Key Meeting Takeaways from 2014 Meeting at Case Western and Changes Made to VOLTTRON™ in Response

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Software Framework for Transactive Energy: VOLTTRON™, VTARI, Arlington, VA

Programmatic Priorities

1. Increase VOLTTRON outreach efforts
   - IEEE and ACM (Virginia Tech Professor S. Rahman(offered to host VOLTTRON session at February IEEE meeting in DC if desired by DOE
     - **A VOLTTRON workshop host by Consortium for Building Energy Innovation**
     - **A VOLTTRON session was organized at the February IEEE meeting**
   - Sponsor Annual User Development meeting piggybacking on existing meetings/conferences
     - **A VOLTTRON session at Energy Exchange 2015 in August (which provide training to energy managers at Fed sites)**
     - **Will hold a 3rd VOLTTRON users' meeting next year**

2. Draft detailed roadmap for VOLTTRON development, with public input
   - **A reference document has been prepared; we will seek public input and we plan to revise and update it**
   - **Transaction-Based Building Controls Framework, Volume 2: Platform Descriptive Model and Requirements. PNNL-24395**
     - **Please provide feedback at volttron@pnnl.gov**
   - **http://transactionalnetwork.pnnl.gov/publications.stm**

3. Present a strawman for VOLTTRON community structure, and then get public input on it
   - **We have a draft document, which needs stakeholder input and refinement**

Programmatic Priorities (cont.)

4. Define scope of VOLTTRON Nation. Is it very broad (Transactive Energy), narrower (Buildings-to-Grid) or narrower still (Building Controls)

5. Quantify the potential economic value (business case) of services VOLTTRON would create
   - **Studies exist on the general value of a smarter/more transactive grid**
     - **"McKinsey on Smart Grid" - $130 billion annually by 2020**
     - **Unpublished estimates by PNNL**
   - **For BTO and DOE's Office of Electricity, PNNL is currently conducting a valuation of Transactive Energy Systems**
   - **For VOLTTRON more specifically, we could start by taking the economic values of the multiple services delivered today using traditional automation systems that are only viable in large buildings, and then apply these services to small buildings, showing that low cost solutions (BEMOSS) are enabled by VOLTTRON. Could extrapolate using EUI cost, square footage, etc. and derive a national estimate**
   - **Navigant is also conducting a broad market assessment of VOLTTRON both in the building and grid space**
   -

6. DOE should always support foundational development but industry will drive future enhancements and specialized/proprietary agents

Programmatic Priorities

7. Clarify VOLTTRON licensing models. DOE intent is open source.
   - **Protected (patent-pending) security features require a license from PNNL**
   - **License is non-exclusive and requires no royalty for building applications**
   - **Later this year, PNNL will create a software portal where the licensed code can be downloaded with a "single-click"**

8. Need VOLTTRON security enhancement plan (Agent-to-agent security as they it is added; Consider how/where implemented)
   - **Security Features of VOLTTRON™ Distributed Sensing and Control Platform**
   - **VIP (VOLTTRON Interconnect Protocol) and RPC (Remote Procedure Call) methods allow for peer-to-peer and a more secure communications**

Technical Priorities

1. VOLTTRON has been developed to be very general purpose, but standards would help application developers. Some of these standards may fall out of other ongoing research. Including apps to platform services, app to app, and common data/representation models
   - **LBNL created a strawman**
   - **Encourage others to comment at:** https://github.com/VOLTTRON/volttron/wiki/Data-Model-Standards

2. Set of simple, clear, specific agents (including a non - Python agent) which demonstrate how to work with platform services. These agents could also serve as templates for building more complex agents.
   - **Example implementations of new drivers and historians, RPC calls**
   - **Will continue to expand example sets**
   - **LauncherAgent is a generic way to launch non-Python agents**

3. The contributed applications need more documentation to understand what they are doing. These complex applications provide more realistic examples of operation than the simple example agents
   - **All PNNL developed agents/applications have detailed documentation**
     - http://transactionalnetwork.pnnl.gov/publications.stm
     - **Links to other labs and Virginia Tech sites are also included on this page**

Technical Priorities (cont.)

4. Re-examination of publish/subscribe with a scalable methodology. As part of this, seek comments and peer review and test alternative methods.

5. Allow agents to communicate peer-to-peer in cases where data (especially large amounts) does not need to be shared with other agents on the message bus.
   - **VIP (VOLTTRON Interconnect Protocol) and RPC (Remote Procedural Call) methods allow for peer-to-peer and a more secure communications**

6. Implement a Directory Service for capability discovery so that it is easier for apps to discover devices, services, and other apps.
   - **VOLTTRON "Analytic" Central registration gives access to agents on platform**
   - **Rudimentary Directory Service contributed by LBNL**
   - **Expand VOLTTRON for additional information on platforms**

Technical Priorities (cont.)

7. Robust developer tool suite needed
   - **Unit Tests**
     - **Pattern established. Need additional tests**
   - **Ability to easily debug agent communication**
     - **Communication monitoring option to give full details of communications**
   - **Library of simulated devices to facilitate running apps with out access to real devices**
     - **Community encouraged to contribute**
   - **Algorithm Toolbox for common algorithms benefitting multiple apps**
     - **Community encouraged to contribute**

8. Provide a clear distinction between capabilities of the base platform and applications which are built on top of it, e.g. Virginia Tech's system
   - **Posted on wiki**

9. There is market interest in embedding VOLTTRON in consumer products and routers. Investigate how this might be done
   - **Investigating this with interested vendors**

Technical Items (cont.)

10. Determine how to distribute products built on VOLTTRON (E.g., Appstore concept). First instance would be Virginia Tech OS
    - **Still under investigation**

11. Build an automated configuration capability to enable:
    a. Plug and play
    b. Auto discovery and configuration
    c. Auto mapping of device points to a common data format
        - **Auto-mapping is one of the research project funded for FY16 under BTO's Sensors and Controls Program. Activities envisioned include a technical meeting with other auto-mapping developers to understand current status of the field to identify priority needs, and a Request for Proposal via the Federal Register to reach out more widely. VOLTTRON team will leverage this work**

Questions?

- Interest in holding Steering Committee meetings for those in the community contributing to VOLTTRON
  - Prioritize the true needs of the community
  - Prevent duplication of effort
  - Make best use of available resources
- VOLTTRON Resources
  - Wiki: https://github.com/VOLTTRON/volttron/wiki
  - Email: volttron@pnnl.gov
  - Bi-weekly office hours (Friday 11 a.m. PDT)