**

## DERs in Wholesale Markets

- Aggregation of DER capacity and flexibility for participation in wholesale energy and ancillary service markets
- Coordinating groups of DERs into Virtual Power Plants that can be managed together for monetization

**“How can we bundle, buy and sell DER flexibility in existing wholesale markets?”**



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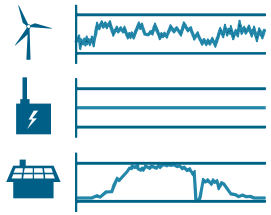
**Europe & USA+**

## DERs in Grid Management

- Dynamic management of DERs to supplement utility-owned grid assets and protection systems
- Coordinate and limit DERs active and reactive power flows to align with real-time and anticipated grid constraints

**“How do we turn DERs from a source of grid stress into a grid flexibility resource?**



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**Global Interest**

## Targeted DER Procurement

- Procurement of DER capacity and flexibility targeted to specific feeders and substations
- Access for DER retail marketers or retail prosumers
- Incentive program or market-based

**“How can we procure reliable DER flexibility on a targeted and least-cost basis?”**

4

**Emerging/Future**

# The Opportunity

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- Distribution grid operational used cases (i.e. DERMS) generating strong utility interest
- Will be driven by increased DER deployment, esp. PV, storage and EVs
- No strong standards contender for small/medium demand-side resources.
- Focus has been on aggregator connectivity to TSO – i.e. IEC 60870-5-104, IEC 60870-6/TASE.2 (ICCP)
- Increased awareness that Internet-based message protocols are more suitable for smaller DERs
- Cybersecurity an overarching concern
- OpenADR well positioned to meet these needs

# smartEn: Good Resource

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smartEn
Smart Energy Europe

**smartEn is the association of market players driving digital and decentralised energy solutions.**

A successful European energy transition requires the intelligent cooperation between consumption, distribution, transmission and generation, acting as equal partners in an integrated energy system.

Our **vision**:

The digitally enabled interaction of demand and supply is an integral part of an increasingly decentralised, decarbonised energy system.

Our **mission**:

- **Promote system efficiency** through the advanced management and
  demand and supply in homes and buildings, transportation, businesses a
  projects.
- **Empower energy users** by enabling them to participate in the energy
  demand, storage, self-generation and the participation in community p
  control of their energy data.
- **Encourage innovation and diversity** by enabling new market players
  provide attractive choices for consumers and allow for healthy competitio
- **Drive the decarbonisation of the energy sector** through the cos
  renewable sources and the electrification of heating, cooling and transpo

SEDC White Paper: Empowering Residential and SME Consumers

As the European energy system progresses, the need to empower the consumer has become an increasingly mor
European energy policy. Yet today, only a…

Download the Report

SEDC Position Paper: Explicit and Implicit Demand-Side Flexibility -

Two types of Demand-Side Flexibility can be distinguished; implicit and explicit DSF. The SEDC position paper
implemented in order to ensure that both…

Download the Report

*Formerly Smart Energy Demand Coalition (SEDC)*

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# Take Aways

SIEMENS
Ingenuity for life

- Important to understand each market in Europe
- Knowledge of OpenADR is improving and acceptance as an IEC standard is a positive move
- Still a wide-open field for DER connectivity standards

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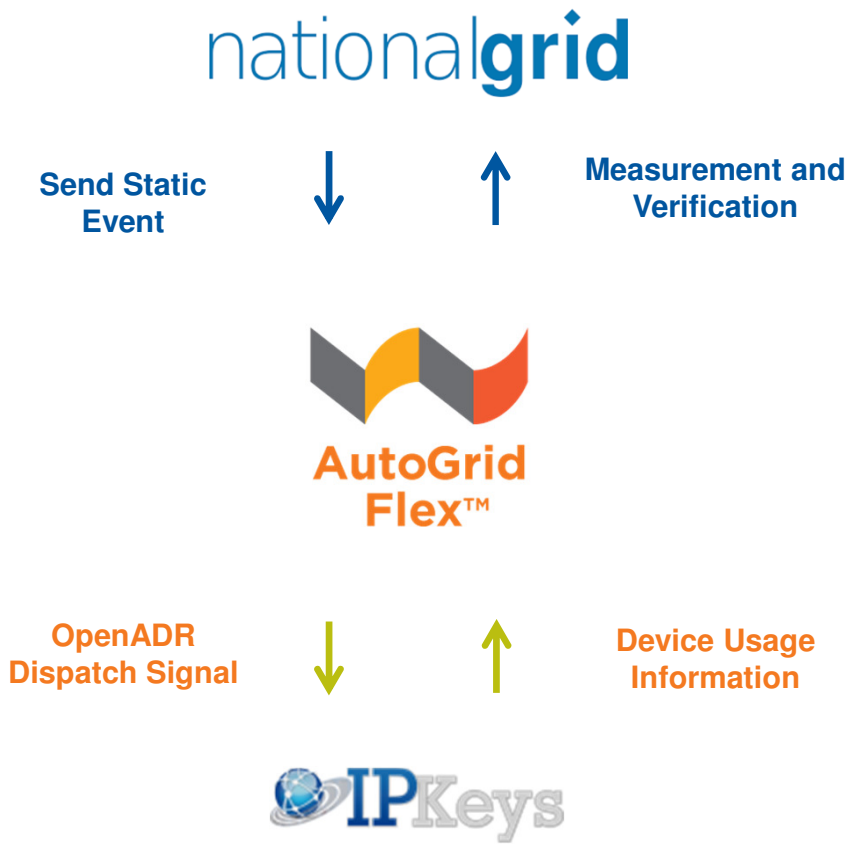
**siemens.com/digitalgrid**

