

EPRI's Open-Source OpenADR 2.0b Software

OpenADR Alliance Member Meeting

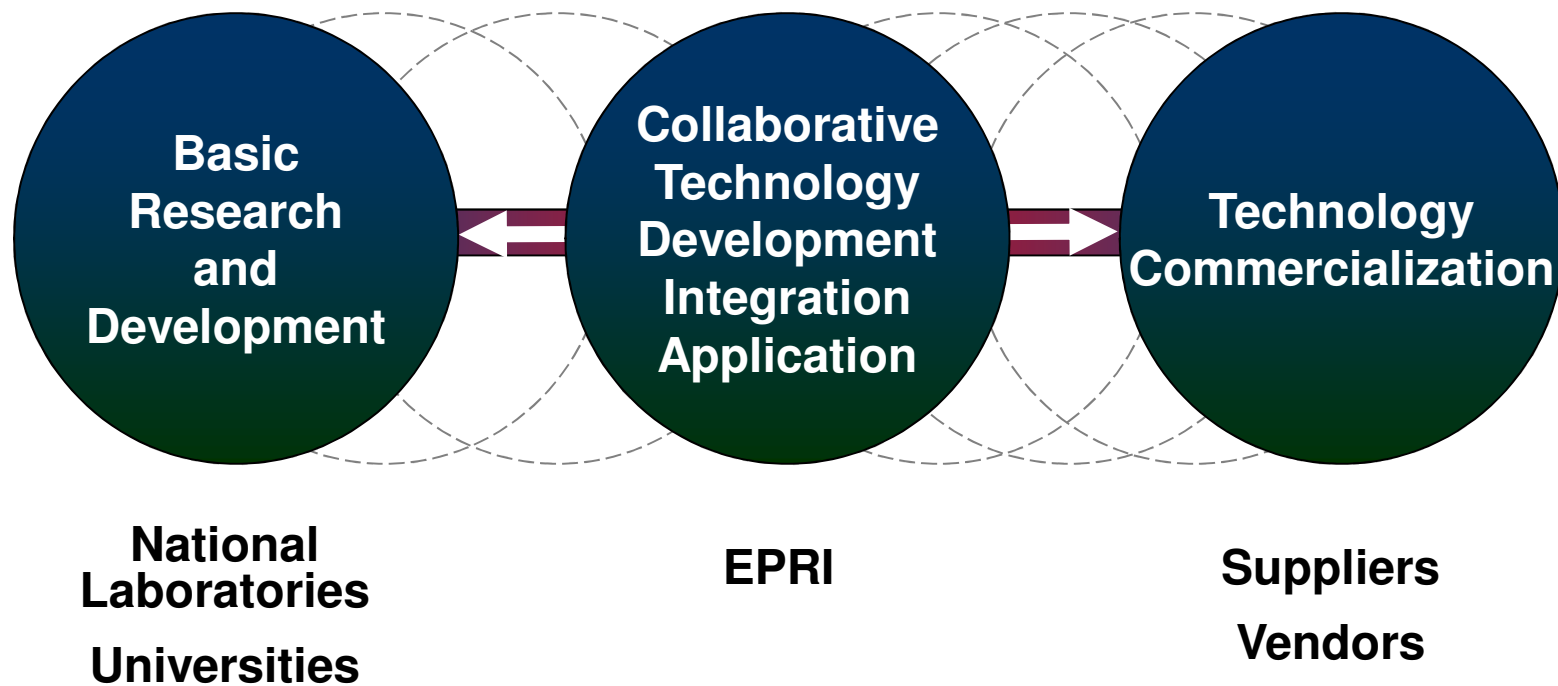
Walt Johnson
Technical Executive

May 14, 2015






EPRI's Role...

Help Move Technologies to the Commercialization Stage...



“Technology Accelerator!”

OpenADR 2.0b Open-Source Software

	 VTN	 VEN	 VEN
Role	Virtual Top Node	Virtual End Node	Virtual End Node
Designed Use	DRMS	Desktop Client	Embedded Client
License	BSD 3-Clause	BSD 3-Clause	BSD 3-Clause
Profiles	2.0a and 2.0b	2.0b	2.0b
Data Models	Push/Pull (Poll)	Pull (Poll)	Pull (Poll)
Transports	HTTP, XMPP	HTTP	HTTP
Programming Language	JRuby, Java	C#	C++
Tested Operating Systems	Linux, Mac OS	Windows 7, 8	C++
Available on www.SourceForge.net	Yes	Yes	Yes

Slide 3

WJ4

Chuck, do you have a better slide for this?

Walt Johnson, 12/3/2013

BSD 3-Clause License

- BSD 3-Clause ("BSD New" or "BSD Simplified") license:
<http://opensource.org/licenses/BSD-3-Clause>
- Permissive – non-viral – do as you please with the source :)

Copyright (c) 2014, Electric Power Research Institute
All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Virtual Top Node (VTN) and Virtual End Node (VEN)

