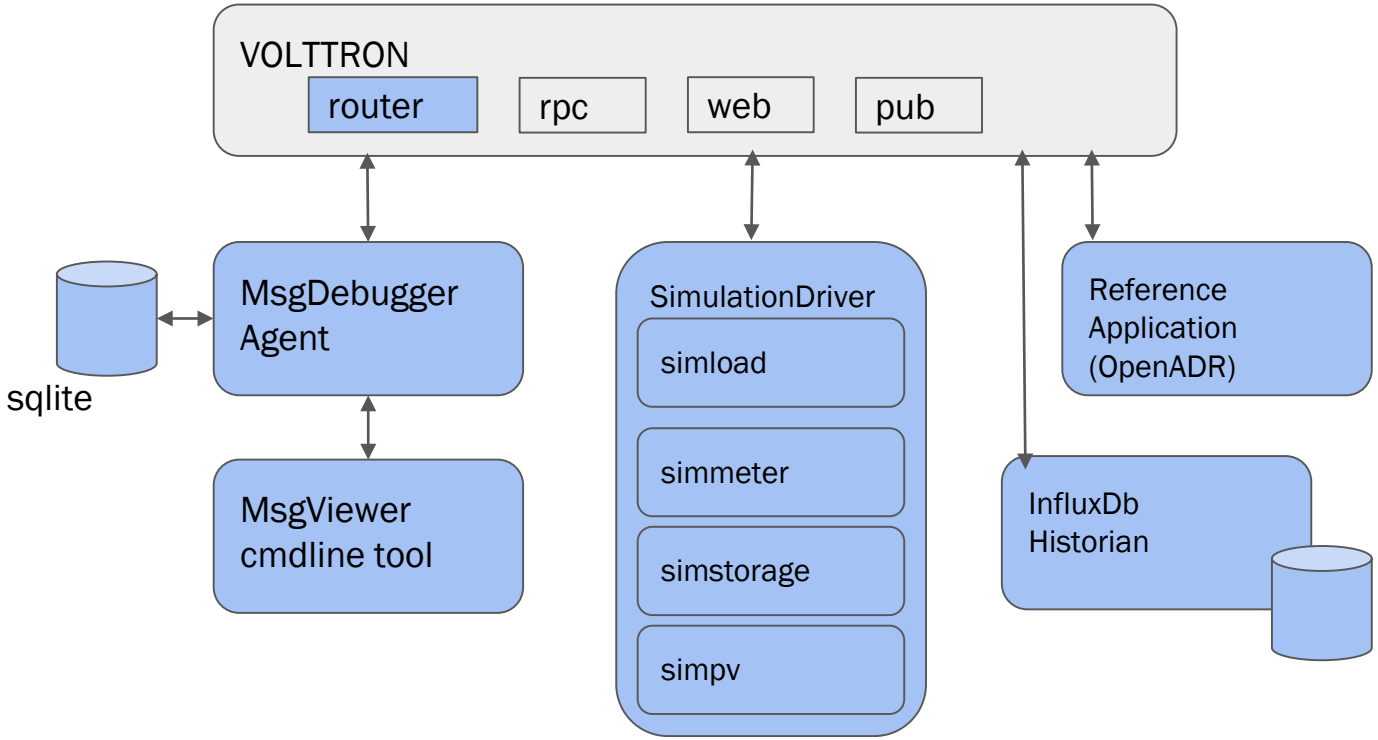
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

VOLTTRON Test Tool Kit



Performing Organization(s): SLAC National Accelerator Laboratory & Kisensum

PI Name and Title: Sila Kiliccote, Staff Scientist and Dept. Head

(Presented by Bob Barcklay, Kisensum)

PI Tel and/or Email: 510.384.1635 | silak@slac.stanford.edu

Project Summary

Timeline:

Start date: October 2016

Planned end date: September 2018

Key Milestones

1. Visual Debugging Tool; Mar 2017
2. Simulation Framework; May 2017
3. Learning Lab; Sep 2017
4. Reference Application; Feb 2018
5. Database Historian; Mar 2018

Budget:

Total Project $ to Date:

- DOE: $481, 005
- Cost Share: $22,424

Total Project $:

- DOE: $700,000
- Cost Share: $70,000

Key Partners:

Kisensum

Project Outcome:

- Demonstrate the functionality and facilitate adoption of open execution protocols and the VOLTTRON platform for Distributed Energy Resource (DER) management systems by adding testing tools for both research entities and product companies to test their development against its specifications before productizing their own development.

