Analysis Me

**Fall**

2015

Technical Report

Team

Enclosed in this document is the technical report of the SLAC (Powernet) sponsored by Stanford (SLAC).

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1. **Introduction**

The project “Powernet” is an initiative of Stanford Linear Accelerator Laboratory (SLAC) operated by Stanford on behalf of DOE (Department of Engery, US).

The main objective of “Powernet” project is to provide an end- to end open source technology for economically efficient scalable and secured coordination of grid resources 1.

The project is being developed in collaboration with Carnegie Mellon University (SV) students, under the guidance of Prof Osman Yagan (Assistant Prof (E&C) at CMU) and Sila Kilicotte, Staff scientist at SLAC 1.

1. **Motivation**

The project is a stepping stone to integrate Information Technology (IT) into the traditional grid system to make it a “smart grid”. The need for “smart grid” arises due to the unprecedented change in landscape of electric grid both on the demand and the supply side. Some of the changes have been listed below

1. Proliferation in use of Solar PV & Wind as source of power resulting in two way flow in the electric grid 1.
2. Reduction in cost of storage resulting in their use on a large scale 1
3. Emergence of decarburization policies 1.
4. Increase in natural calamities disruption grid services 1.
5. Variation in load due to introduction of electric cars.

The project was started as a pilot project to identify the potential use of information technology in the grid system as a means to harness the information/data available and exploit data driven approach in making informed decision.

1. **Related work**

OpenADR Alliance has emerged as the one of the key players in the smart grid space. Their DR (Demand Response) standard - OpenADR smart grid standard, is being widely adopted across the industry. The OpenADR standard is an open and information exchange model that allows dynamic price and reliability signals exchange in a uniform and interoperable fashion among utilities, ISOs, and energy management and control systems.

1. **System design**
2. **System implementation**
3. **Experiments and analysis**
4. **Conclusions and future work**
5. **Reference**

1.Intern Guidelines powernet\_OBMS,Practicum proposal

2.http://www.openadr.org/faq

1. **Appendix 1: Software Information**
2. **GitHub Account**

The following github account is used for the project

[https://github.com/Cpruce/OpenDER](https://github.com/Cpruce/OpenDER.git)

1. **Directory Structure**
2. **Installation Procedure**

* **Cloning**:

Clone the git hub repository (OpenDER and bootstrap\_dashboard) using the following command

*git clone*[*https://github.com/Cpruce/OpenDER.git*](https://github.com/Cpruce/OpenDER.git)

*git clone* [*https://github.com/Cpruce/bootstrap\_dashboard.git*](https://github.com/Cpruce/bootstrap_dashboard.git)

* **Dependency Resolution :**

Resolve dependency using the npm package

*npm install*

Note: In case of error run “npm install” command after deleting the folder node\_modules using the command

*rm –rf node\_modules*

* **Build:**

Build using the command

*gulp build*

* **Running the server:**

*gulp run*

If the server runs without any error the command prompt displays the port on which the server is listening. Open the browser and connect to the displayed URL

1. **Contact Information**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No** | **Name** | **Contact No** | **Mail ID** |
| 1 | Praveen Gandala | 4088345482 | Pravk.reddy@gmail.com |
| 2 | Cory Pruce |  |  |
| 3 | Bixian Bao |  |  |
| 4 | Yizhen Chen |  |  |

1. **Appendix 2: Additional Information**
2. **OpenADR**

* **Introduction**

Demand response is a crucial entity in creating a “smart grid” system. It refers to the

the “changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.” 2

OpenADR Alliance, a consortium of members including utilities, device manufacturer, national labs, DR aggregators etc. 2

,is actively involved in bringing interoperability in this DR (Demand Response) space by proposing OpenADR smart grid standard. Its vision is to standardize, automate and simplify the use of Demand Response (DR) worldwide – making DR a more reliable and cost-effective resource to help utilities meet growing demand for energy, and giving customers greater control over their energy future 2.

* **Background**

The original OpenADR specifications were initiated by Lawrence Berkeley National Laboratory (Berkeley Lab). Currently other organization listed below have joined to enhance the specification

1. Organization for the Advancement of Structured Information Standards (OASIS)
2. Utilities Communications Architecture International User’s Group (UCAIug)
3. North American Energy Standards Board (NAESB).

Recently, The International Electrotechnical Commission (IEC) has 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. This has provided impetus to OpenADR initiative and has given it an international relevance.

* **Advantages**

1. This standardization in DR (Demand Response) has proved to be of great value to multiple stakeholders in the electric grid space.

|  |  |  |
| --- | --- | --- |
| Utilities & Energy Service Providers | | |
| 1 | Increased grid reliability | By providing more predicatable DR resource for utilities |
| 2 | Differ need for new generation | DR enables the demand side to vary their consumption thereby differ the need for new power generators |
| Customers | | |
| 1 | More control over utility bills | Customer installing DR systems get the dual benefit of managing their consumption based on dynamic cost and also from incentives provided by suppliers |
| 2 | Choice of products & vendors | The standardization provides immunity to the customer from vendor locking in use of devices |
| Equipment Manufacturers & System Integrators | | |
| 1 | Standardization | Ease of installation and operation |
|  |  | Reduced complexity |

* **Security**

OpenADR 2.0 supports ECC and RSA server and client certificates with TLS and XML wrapping functionalities.

* **Generic**

OpenADR can be implemented in applications that serve all market segments. There can be incorporated in products that can be used for Commercial, Industrial and Residential markets.

* **Resources**

|  |  |  |
| --- | --- | --- |
| 1 | Specification | <https://openadr.memberclicks.net/specification>. |
| 2 | Certified Products | http://products.openadr.org/ |
| 3 | OpenADR Certification Organisation | http://www.intertek.com/ |

1. **Virtual Top Node (VTN)**

Virtual Top Node is a server responsible for transmitting price information to the other server or terminal/client devices via OpenDER protocol.

1. **Virtual End Node (VEN)**

Virtual End Node are the terminal devices such as thermostat that receives price signals in OpenDER format from The Virtual End Nodes(VEN). “Energy management Systems” can also acts as a VEN. In certain cases same device can act as a VEN and a VTN.For eg. DR aggregation servers can acts as VEN for utility DR(Demand Response) signals or as a VTN for end devices.

