Utility Transformation: Automation – All about sensing, analysis and control

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Meet the Author:

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Let us continue to use the hypothetical case study from the last article.

"I just returned from Houston and my friend got a message on her cell phone that the power was out at their house, but that it would be back on in 2 hours, so we kept playing tennis. When she checked the app, she also showed me her car was only charged 80% but it was ok, because she was using her solar cells to charge it and it would be complete in 3 hours. She smiled and said she sold $75 worth of power last month back to her retailer and it paid for lunch today. She said her electricity bill now only includes a connection charge unless she does her clothes washing and baking on the same day. I am calling PSE to see what they can provide."

Case credit to Charles Filewych, CEO, of Smart Grid Interconnect. Used here with permission

Using this same case study, let us focus on one aspect of utility transformation – Automation. Automation is all about sensing, control, and the algorithms that are necessary to take the data from the sensors, perform some calculations on them and control some device in the field.

- *Let's start with sensing:*
    - *Just like any other system, the power system network requires sensors that gather information such as the voltage at a point, current flow, MW/MVAR flow, transformer temperature or oil status, and so on. Sometimes, this sensed data is used locally or communicated to another location where it can be used in a centralized location to make broader decisions.*
    - *Sensing has seen significant change over the last several years. It has become smaller, more sophisticated, capable of sensing more than one quantity, performing localized calculations faster and even communicating to distant locations using different mechanisms.*
- *Moving from sensing to analysis.*
    - *The next step to sensing is the role and presence of analytics. Analytics takes a combination of the data received from sensors and the as-operated model to define the state of the network and*
    - *identify potential problems, or detect the source of an existing problem*
    - *Gauge potential solutions to enhance the state of the network and/or solve an existing problem*
    - *Assess the network state trend and define better ways of managing and/or designing the network.*
    - *Provide results of analysis to other entities either within the utility or external sources to assist in their decision-making processes.*
    - *Or something else.*

Analysis is another area that has seen tremendous change through the use of as combination of faster and better processing, better algorithms, and the introduction of distributed analysis very often embedded into the sensors themselves.

- *The last step is from analysis to control:*
  - *The end result of analysis or standard action in utility operations is the need to control something in the field – very often controlling a circuit breaker position, testing for a fault, ramping up/down a generator, increasing/decreasing the tap-level of a transformer or something. The intent of these actions is to change the operational state of the network in ways that either alleviate an existing problem or move the system to a better state.*
  - *Controls have moved from being mostly manual (in the distribution network) to becoming more and more automated and having the ability to support extremely complex control schemes many of which were only available in transmission until now. Very often, the complexity of distribution level control schemes comes from the need to manage and handle Distributed Energy Resources (DERs) and/or microgrids.*

What is the future of this area?

The future in this area is moving more and more toward embedded sensing, analysis, and control mechanisms.

Think of a scenario where we can move away from today's paradigm of the utility placing sensors and controls on a distribution transformer and also the communications, necessary to move the data to where it is needed. The device of the future will already come with pre-installed sensors, analysis mechanisms, controls, and communications mechanisms built into it.

The addition of the new functionality will come at very little added cost, has the ability to be self-maintaining, remote-upgrading on functionality, and can take advantage of the latest technologies of bringing "silicon to the edge of the grid".
These capabilities also bring increased ability to manage DERs and microgrids much more effectively thereby allowing the grid to be managed using newer and more advanced control mechanisms and allowing for greater penetration of DERs into the grid.

Conclusions and Closing Thoughts - How does the utility transform itself with these automation capabilities?

Automation as a pure technology play brings much more minimal value to the implementer. True value comes from changes in the business model through the provision of improved processes and people changes.
For automation to deliver value both the utility's front, mid, and back offices need to be transformed.
Let us look at some examples:

- *Outage Management:*
  - *through the use of automation, the utility can, not just know where the problems are but also what the problem is, what is exactly broken, the specific parts required, how long the crew with the right capabilities and parts will take to get to the fault location and fix the problem. All of this results in a more accurate ETOR (Estimated Time of Restoration) leading to better customer satisfaction at lower costs to the utility.*

- *Asset Management and Planning (e.g., Predictive maintenance)*:
  - *everyone knows that the worst problems in the utility happen at 3 AM leading to the need for a crew to be paid overtime rates and still taking more time to resolve. Predictive maintenance allows the use of data, using analysis to spot equipment behavior signatures, identifying potential failure possibilities, and scheduling a crew to visit the equipment during the day-shift thereby avoiding equipment blowout and the resultant outage.*
- *Power quality*:
  - *The advent of new types of loads and supplies (solar-PV, EVs, and others) led to increased voltage fluctuations at the customer site. Better automation and implementation of systems such as CVR, IVVC, and voltage regulators will both find and resolve the problem before the customer even finds them.*
- *New and unregulated services*:
  - *As new PV systems, electric cars, and other newer devices get added to the grid, customers who, until now did not need to do much with the electric system have to learn to interact with the system and the utility. The incumbent utility that has implemented the automation mechanisms has the potential to deliver new services to the customer including those such as (1) PV system implementation and maintenance (2) microgrid control and support and others.*

Automation is the first step to making the grid smart (Smart meters/AMI were an initial step in this direction) and the release in value comes from the utility, the customer, the regulator, and all others along the value chain only when they also transform themselves.

Author's note: This is a part of a series of articles written by this author for Intel. This is the third article and the next set of articles will continue the focus on expanding on the concepts introduced in first and second article.