Team

Sila Kiliccote
(PI)

Anupama Kumar
Software Engineer

Nani Sarosa
Financial Analyst

Bob Barcklay
CTO

Rob Calvert
Principal Engineer

Anh Nguyen
Software Engineer

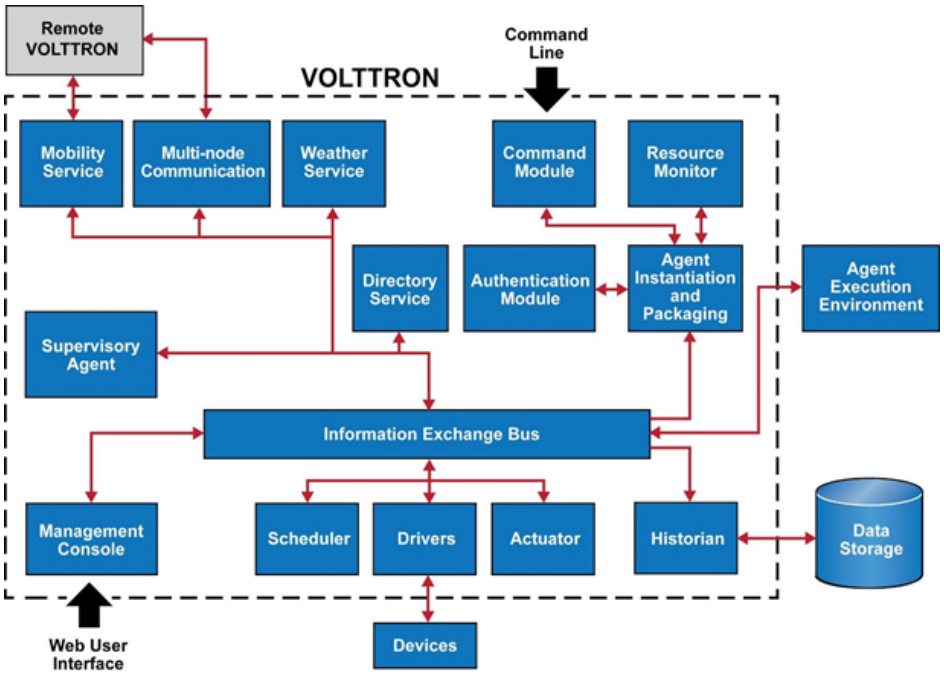
James Sheridan
Software Engineer

Challenge

- Behind-the-meter integration of distributed energy resources (DERs) is expensive and cost both time and money.
- Many companies in this space are singular industries (PV, storage, CHP, etc.) because they market these technologies as the technology evolves.
- Integrators that claim to optimally control resources that include building loads use proprietary algorithms that are difficult to evaluate for owners.

Approach

- Clear technology return on investment
  - Adoption happens when a technology solves a complex problem in a simple way
- The platform must deliver a critical mass of “solved problems”
  - These solutions must be well documented and searchable
- The platform risk must be minimized



Impact

- Facilitate (and lower the cost of) DER integration by extending VOLTTRON into the DER domain to provide greater reliability and resiliency.
- Create an open source virtuous cycle in which labs and developers gain benefits from using VOLTTRON and contribute work back to it
- Demonstrate viability of VOLTTRON as a microgrid platform for real world testing in commercial projects.
- VOLTTRON for DER Management is happening: Kisensum is working with two commercial entities that have recently initiated VOLTTRON based projects for DER management

Progress

- Message viewer adds a valuable debugging tool to the platform
- Simulation framework provides a suite of well documented code demonstrating how microgrid components interact within VOLTTRON
  - http://volttron.readthedocs.io/en/develop/volttron_applications/Reference-App.html
- Jupyter notebooks provide detailed, interactive documentation across all project deliverables
  - http://volttron.readthedocs.io/en/develop/devguides/supporting/JupyterNotebooks.html
- OpenADR reference application demonstrates coordinated agent interaction to implement load shed
  - http://volttron.readthedocs.io/en/develop/core_services/openadr/index.html
- InfluxDb historian adds a time series historian with easy integration to third party analytics tools (eg Grafana)
  - http://volttron.readthedocs.io/en/develop/core_services/historians/Influxdb-Historian.html

Stakeholder Engagement

- Held a technical advisory meeting at SLAC
  - Invited CEC (2), utilities (4) and DER companies (5)
  - Reviewed platform, discussed use case
    - Key take away: For some DER companies, they already have their own proprietary systems.
- Held a full day Learning Lab at SLAC's GISMo Lab
- OpenADR projects are under discussion
- Architectural recommendations based on VTTK work are being implemented by the PNNL team. Most notably, using RabbitMQ as the platform message broker.

