Summary Notes (Q&A and Comments following each of the Presentations) from the Technical Meeting on the *Reference Guide for a Transaction-Based Building Controls Framework: Unlocking energy efficiency and grid service values for building energy consumers* (May 2, 2014)

Opportunity for transaction-based building controls – Joe Hagerman

Buildings have huge role in energy consumption, but controls are expensive, complicated and usually only implemented in large buildings; future state is a transaction-based energy eco-system with transaction-based controls, and need sensors and controls to make this happen; transactive energy is physical, logical and financial.

Transactive Energy Markets and Services – Steve Widergren

Discussed GWAC activities, the AEP project as well as the ongoing NW Smart Grid Demo project

Question: Ohio project with AEP, is that a single device responding to real time pricing in PJM markets? Is that considered transactive energy? Where do you draw the line?

Answer: We envision it as something that is happening all the time, on a 5 minute basis, not critical peak pricing. They are helping to come up with clearing prices all the time.

Question: A general issue that is of concern is the economic reality that is faced by participants. Any thoughts on moving from play money to real money with real economic consequences?

Answer: They were given a pot of money. Anything they could save, they could keep. The consumers were sending their intelligent agent to behave as if they were constantly seeing real prices and consequences. The devices weren't reacting as if they were consumers; they were reacting as if they were seeing all those penalties.

Question: You used the terms winning and losing. They were settling on a price. Why did you use those terms?

Answer: If you bid in lower than what the market price cleared you could determine that was losing. That was in terms of lower and higher bids, perhaps not the correct terms to use.

Question: In Joe's slides he talked about how buildings negotiate with each other, in this project it was still between building and the grid? What were the major challenges you see for larger scale implementation?

Answer: Yes to the first question. There are many dimensions to the second question. With AEP we did not put any forecasting in there.

Question: Why was a 5 minute time span chosen? That seems too short to me? Cycling your unit on and off a lot?!

Answer: Cycle times of the units played into it. The thermostat was using set point controls so that the manufacturers' ability to control so you're not harming it. 5 minutes was something we felt we could achieve from a communications point of view.

Q: Can you walk through one example of the double auction process?

A: Consumer has the ability to say he wants more comfort or more savings. The flatter the line, the more sensitive the consumer is to the price.

Q: With thermostat pilots, where is the logic? Was it in energy management system, cloud or thermostat?

A: In AEP it was done in home energy management system that was communicating with smart thermostat and communicating back to central market grid.

Rooftop A/C Unit Transactional Network, a DOE/BTO research project – George Hernandez

The research project spans across three labs: PNNL – automatic fault detections, can reside in device, building or cloud, that's the beauty of this platform; ORNL – wireless interoperability; LBNL – same thing for buildings on their campus, DR also.

Question: We're all about autonomous RTU control, want to follow up with you on this

Answer: Need to develop things that people will actually use. Initial problem: we can do all this work and no one can use it, licenses, etc., but VOLTTRON is free.

Q: How do you make sure they talk to the thermostat and people stay comfortable?!

A: There are different implementations, the VOLTTRON application is talking just to the thermostat, which is kind of rudimentary; one cool thing is that researchers at Oak Ridge National Laboratory (ORNL) are looking at putting VOLTTRON in the thermostat, so it will all be in the unit. If one unit fails, and 3 are still working, then the three other units try and keep up and do the work of the failed unit. When putting the VOLTTRON only in the thermostat, we only know what is going on in the thermostat. Other cases we know about what's happening in the space and the unit.

Q: The problem is that you didn't lean on cross-platform integration enough. The autonomy is the big deal. Individual systems as they grow autonomous know themselves better. The autonomy is where the future lies in a useful way.

A: I think using this platform we can get to devices that are self-aware; availability of a device is a great word, that's where I think we can go. In two months, we will be having a meeting with developers and vendors about where VOLTTRON is going.

Specification of Transactive Control for a Microgrid – Erich Gunther, Enernex

Video presentation

DOE/EERE's Multi-Year Plan for the Grid integration Initiative -- Kevin Lynn, DOE

Question: What consideration and work are you doing toward using transactive energy, not just the real time stuff, but the application of forward markets of planning, projecting renewables both on shortage and surplus side?

