

EPRI's Open-Source OpenADR Software Leveraging Third-Party Resources

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OpenADR Member Meeting and Open House
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Contents

- Software Overview
 - Components
 - Versions
- Case Studies
 - Utility BYOT Program
 - High-Availability
 - Automated OpenADR
 - Big Data Analytics
 - Distribution Transformers
 - EVSEs
- Software Developments
 - New Features
 - New Releases
 - Mobile VEN

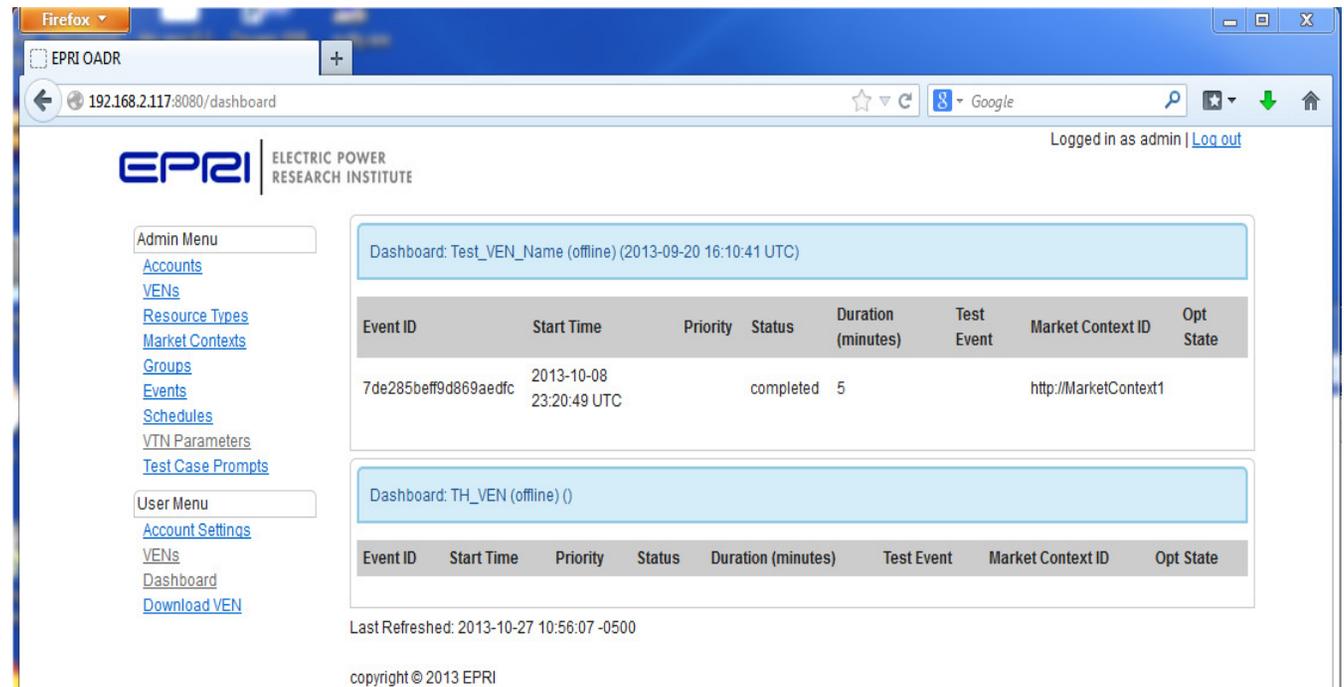


OpenADR 2.0b Open-Source Software

	 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

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 in a Firefox browser window. The page title is "EPRI OADR" and the URL is "192.168.2.117:8080/dashboard". The user is logged in as "admin" and can click "Log out". The EPRI logo and "ELECTRIC POWER RESEARCH INSTITUTE" are at the top left. The page is divided into an "Admin Menu" and a "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 shows two dashboards: "Dashboard: Test_VEN_Name (offline) (2013-09-20 16:10:41 UTC)" and "Dashboard: TH_VEN (offline) ()". The first dashboard contains a table with the following data:

Event ID	Start Time	Priority	Status	Duration (minutes)	Test Event	Market Context ID	Opt State
7de285beff9d869aedfc	2013-10-08 23:20:49 UTC		completed	5		http://MarketContext1	

The second dashboard is empty. At the bottom, it says "Last Refreshed: 2013-10-27 10:56:07 -0500" and "copyright © 2013 EPRI".

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.