Remaining Project Work

Engaging industry and growing developer community

- Ansible script for deploying cloud-based Volttron instance
- Hackathon/Learning Lab
  - Main objective is to introduce VOLTTRON and demonstrate how to use it.
  - Designed to grow the developer and user communities
  - Attendees will include DER integrators and SF Bay Area university students studying in an energy related field.

Thank You

SLAC & Kisensum
Sila Kiliccote, Staff Scientist, SilaK@slac.stanford.edu
Bob Barkclay, CTO, bob@kisensum.com

REFERENCE SLIDES

Project Budget

Project Budget: $700,000 (DOE), $70,000 (Cost-share)
Variances: None.
Cost to Date: $508,042
Additional Funding: California Energy Commission provides the $70,000 cost share budget, making the total project budget $770,000.

Budget History					
Sept. 2017 – FY 2017 (past)		FY 2018 (current)		FY 2018 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$398,664	$0	$83,514	$25,864	$287,822	$44,136

Project Plan and Schedule

Task	Description	Verification	Due	% Comp.
0.1	PMP	PMP Document	Oct ‘16	95%
0.2	Quarterly Reports	Delivered reports	Jan “17	
1.1	Simulation Testing Framework Demonstration at hosted webinar or VOLTTRON office hours	Completion of public demonstration of Testing Framework	April ‘17	100%
1.2	Framework and Pull Request published.	Publish framework and issue Pull Request announced on our website	June ‘17	100%
2.1	Draft specification for visual debugging tool completed and published	Publish draft specification for visual debugging tool so that open source community can comment on specifications	Nov. ‘16	100%

Project Plan and Schedule

Task #	Description	Verification	Due Date	% Comp.
2.2	Final specification with change log based on community feedback for visual debugging tool completed and published.	Publish final specification with change log for visual debugging tool so that open source community is aware of the changes made as well as the final specification	Dec '16	100%
2.3	Visual Debugging Tool demonstrated at hosted webinar or VOLTTRON office hours	Completion of public demonstration of visual testing tools	March '17	100%
2.4	Visual Debugging Tool and issue pull request published	Publish Visual Debugging Tool and issue pull request, announce on public website and make available to open source community	April '17	100%
3.1	DOE acceptance of First Hackathon workplan	DOE's written approval to move forward with the hackathon	June '17	-

Project Plan and Schedule

3.2	VOLTTRON installation process improved by the targets specified in the workplan.	Comparison of actual data to target metrics	Aug ‘17	100%
3.3	Report on success metrics identified in the workplan.	Reporting of actual data collected at the hackathon to target metrics in the workplan	Sept ‘17	-
3.4	Hackathon results published.	Hackathon results made available through public website	Sept ‘17	-

Project Plan and Schedule

4.1	Reference Application specification published for at least one use case for VOLTTRON as a DER integration platform.	Completion of public demonstration of reference application specification	Nov 17 (100%)
4.2	Reference Application successfully implemented utilizing all the agents developed and meets all the requirements of the specification document, and demonstrated at hosted webinar or VOLTTRON office hours.	Completion of public demonstration of reference application	Jan 18 (100%)
4.3	Pull request published and issued making documentation and packaging available	Publish reference application documentation and packaging and issue Pull Request to make available to open source community	Mar 18 (100%)
5.1	Alternate database historian successfully implemented and demonstrated at hosted webinar or VOLTTRON office hours.	Completion of public demonstration of alternate database implementation	Mar 18 (100%)

Project Plan and Schedule

5.2	Pull request published and issued to make alternate database historian source available.	Publish alternate database historian implementation and issue Pull Request to make available to open source community	Apr 18 (100%)
6.1	Beta test cloud instance development and pull request to make available to open source community	Publish test cloud implementation and issue Pull Request to make available to open source community	Jul 18
6.2	Minimum of 3 developers have successfully tested their agents against the VOLTTRON cloud instance.	Names, contact information and feedback collected from minimum of 3 developers	Aug 18
7.1	DOE acceptance of Second Hackathon workplan.	DOE's written approval to move forward with the hackathon	May 18
7.2	Report on success metrics identified in the workplan.	Comparison of actual data to target metrics	Sept 18
7.3	Hackathon results published	Hackathon results made available through public website	Sept 18