# Use Case examples

# National Grid




## Gas DR with smart thermostats

**Profile**

- 3.3 million U.S. customers in MA, NY, and RI

**Problem: Natural Gas in New York**

- Natural Gas pipeline constraints entering Long Island
- Existing gas turbines running up to capacity during peak demand
- Looking for non pipes alternative to reduce peak load

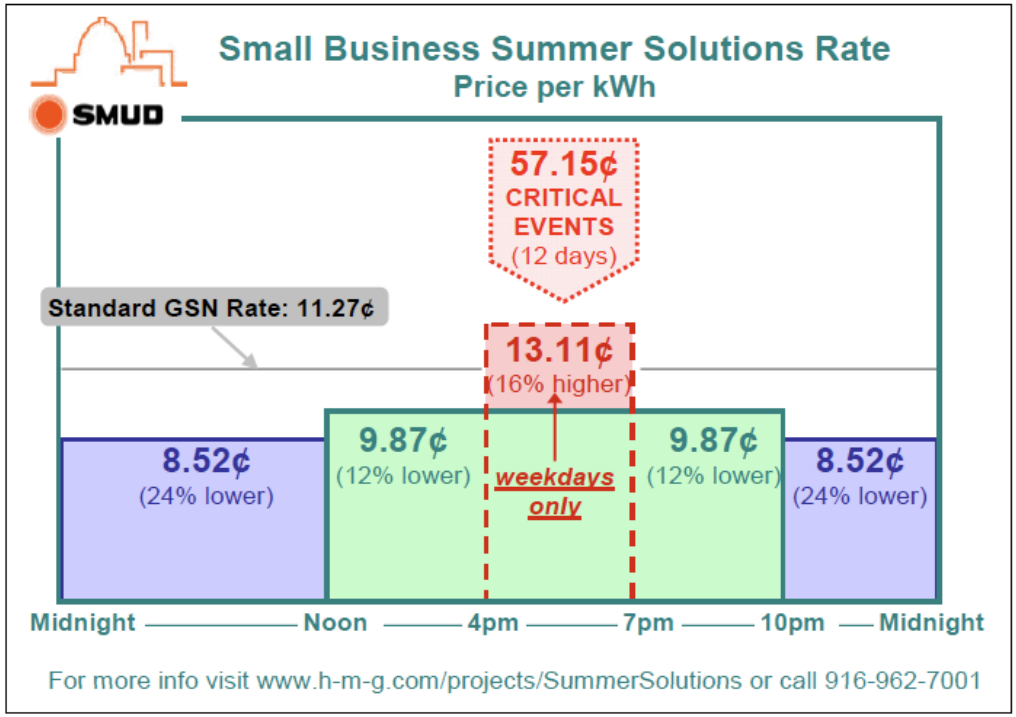
**Solution: AutoGrid Flex**

- Unified dashboard for gas and electric programs
- Focus on timely dispatch
- See device usage information at near real time on open platform
- First Natural Gas DR project in the world