Answer: Early stage developments. Understand how these pieces are put together.

Q: This is a challenging task. Curious about northern Europeans that are much farther along in integration of renewable energy and how we're learning from them?

A: German system – there are things you can learn and there are things that are not transferrable. One thing we've learned is that it's not quite as scary as we thought it would be. Market challenges in Germany are things we can learn from; Denmark (thermal energy) has demonstrated and integrated the systems more quickly. Spain is at 33% renewables.

Q: How can we as manufacturers get involved? Where can we get engaged and bring highest level of benefit? In the short- or medium-term?!

A: EERE is making efforts to emphasize tech transfer from labs to industry. In February, for multi-year project plan (MYPP) one major input we got is to push tools from labs to industry.

Q: What is the acceptable amount of renewables? Solar and wind are different in their performance. Can you accept more of one or the other, given their variability?

A: Even split of solar/wind gave best results in terms of management of the grid. CA RPS study – just by controlling the integration of the different percentages of different technologies, you can dramatically lower price of energy for consumers without using DR, storage, etc. Report with hypothetical study where transmission was unlimited – what does it take to provide Europe with 100% renewables? Regarding PVs and wind, there is a strong negative correlation between the two resources. There is an optimal mix that is close to 60/40 or 70/30.

Q: What's the state of the art in forecasting now?

A: Wind and solar have both partnered with NOAA for technical assistance to be able to improve their rapid refreshing models. Solar solicitation to use new techniques, in the future.

Comment: Transactive energy and net metering – in any tech cycle, early adopters have different motivations. Net metering, while necessary for early adoption, has ruined the process for later adopters, can only be fixed by transactive energy and appropriate marketing.

Overview of the Reference Guide – Rob Pratt and Ebony Mayhorn

Q: Other Categories of Transactions?!

Comments:

- Generally like the framework. Subject that you are trying to transact is what drives the services; categories of products you deal with are more important; there is a transactive set of fundamentals under need.
- One issue with utilities and dealing with customers are retail rates. The PUC is the bridge keeper in Monty Python's Holy Grail; one big hurdle is the demand charge that is based on non-coincidental demand and applies to all hours. That is a big constraint.
- Some individuals might be motivated by environmental services which are not completely agreed upon by society, perhaps a new kind of societal service?!
- There is an assumption here of a market giver and a bunch of market takers, there is no reason you can't have point-to-point transactions if they clear in time; environmental benefits and environmental costs need to be considered here too.

Q: Other products, rights and services?!

Comments:

- Need to use the term "benefits" in addition to products, etc. It is much more general
- From HVAC standpoint, energy is the cost of providing comfort, so that needs to be measured in some way. Acceptable range of temperatures, health, safety and comfort, e.g., someone with medical condition
- Quality of Service (QoS) needs to be added in addition to just comfort
- "Options" value for services need to be added to the financial products, among others;
- Not just the product itself, but also quality of product (e.g., energy, power) is important
- Comfort doesn't belong to the grid transactions because of the different occupants' requirements in a typical home (his and her comfort, to begin with)

Transaction-based energy services may not have a control objective, so expanded view; energy market services and grid services strongly related;

Energy Market Services – reaction to prices – receiving entity does not need to react

Grid Services – grid pays for entity to react to – highly contractual

Use cases for end-user services – people may recognize existing technologies; grid is transactive today, but based on monthly paper bill; taking a system that is marginally transactive and making it hyper-transactive; reduce granularity of transactions in time and space; exchange value with higher fidelity.

Q: End-User Services – any more services examples?!