The screenshot displays the OpenADR VEN2b user interface. It is divided into several sections:

- Settings (1. Settings):** Located at the top, it includes fields for Default Opt (Server, Opt In, Opt Out, Manual), URL (https://openadr.nebland.com/OpenADR2/Simple/2.0b), Client Certificate (ven.pfx), Client Cert Password, Use SSL/TLS (checked), VEN Name (Test_VEN_Name), Password (masked), Poll Interval (10), and buttons for Choose Client Certificate, Start Polling, and Clear Log.
- OpenADR Services (3. OpenADR services):** A central area with tabs for Events, Resources & Reports, Opt Schedule, Registration, and Testing. The Events tab is active, showing a table with columns: ID, Start Time, Duration, Status, Market, Signal T., and Current. Below the table are tabs for Event Details, Active Period, Event Signals, and Targets, with input fields for Event ID, Modification Number, Priority, Market Context, Created Date/Time, Event Status, and Test Event.
- Log/Communication History (2. Log/communication history):** A table with columns: Date, Response Time, Request Type, Respon..., and Response Code. It lists several log entries. Below the table are sections for Request XML and Response XML, showing the raw XML data for a selected log entry.
- Status (4. Status):** A status bar at the bottom of the window displaying: Idle | 200: OK | Server time: 12/6/2013 11:31:46 AM | Version: 0.0.5.0 | VEN IS Registered.

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*

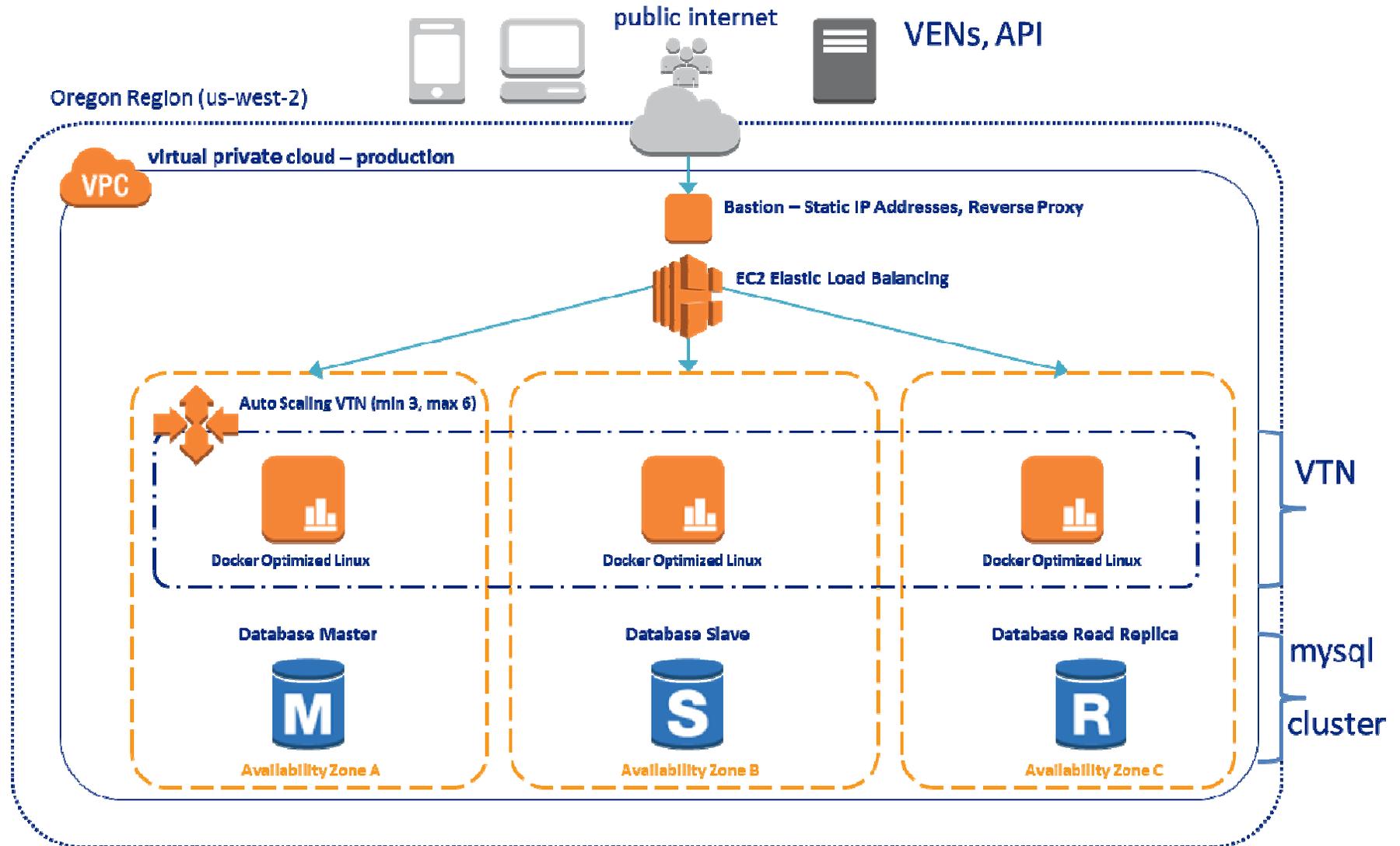
***Note:** Use of EPRI's Alliance-certified software to create a new application does *not* confer certification on the resulting application. All applications are individually certified by the OpenADR Alliance.