# Sacramento Municipal Utility District

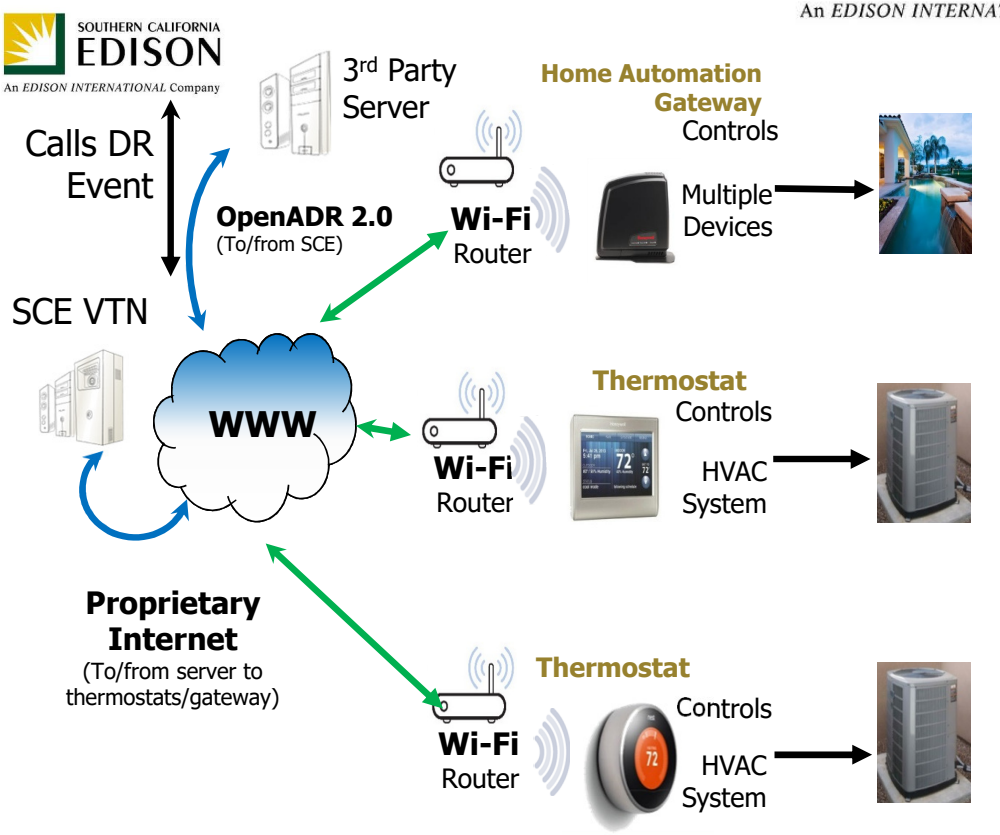
## Critical Peak Pricing Programs

- Equipment pre-programmed to respond to price signals
- Rate and/or price structure designed to encourage reduced consumption
- PUCs adopting CPP programs for residential and commercial customers
- Signal with levels range from 1 to 3 and multiple prices in single event
- Supports price responsive demand for wholesale and retail prices



# Southern California Edison

- BYOT model
- 4,800 customers select own devices
- 8 events with an average 750 watts of load reduction per hour per customer
- Energy savings:
  - 3.6MW of average energy reduction per event (peak ~7MW)
  - 115.2MWh of energy saved annually

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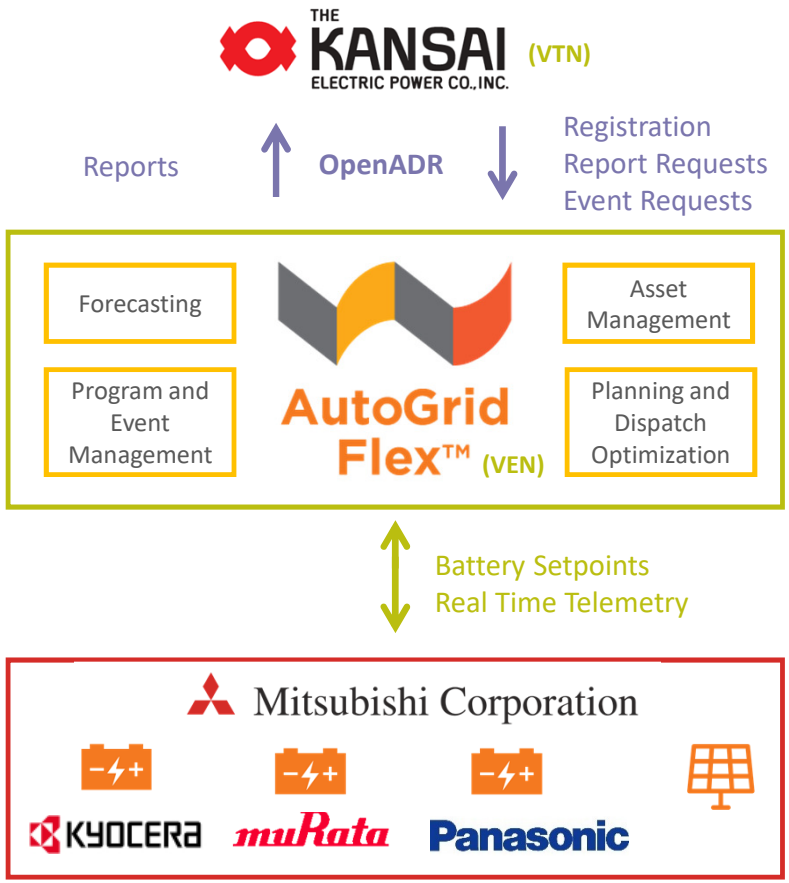
# Kansai Electric Power Co




