Southern California Edison — Energy for What's Ahead®

RESIDENTIAL BATTERY ENERGY STORAGE:

Demand Response Opportunities with OpenADR 2.0b

INTRO: OPENADR 2.0B ASSESSMENT WITH RESIDENTIAL BESS

Electric utilities are exploring opportunities to leverage the potential demand response (DR) flexibility offered by energy storage systems and how customers may reduce energy costs and benefit from these grid service offerings.

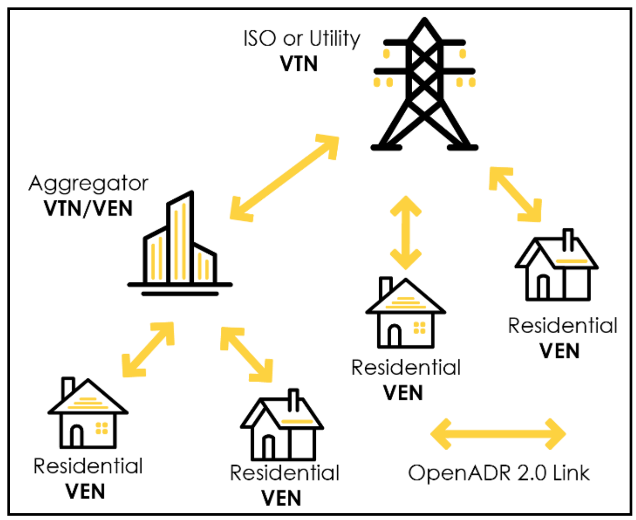
The Electric Power Research Institute (EPRI) conducted preliminary testing in a laboratory environment and testing at one field site to determine the feasibility of communicating standardized DR signaling via the open automated DR communications standard (OpenADR 2.0b) with residential, behind-the-meter (BTM) battery energy storage systems (BESS).

The project demonstrated successful application of the OpenADR 2.0b communication protocol standard to send and receive LOAD_DISPATCH signals to manage flexibility from an OpenADR certified energy storage system.

PRODUCT & TECHNOLOGY REQUIREMENTS

As energy storage becomes an increasingly important customer asset and potential grid resource, communications systems for DR programs become increasingly important. In the OpenADR figure we see the 2-way top down communication model showing the utility or ISO as the Virtual Top Node, VTN, initiating OpenADR signals to Virtual End Nodes, VEN like Residential sites or an Aggregator of multiple residential sites.

a. VTN is typically a server that transmits OpenADR signals to end devices such as BESS or other Servers.
b. VEN is typically a client like an Energy Management System, smart thermostat or other end device that accepts an OpenADR signals from the VTN.
c. OpenADR provides a non-proprietary, open, standardized DR interface that allows electricity providers to communicate DR signals directly to existing customers using a common language and existing communications such as the Internet.



OpenADR: ADR, VTN & VEN

Current challenges in data communication, products and other standards include:

- As of December 2018, EPRI found that none of the standalone products with significant market share potential in SCE's service territory offered OpenADR 2.0b functionality yet.
- Significant technology gaps and obstacles to integration including storage industry preferences, a lack of standards for controls mapping, expenses and technical challenges associated with the addition of VEN.
- Both VTN and VEN will require customizations to support utility electricity pricing programs and structures before achievement of protocol customization for price signaling.
- Another industry-supported standard, Institute of Electrical and Electronics Engineers' (IEEE) Smart Energy Profile (SEP) 2.0, also supports price signaling but does not have a mature interoperability compliance and testing program yet.

DID YOU KNOW?

While OpenADR 2.0b is not required by the California Rule 21 condition of service for behind the meter storage, the **OpenADR 2.0b protocol is used by many utilities for secure communications to customers for their demand response programs**. The protocol is also now included in the California Energy Commission's Title 24 new construction standard.

TEST METHODOLOGY

EPRI tested the efficacy of using OpenADR 2.0b for messaging DR signals to residential battery energy storage systems in the lab and in the field. The following DR signals were used for the testing:

- Charge
- Discharge
- Hold
- Returning to normal operations

Each signal included a power and time component, as well as a start time and duration.

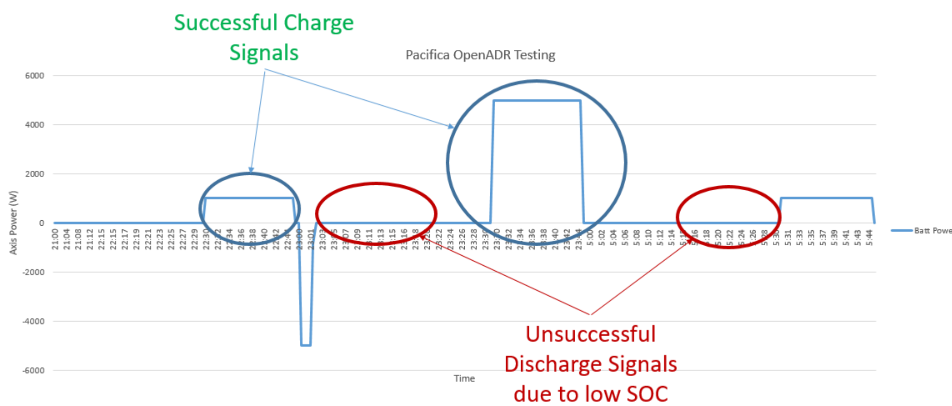
Testing was accomplished using OpenADR server infrastructure provided by Nebland's DR Engine as the VTN and E-Gear's residential energy storage system as the OpenADR 2.0b profile VEN. EPRI assessed interoperability among OpenADR VTN and VEN for the BESS and implemented software updates to conduct the tests to implement OpenADR 2.0b LOAD_DISPATCH control logic.

FIELD TESTS & RESULTS

Testing was conducted in two phases. Phase 1 of testing was conducted at the E-Gear testing facility ("Batt-Cave") in Hawaii. Four formal proof of concept tests and supplementary testing was conducted to ensure accuracy of results. All OpenADR signals, as sent to the BESS were correctly interpreted and executed.

Phase 2 of field testing was conducted at the EPRI Pacifica site. EPRI updated control logic from Phase 1 of testing and executed two tests. While the battery charged as expected, it did not discharge as expected because the State of Charge (SOC) was below its minimum threshold of 20% at the start of testing. The OpenADR signals were properly sent and the battery responded by charging accordingly. However, the BESS did not respond to the test discharge command because it was prevented by the SOC threshold limiter.

The figure below shows the results of the two field tests:



CONCLUSIONS

EPRI's research and testing confirm that OpenADR 2.0 communication standards, in particular the OpenADR 2.0b profile VEN, can be used to manage residential battery energy storage assets in the field. The greatest limitation to providing a more comprehensive assessment of the messaging protocol was that only one field asset was used and hence the datapoint is not indicative of scaled assessment. However, the test validated the applicability of BESS for possible future models of demand response via OpenADR 2.0b.

OpenADR 2.0b certification of energy storage systems allows signal reception but does not specifically provision the control logic to respond to OpenADR signals. Further software updates to the BESS control logic may be required to respond to the OpenADR 2.0b protocol message structure, as DR use cases are developed.

Control of BESS customer operated assets via OpenADR may align well for utilities and energy markets that already use OpenADR for remote messaging of other field assets or for enabling response to dynamic prices for customer benefit and providing flexibility for local grid reliability and wholesale market resources.

SCE EM&T PROGRAM

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