Austin Energy's Load Coop Program Overview



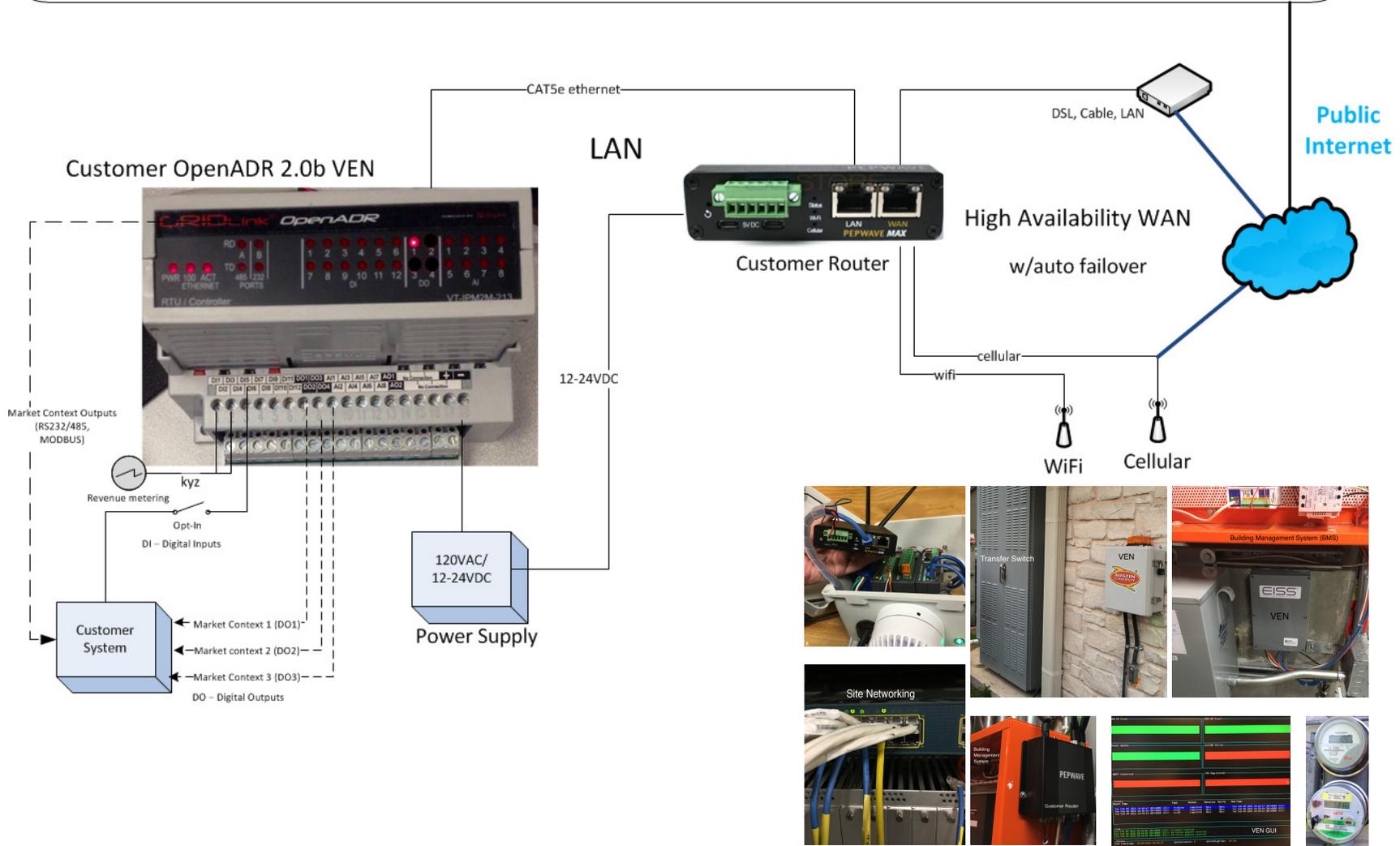
- Voluntary program between AE and qualifying C&I customers who can reduce load at peak demand times
- Customers receive 1-hour notice to reduce their load
 - 3-hour time period
 - Most events last 2 hours (generally 4-6 PM time frame).
- Customers receive \$1.45 per kWh curtailed
- Requires 15-minute IDR meters via AMI/AMR systems to collect meter data
- AE IDR data uploaded daily to Schneider's Energy Profiler On-line (EPO)
- EPO used for event notification and settlement