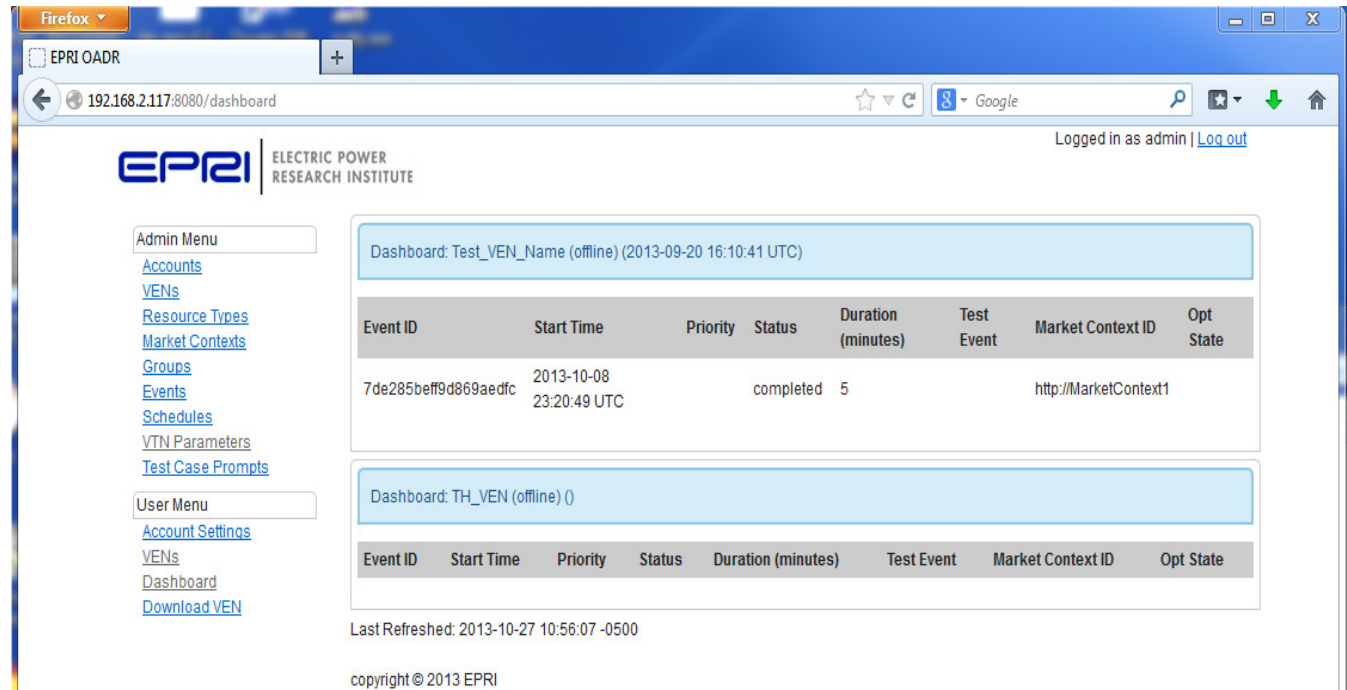
- Complete OpenADR 2.0b-compliant server and standalone client
- Made available to the open source community in February 2014
- Received Alliance certification in October 2014
- Revised versions released in December 2014
- Overview DVD available

The image displays two screenshots related to the EPRI OADR system. The top screenshot is a web browser view of the EPRI OADR dashboard. The browser address bar shows '192.168.2.117:8080/dashboard'. The dashboard is titled 'EPRI | ELECTRIC POWER RESEARCH INSTITUTE' and shows a 'Logged in as admin' status. It features an 'Admin Menu' with links to Accounts, VENS, Resource Types, Market Contexts, Groups, Events, Schedules, VTN Parameters, and Test Case Prompts. A 'User Menu' includes Account Settings, VENS, Dashboard, and Download VEN. The main content area shows two dashboards: 'Dashboard: Test_VEN_Name (offline) (2013-09-20 16:10:41 UTC)' and 'Dashboard: TH_VEN (offline) ()'. Both dashboards contain a table with columns: Event ID, Start Time, Priority, Status, Duration (minutes), Test Event, Market Context ID, and Opt State. The first dashboard shows one event with ID '7de285be9d989aedfc', start time '2013-10-08 23:20:49 UTC', status 'completed', and duration '5'. The second dashboard is empty. The bottom screenshot shows the 'OADR VEN2b' application window. It has a 'Help' menu and a 'Server' tab. The 'Server' tab shows configuration for 'Opt In' with URL 'https://openadr.neiland.com/OpenADR2/Simple/2.0b', 'Client Certificate' 'ven.pfx', and 'Client Cert Password' '*****'. It also has a 'Credentials' section for 'VEN Name' 'Test_VEN_Name' and 'Password' '*****'. The 'Log' tab shows a table of events with columns: Date, Response Time, Request Type, Response, and Response Code. The 'Log' tab also shows a 'Log/communication history' section with 'Request XML' and 'Response XML' fields. The 'Status' tab shows 'Idle', '200 OK', 'Server time: 12/6/2013 11:31:46 AM', 'Version: 0.0.5.0', and 'VEN IS Registered'.

View of all XML Messages

The EPRI OpenADR VTN User Interface (Current Release)

- The Admin menu consists of the following options: *Accounts, VENs, Resource Types, Market Contexts, Groups, Events, Schedules, VTN Parameters, and Test Case Prompts.*
- Non-admin users have limited access to the system. Their User Menu consists of five links: *Account Settings, VENs, Dashboard, and Download VEN.*



The screenshot shows the EPRI OpenADR VTN User Interface dashboard in a Firefox browser window. The address bar shows the URL 192.168.2.117:8080/dashboard. The page header includes the EPRI logo and the text "ELECTRIC POWER RESEARCH INSTITUTE". The user is logged in as admin, with a "Log out" link. The dashboard is divided into two main sections: "Admin Menu" and "User Menu". The "Admin Menu" includes links for Accounts, VENs, Resource Types, Market Contexts, Groups, Events, Schedules, VTN Parameters, and Test Case Prompts. The "User Menu" includes links for Account Settings, VENs, Dashboard, and Download VEN. The main content area displays two dashboards: "Dashboard: Test_VEN_Name (offline) (2013-09-20 16:10:41 UTC)" and "Dashboard: TH_VEN (offline) ()". Each dashboard contains a table with columns for Event ID, Start Time, Priority, Status, Duration (minutes), Test Event, Market Context ID, and Opt State. The first dashboard shows one event with ID 7de285beff9d869aefdc, starting on 2013-10-08 at 23:20:49 UTC, with a status of "completed" and a duration of 5 minutes. The second dashboard is empty. The page footer indicates "Last Refreshed: 2013-10-27 10:56:07 -0500" and "copyright © 2013 EPRI".