## First Residential Solar and Storage Virtual Power Plant in Japan

**Profile**

- Mitsubishi Corporation owns and operates 5GW of generating capacity and 1,000 km of transmission
- KEPCO supplies 13M customers in the Kansai region of Japan

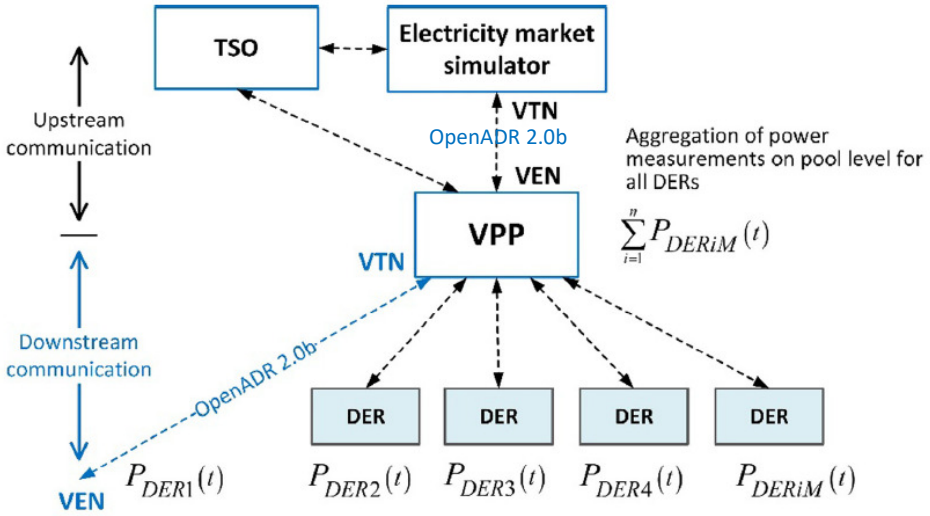
**Problem**

- METI-funded program for development of VPP applications
- Need flexible platform to support optimization over solar self consumption and communicate with multiple vendors
- Ultimately support more renewable integration for Japan

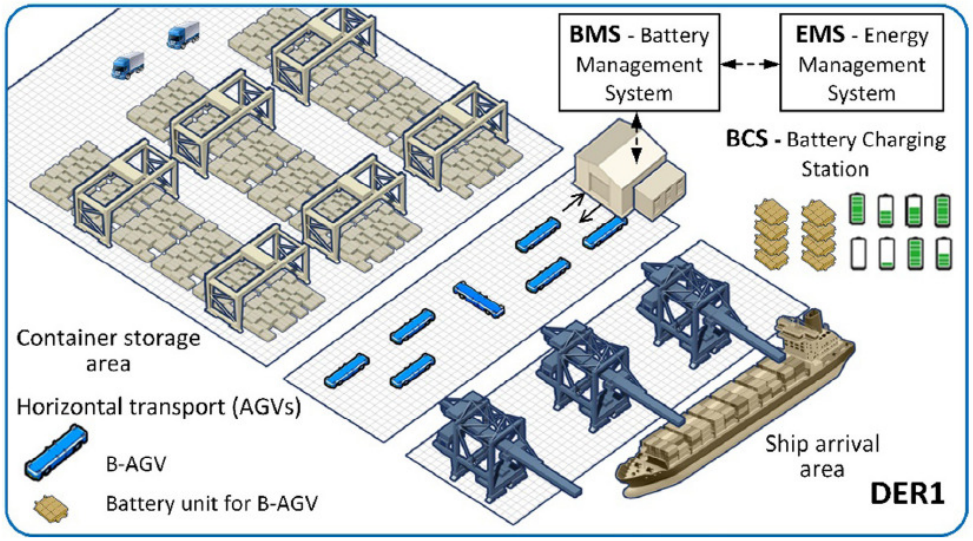
**Solution: AutoGrid Flex**

- Aggregation of 300 residential storage assets on one monitoring and control platform
- Storage vendors including Kyocera, Murata, Panasonic
- Co-optimization of self-consumption with aggregate-level capacity