VTN High-Availability Architecture



Typical Configuration

OpenADR 2.0b VTN



EV Charging Transformer Overload Mitigation

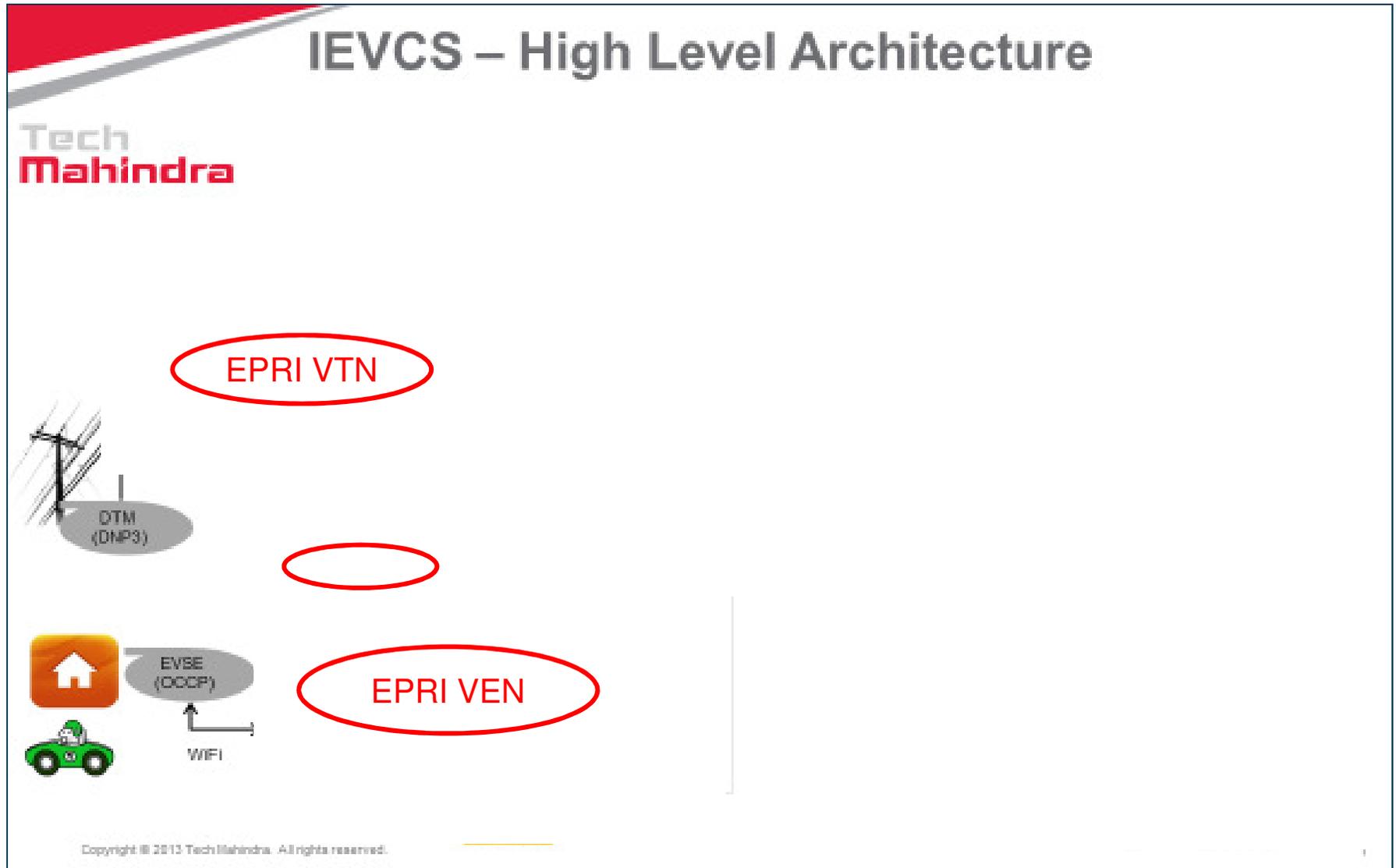
- Two-year project to ensure that transformers do not overload as a result of EV charging
- Sponsored by the Ontario Ministry of Energy
- Analyzes the effects of EV charging on transformers
 - Real-time transformer monitoring and analytics
 - Automatic management of charging between vehicles