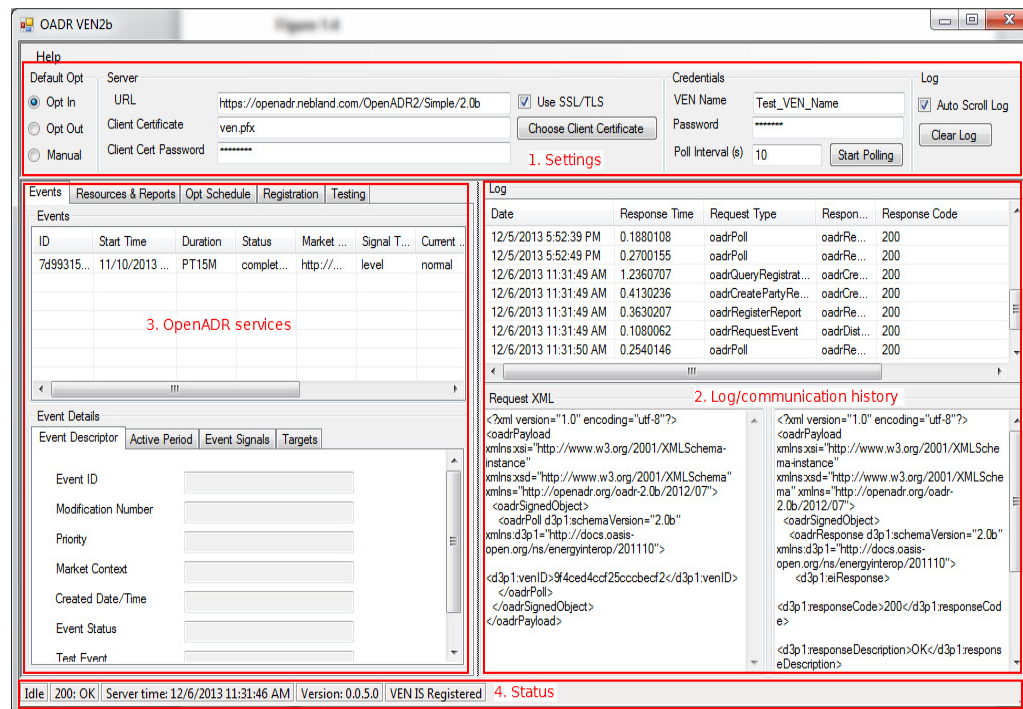
Event ID	Start Time	Priority	Status	Duration (minutes)	Test Event	Market Context ID	Opt State
7de285beff9d869aefdc	2013-10-08 23:20:49 UTC		completed	5		http://MarketContext1	

More information about the EPRI OpenADR software is available in *Automated Demand Response and Ancillary Services Demonstration Project Update: Volume One* (Product ID 3002002782) and *OpenADR Technical Workshop DVD – 6.19.2013* (Product ID 3002001822).

The EPRI OpenADR VEN User Interface

1. Settings: This section has the following controls and actions: *Default Opt, URL, Client Certificate & Password, SSL/TLS, VEN Name, Password, Poll Interval, and Auto Scroll Log.*

2. OpenADR Services: This area has tabs that show the status and state of the four OpenADR services: Events, Reporting, Opt, and Registration.



3. Log/Communication History: All OpenADR messages exchanged between the VEN and VTN are captured in the log list view. Selecting a message in the list view causes the associated request and reply messages to display in the request and reply XML areas.

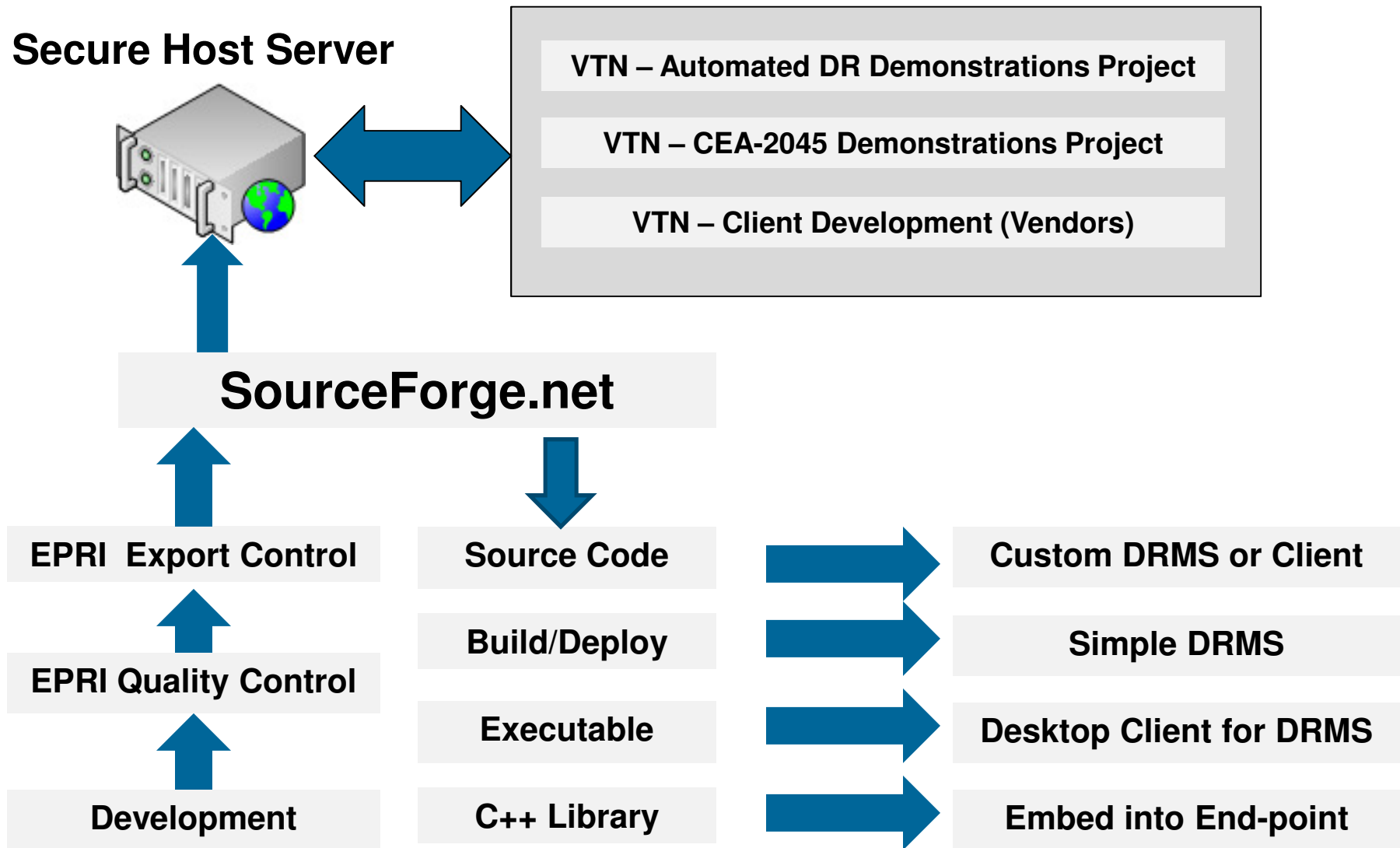
4. Status: The status bar, located at the bottom of the VEN's user's interface, displays information regarding the current state of VEN polling, the last message status, the VEN version, and the OpenADR registration state.

