Transactive Microgrids: Creating Resilience and Economic Benefits

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Microgrids come in different shapes and sizes catering to a diverse set of operational drivers and objectives listed below:

- System Resiliency: Ensuring that the system can tolerate a major event resulting in the loss of electricity supply from the local utility.
- System Reliability: Ensuring acceptable electricity quality (voltage and frequency) at all times.
- System Economics: Minimizing the operational cost.
- Environmental Stewardship: Minimizing Environmental foot-print.

Whereas resilience is the main deriver for investment in microgrids, thus far the economic objectives have popularized microgrids as Transactive Energy actors. With the changing electricity industry landscape in recent years associated with cost-effective distributed energy resources (DERs), such as rooftop solar Photovoltaic (PV) Systems, distributed storage, and increased active demand-side participation microgrids are now finding their place in this landscape as resiliency and reliability agents as well capable of providing a variety of services to the simultaneous benefit of the microgrid as a prosumer, the distribution utility, and the power system at large. The emergence of the new Distribution System Operator (DSO) construct and Transactive Energy paradigm further enhance microgrids' capabilities to engage in bilateral trades with other microgrids, prosumers, or consumers. Specifically: 1) Microgrids can participate in peer-to-peer transactive exchanges for energy and derivative products, peer-to-market exchanges with distribution utilities in conventional demand response (DR) and other demand-side programs, and in some cases for provision of voltage support. 2) Through bilateral or market-based transactive arrangements, microgrids can act as the restoration agents when the grid goes down, supporting the utility restoration process. 3) Microgrids can provide resiliency to neighboring facilities under emergency conditions to the mutual benefit of the microgrid operator, the distribution utility, and other consumers/prosumers. 4) Microgrids can participate in bid-based wholesale electricity markets providing energy and Ancillary Services (AS) for the benefit of the broader power system operation.

We refer to an advanced microgrid which can achieve the above objectives as "Transactive Microgrid". A significant degree of consideration needs to be given to the technology and controller designs for a Transactive Microgrid.

In this presentation, a technology framework is provided which facilitates the design and deployment of transactive microgrids capable of achieving the above goals followed by some use cases demonstrating the resiliency and economic benefits that such microgrids are capable of generating.