Comments:

- EMS in buildings, EVs charging as use cases, go to www.EISAlliance.org for free downloads of more use cases (19 customer domain use cases, January 2010)
- San Diego Gas & Electric is already doing the EV charging service (phone app for Dutch auction for charging of EVs for employees)
- There is a lot of overlap between these categories, transactive techniques needs to be separated; discussion needs more cross-connection. Also, need more products to know about building services like these.
- Low carbon energy sources traded against comfort, the consumer may want to choose to be more green than any other generation source

Q: Generic Transactive Node – sufficient definition

Comments:

- Yes, it serves all use cases and it's a good description, but still needs a few caveats
- Third-party aggregator would essentially operate as a node
- Node serves as a settlement and transaction and may even have pass-throughs; even double payments are possible
- Concept of transaction costs is missing here. Not sure how to capture that but it should be addressed.

Q: Information Model for Transactions – Is this necessary? Is it always required? Are there other elements?

Comments:

- This is a good list, but not all of these are necessary in all transactions; there is no actionable information from this list;
- NIST helped drive through these (EMix) or TEMix; EMI Exchange is another link
- Financial services market, e.g., American Express need to be investigated more; NIST has already enabled the interaction with the financial community with Financial Information Exchange, etc.

Q: Need something like a roadmap for accomplishing this.

A: In the grid space, GWAC is already doing this, OE it is starting to happen, and in BTO, we are starting to do this between grid and buildings.

Illustrative Use Cases – Ebony Mayhorn

Comments:

- Clearest explanation of TE use cases; retail sale of energy, EVs, etc. need to be added to the list too
- Tenant case that gets the utility bill whereas the building owner may buy the cheapest equipment, but the energy and cost savings may not be there; the chiller example is much more complex than stated here, should be treated more as a "chilled water system" to optimize rather than separate components
- Very clear exposition, building and connections, aggregate and disaggregate the microgrid, office parks can all be examples of these illustrative use cases
- Service professionals need to be involved, very opaque markets, time is more precious and so can't go about getting a lot of bids to just get the service done; the Regional Technical Forums (RTFs) in the Pacific Northwest region are already addressing this and they are a critical community to involve in this discussion.
- How to do the electronics on the automated commissioning is another question
- Other manufacturers would need quality of service and timely delivery of services
- Cooling system being complex, need to bring more information into all this, mathematical modeling needs to be incorporated, to make the transactive model work
- Air-Conditioning Contractors of America (ACCA) is another group to involve in this activity, and we need coordination among different service contractors and different manufacturers to get this going; standardized methods of servicing would help.

Meeting Purpose – would you be able to use or provide this concept?

Comments:

- Yes, service Provider or ISO who would provide this and we need to work with all that
- Barrier and qualification, retail resale restrictions, how to sell PV to neighbors (outside buildings); and within buildings, we can get it started right away!
- One meter, not one owner is the stumbling block, secondary retail level
- We should make data available to whoever desires it?! ASHRAE report on chilled water plant operation, for example.
- This is a non-linear dynamic model and so it has to be solved appropriately, perhaps a modular solution; perhaps a market-clearing mechanism is needed to solve the problem

Q: What should be the role of BTO?

A: There used to be a B2G think tank even before NIST got started with their activities, maybe DOE can revive these discussion groups; BTO to convene or urge someone else to convene; BTO to enable discussions with regulators to lay the groundwork for this, especially the PUCs. Winter NARUC meeting in February every year in D.C. is another opportunity.

Q: Is open-source strategy useful to pursue?

Comments:

- Yes, most definitely. Making this plumbing available is absolutely essential so manufacturers can put their own features on it.
- DOE needs to do it with carrot and not with a stick such as new regulations. For example, building codes funding provides analysis support to ICC and ASHRAE, DOE could do something similar in the open-source strategy as well.
- Another yes vote for this strategy. Need to cast a wide net to enable innovation in this area.
- Publication strategy, guide or guidance documents, open standards rather than open-source.
- Different problems from different perspectives; BTO's role is renewable energy and facilitating it is more urgent; do we need a business model to justify this?
- Secret sauce is needed from different manufacturers and a variety of industries, got to be TE surface (the apache stacks) that everybody who wants to participate can.

Q: What should be the role of National Laboratories?

Comments:

- Fundamentals need to be understood. Convene meetings of good content. Merging science and practice, and bring other players to the table to make this work.