C++ End-Node Library

- Released in December 2014
- Implements components of an OpenADR 2.0b pull VEN
- Intended for embedded applications
- Generates compliant messages for all four 2.0b services
- Manages HTTP/s connection with cURL and OpenSSL libraries
- Can be used to create a compliant VEN

Note: Use of EPRI's Alliance-certified software to create a new application does *not* confer certification on the resulting application. All applications are individually certified by the OpenADR Alliance.

OpenADR 2.0b Open-Source Opportunities



What's Next: EPRI OpenADR Development

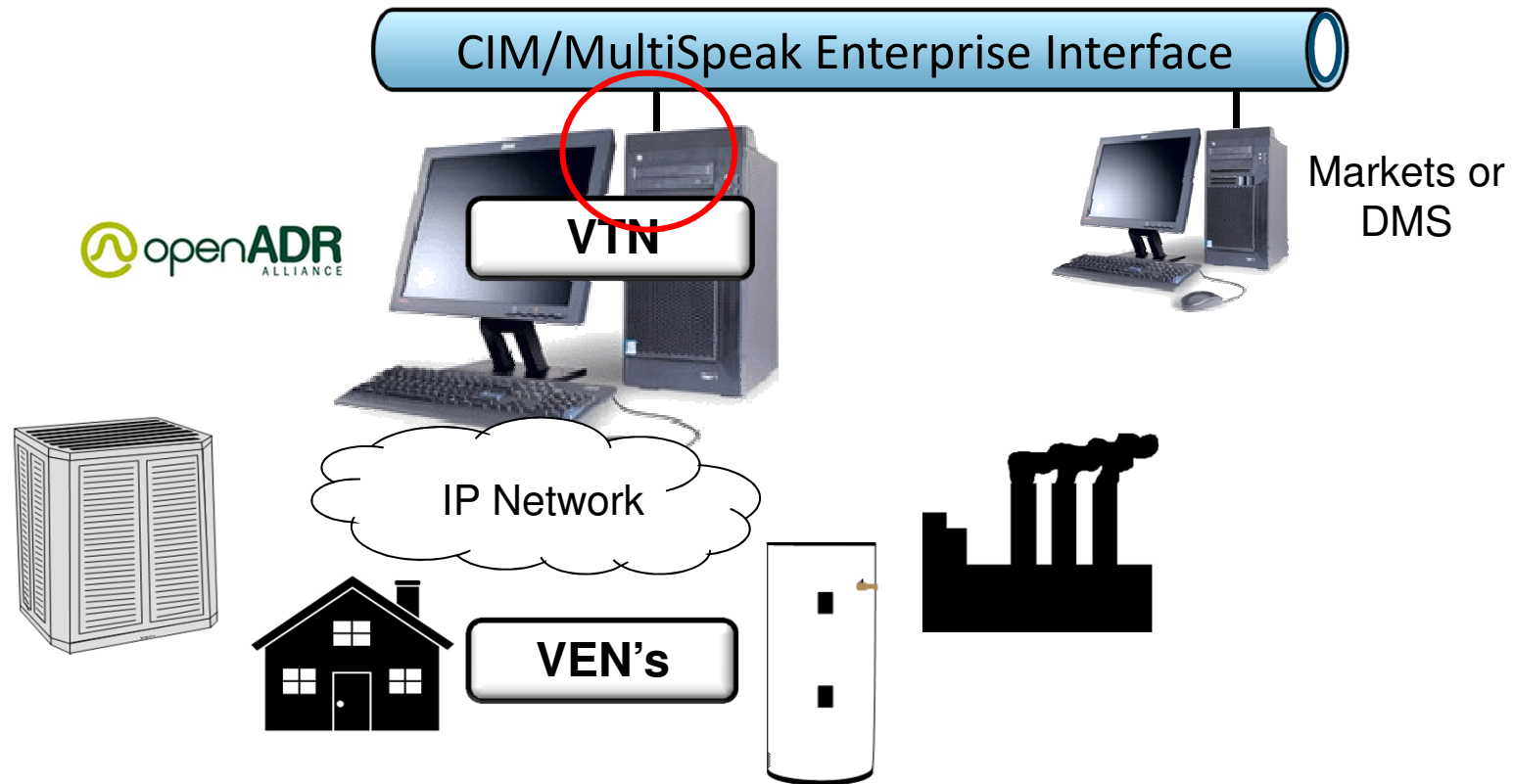
Integratability
Usability

VTN Enhancements

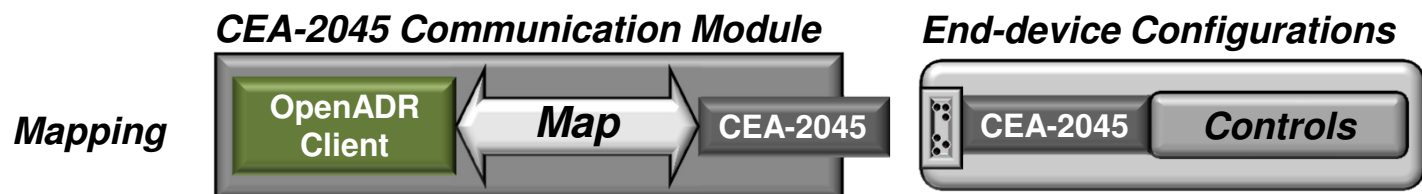
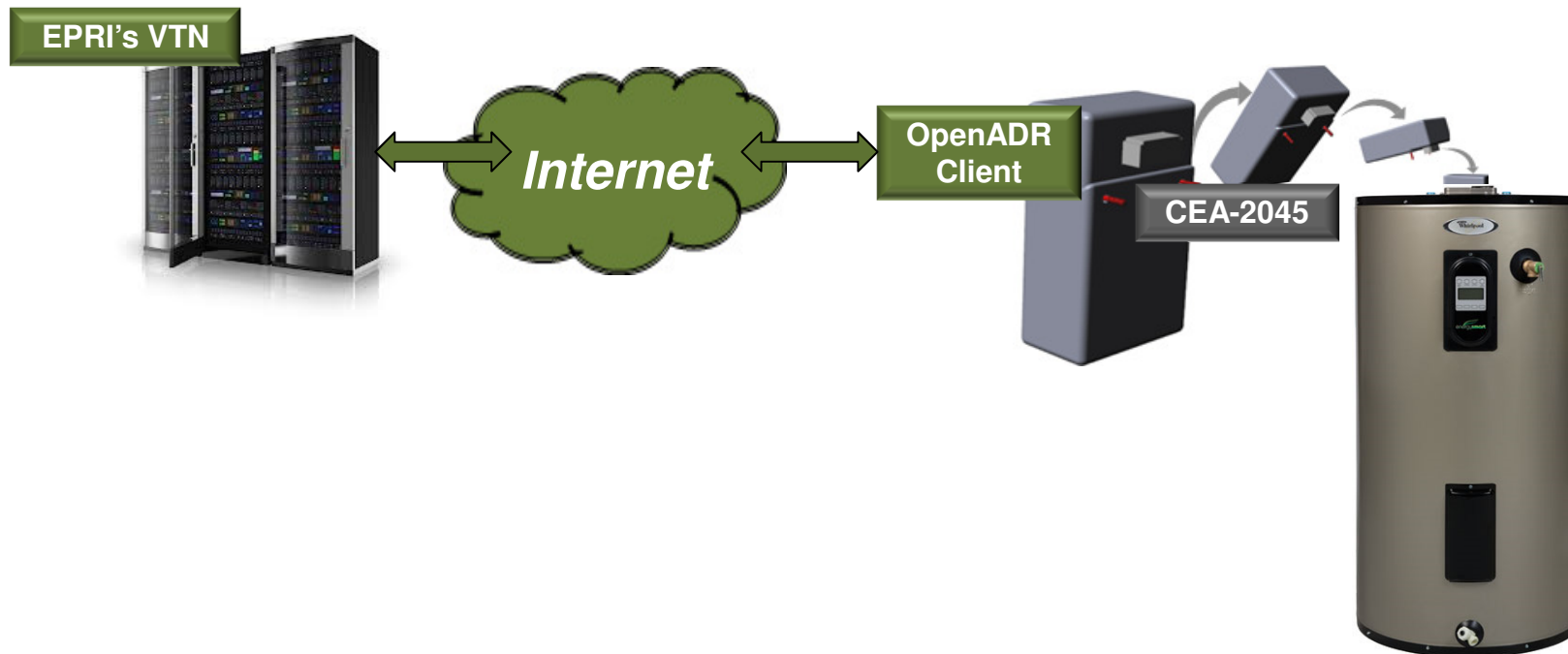
- CEA-2045 Project
- Other usability enhancements
- Create a more utility-friendly OpenADR server
 - Hide complex details of OpenADR
- Use utility terminology
 - Add a utility-specific layer on top of “bare” OpenADR
- Add new features useful to the base OpenADR system

CIM Message Interface

- Building on prior success – over 5,000 downloads worldwide of the EPRI VTN and VEN software
- Scope and use cases were taken from the PAP19 work, coding is in process



CEA-2045 Demonstration



What's Changing?

- New Features
 - Many UI enhancements
 - Simplify
 - Hide OpenADR terminology
 - Allow utility-specific terminology
 - Non-admin account features
 - Time zone added to users, VENs, and events
 - Targeting
 - Status pages
 - Search
- Make the base system generic
 - To make this process repeatable
- Major bug fixes
 - 91 tickets closed (bugs and features)