# Europe - Slovenia & Germany




## Virtual Power Plant (VPP)




https://www.sciencedirect.com/science/article/pii/S0142061517311560?via%3Dihub

# Southern California Edison

- Support EV TOU customers
- Deployed 80 L2 EVSEs with payment modules at 9 SCE facilities
- OpenADR
  - Varied Pricing: Tiers, Rate of Charge, Penalty
  - Varied Curtailment Events
- OCPP
  - Session Reports
  - EVSE Status
  - Credit Card

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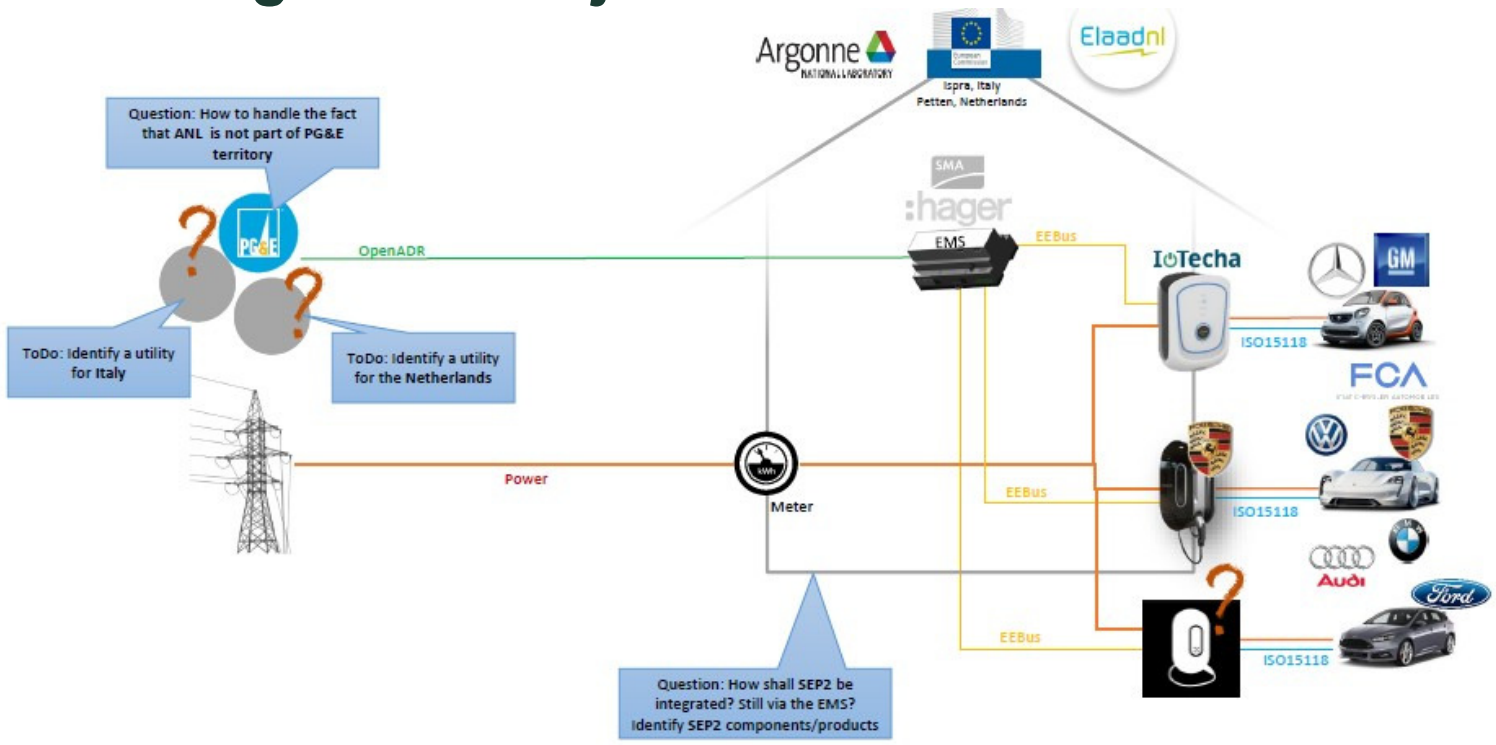
# Pacific Gas & Electric – European Partnership
# Global Grid Integration Project





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# Q&A

- Recording and slides from this presentation will be available at www.openadr.org.

- The OpenADR Webinar Series will continue throughout 2019. More information on the Alliance and future webinar topics can be found on www.openadr.org.

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# Thank you!

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