Niagara
On-The-Lake
HYDRO

Tech
Mahindra



Intelligent Electric Vehicle Charging System

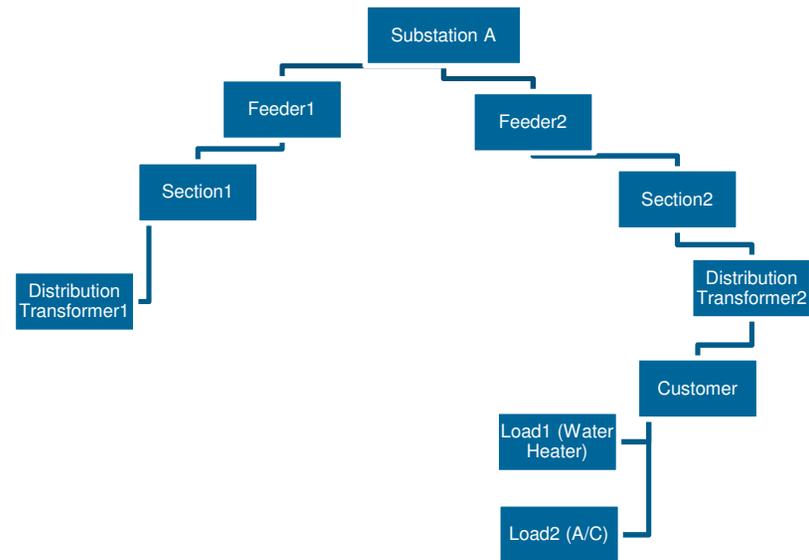


What's New?

- Much-Improved VEN C++ Library
 - Bug Fixes
 - Complete set of signal types
- VTN
 - New Features
 - Many UI enhancements
 - Simplified
 - Hides OpenADR terminology
 - Allows utility-specific terminology
 - Non-admin account features added
 - Time zone added to users, VENs, and events
 - Status pages
 - Search
 - Location Targeting
 - Major bug fixes
- Android VEN

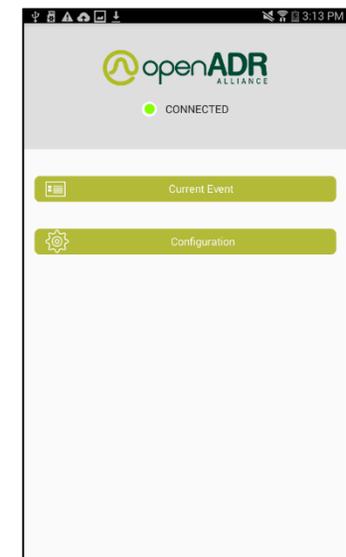
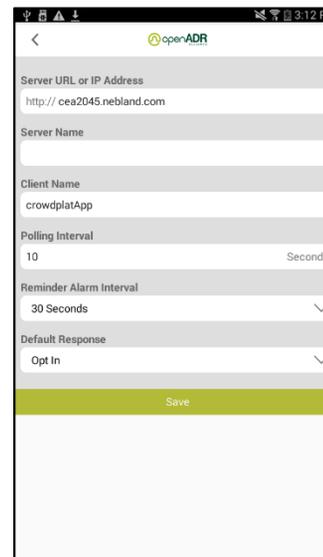
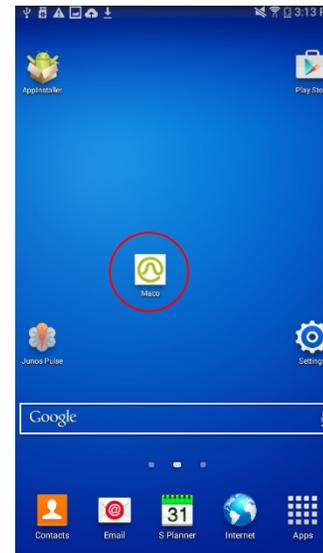
Location Targeting

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



Mobile Application Client for OpenADR (MACO)

- Research Project
 - Proof of concept development work
 - No intention for public release
 - Tested on PC (Android emulator), Android phone (Motorola Moto G), and Samsung tablet
- Simple polling VEN
- Supports only one event at a time
- Provides event notification and alerts, but takes no other actions





Together...Shaping the Future of Electricity

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