Updated UI

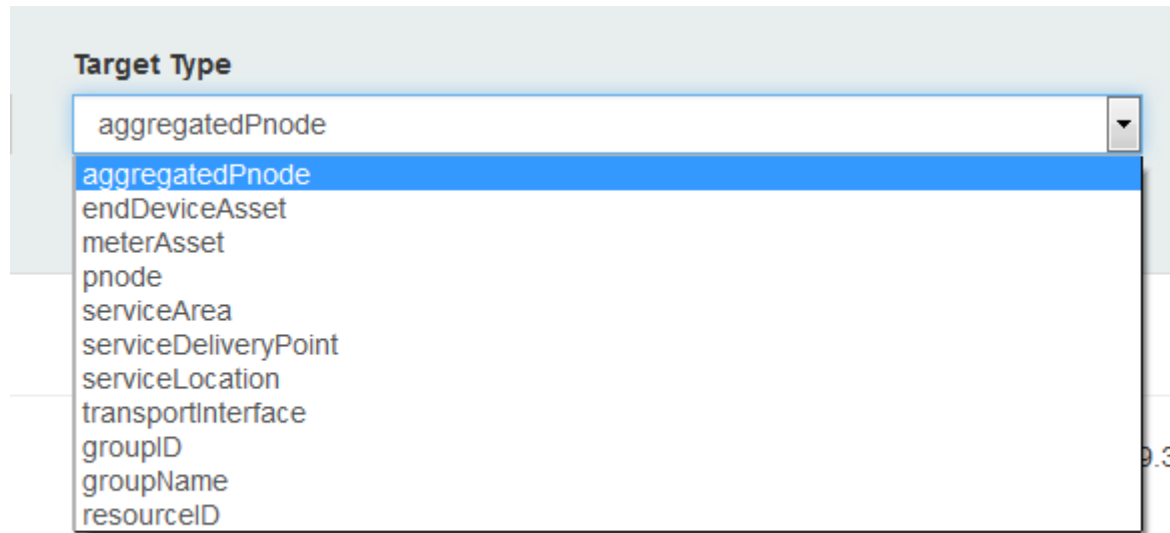
The screenshot displays a web application interface with the following components:

- Header:** Utility Name, Log out (ben), and About (EPR2 logo).
- Left Sidebar (Slimmed down menu w/simplified Utility menu):**
 - Utility (lightbulb icon)
 - Accounts (camera icon)
 - VENs (cloud icon)
 - Events (calendar icon)
 - VTN Config (gear icon)
- Devices Section:**
 - Search:** A search bar with a "Search" button and a dropdown arrow.
 - Create Device:** A blue button.
 - Data "Card" views:** Two device cards are shown, each with a "Connection: offline" status.
 - Card 1:** green bay wi, UCM ID: 1234, Equipment: Water Heater (Resistive), Location: Circuit (Substation), Program: Load Up. Actions: Status, Edit, Destroy.
 - Card 2:** Howard WI, UCM ID: 456, Equipment: HVAC Thermostat, Location: Section, Program: Grid Emergency. Actions: Status, Edit, Destroy.

Copyright © 2015 EPRI

Targeting Enhancements

- Previous version supported four target types
- All types now supported
- VEN ID and PartyID not list – managed by system



New Non-Admin Account Features

- Non-admin users can create **and** edit test events
- Can only target their own VENs
- Useful for multi-user system for testing VENs
- In the current system, non-admin users can create an event, but can't modify it and can't select targets (all VENs in the account are targeted)

The screenshot displays the EPR2 Auto DR Test Server interface for a non-admin user. The top navigation bar includes the EPR2 logo, the text "ELECTRIC POWER RESEARCH INSTITUTE", the page title "Auto DR Test Server", and links for "Log out nonadmin" and "About". The left sidebar contains navigation links for "Account Settings", "VENs", and "Test Events". The main content area is titled "Events" and features a "Create Event" button. Below this, a test event is shown with the following details:

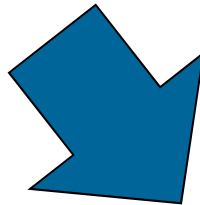
- Event Name:** LoadUp
- Status:** Active (indicated by a green bar)
- ID:** 7ed07f5a0dbbaef41ed
- Scheduled Time:** Tuesday Mar 17 2015, 11:26pm - 11:46pm (UTC) - 20 minutes
- Targeted Devices:** 0 (indicated by a VEN icon)
- Actions:** Status, Edit, Destroy

Utility Terminology: Programs

- “Program” instead of “Market Context”

Market Context ID

LoadUp



Program

LoadUp

Utility Terminology: Devices

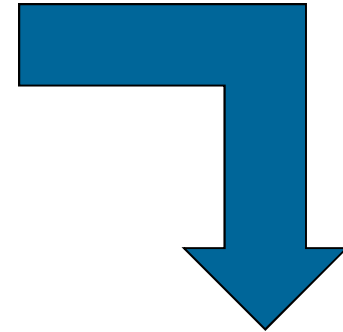
- “Device” instead of “VEN”

Identification

VEN Name

Common Name

Create VEN

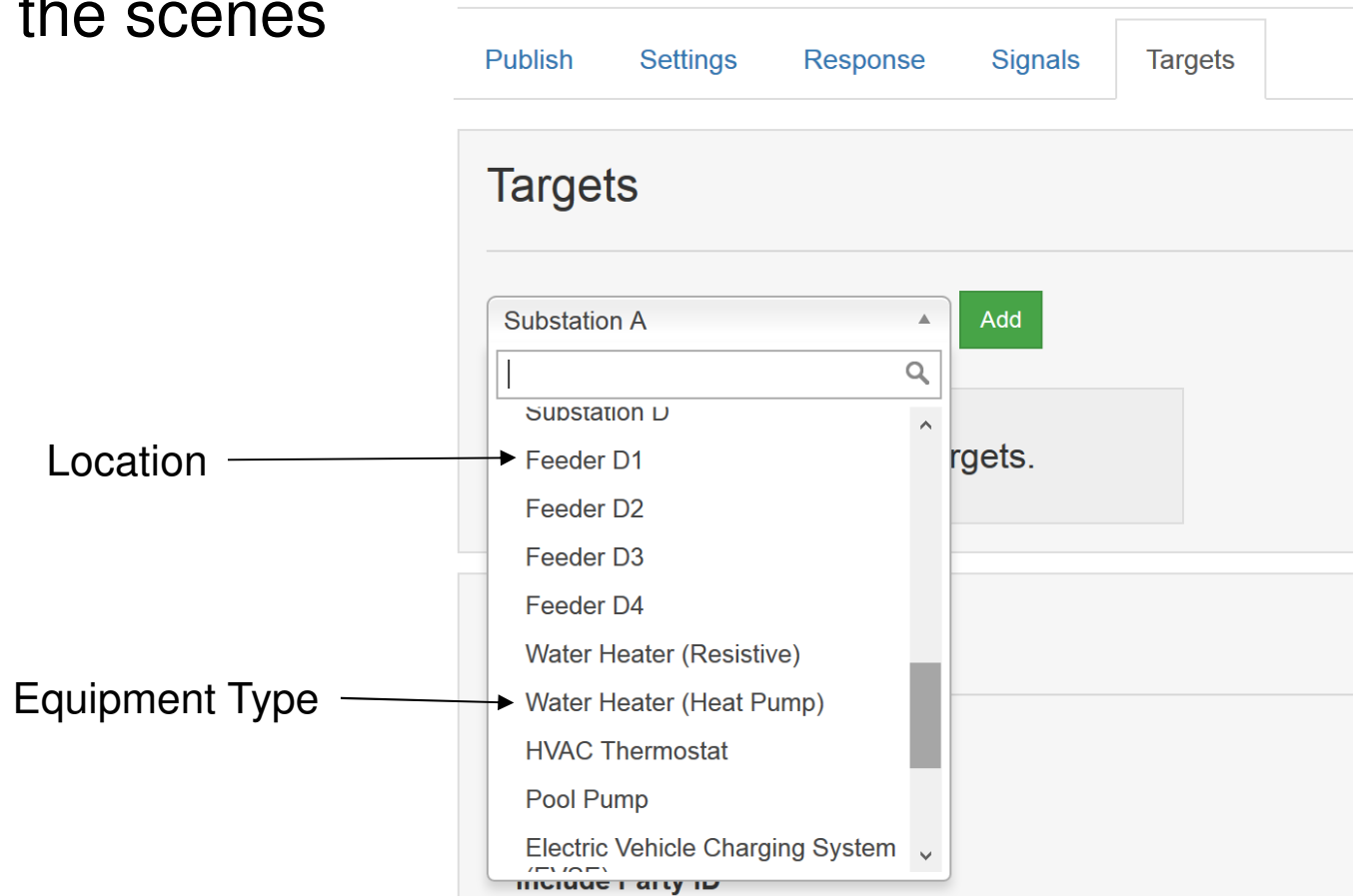


Device

UCM

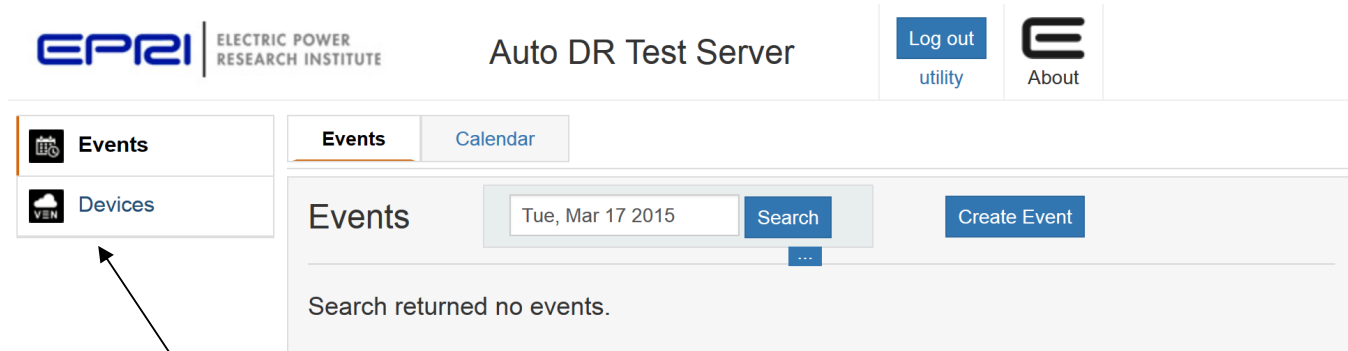
Utility Terminology: Locations and Equipment Types

“Locations” and “Equipment Type” are OpenADR EiTargets behind the scenes



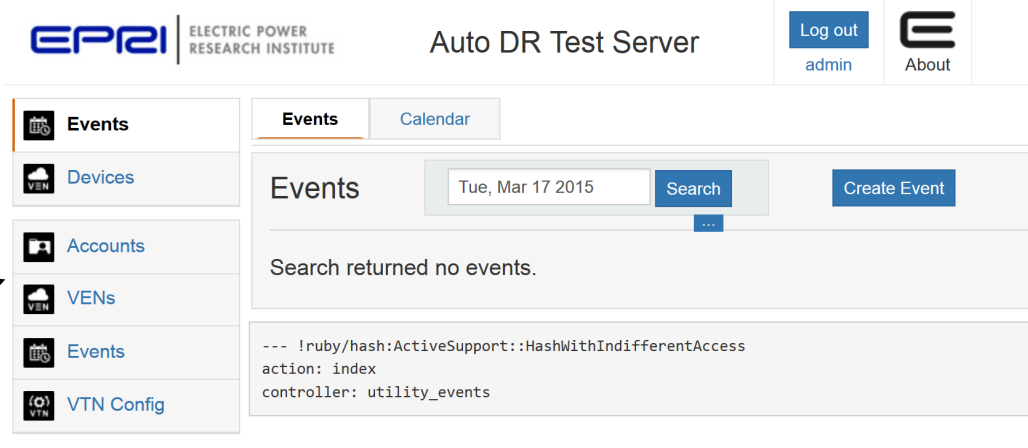
Utility Accounts

Only see Events and Devices



Utility Accounts see only
Events and Devices

Admin accounts see
everything



Copyright © 2015 EPRI

“Events” vs “Utility Events”

- OpenADR Events are very complex
 - Active Period
 - Event Descriptor
 - Signals
 - Signal Intervals
 - Targets

[Publish](#) [Settings](#) [Response](#) [Signals](#) [Targets](#)

Active Period

Event ID
edc9ae4a9e27239c7e2d

Priority
0

Market Context ID
TEST

Status
completed

VTN Comment
Test comment

Test Event
false

Created At
2015-02-11 17:12:20.814

Modification Number
0

[Save](#)

Event Descriptor

Start Time
2015-02-11 17:02:14 UTC

Duration (minutes)
10

Tolerance (minutes)
0

Notification (minutes)
0

Ramp up (minutes)
0

Events vs Utility Events (continued)

- Utility Events are more manageable
 - Program → Market Context
 - Location → Target
 - Equipment Type → Target

Events **eb49a91ae3951917bcd4**

Event

Program
LoadUp

Location
Substation A

Equipment Type
Water Heater (Resistive)

Save

Date & Time

Time Zone
Central Time (US & Canada)

Start Time
2015-03-14 18:24

Duration (minutes)
20

Save

VEN vs (Utility) Device

- VEN setup requires multiple screens

VEN Settings Registrations Resources Subscriptions Reports Opt Schedules

Market Context Subscriptions

Market Context	Party ID
TOU	Subscribe
DR_OPTIONAL	
DR_MANDATORY	
ENERLIANCE	
TEST	
TEST2	

VEN Settings Registrations Resources Subscriptions Reports Opt Schedules

Identification

VEN Name

Common Name

VEN ID

Email

Account

[Save](#)

Groups

Name	Description
<input type="text"/>	<input type="text"/>
GROUP1	GROUP1

GROUP1 membership

Account Name

This group is empty

[Remove Accounts](#)

VEN vs (Utility) Device (continued)

- Utility Devices need minimal information
 - Enter device info
 - Subscriptions, groups, etc., handled automatically

Device

UCM

1234

Location

Substation A

Equipment Type

Water Heater (Resistive)

Program

LoadUp

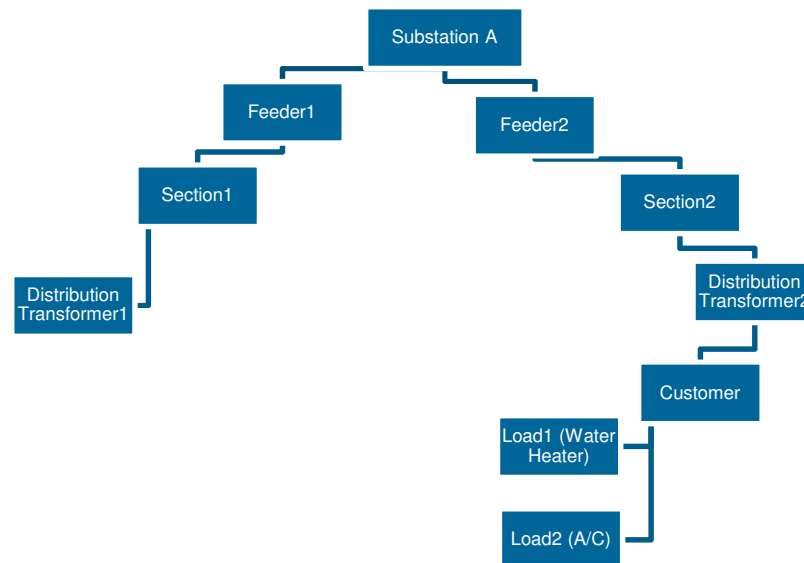
Save

Location Targeting

- Built on OpenADR Targeting
- Location types
 - Circuit (Substation)
 - Feeder
 - Section
 - Distribution Transformer
 - Customer (Service Delivery Point)
 - Load (Physical Location of UCM)
- Hierarchy of Locations

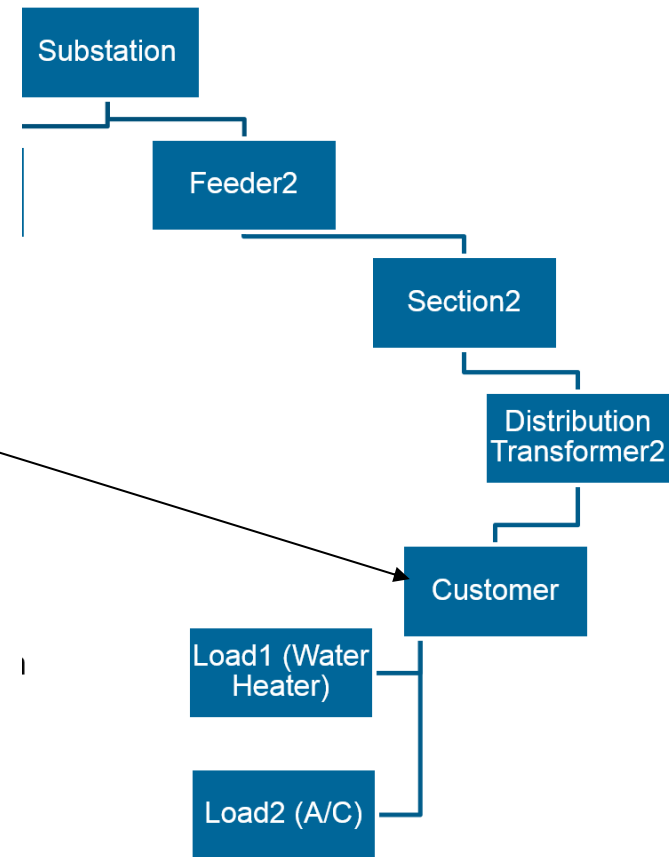
Location Targeting

- OpenADR targets don't have a notion of hierarchy
 - They are arbitrary groups of VENs
- Solution: create a Location object that maps to an OpenADR target, and has a parent Location object
 - Allows arbitrary hierarchy of Locations



Location Targeting (continued)

- Each location has
 - OpenADR Target
 - Parent Location
- Assign device to the Location object at the bottom of the hierarchy
- Automatically added to each parent
- Result: selecting Substation as a location for an event will target ALL devices below the substation





Together...Shaping the Future of Electricity

Walt Johnson
hwjohnson@epri.com
(650) 855-2013