NSERC SMART MICROGRID NETWORK

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Project 3.4

Integrated Data Management and Portals

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Opportunity:

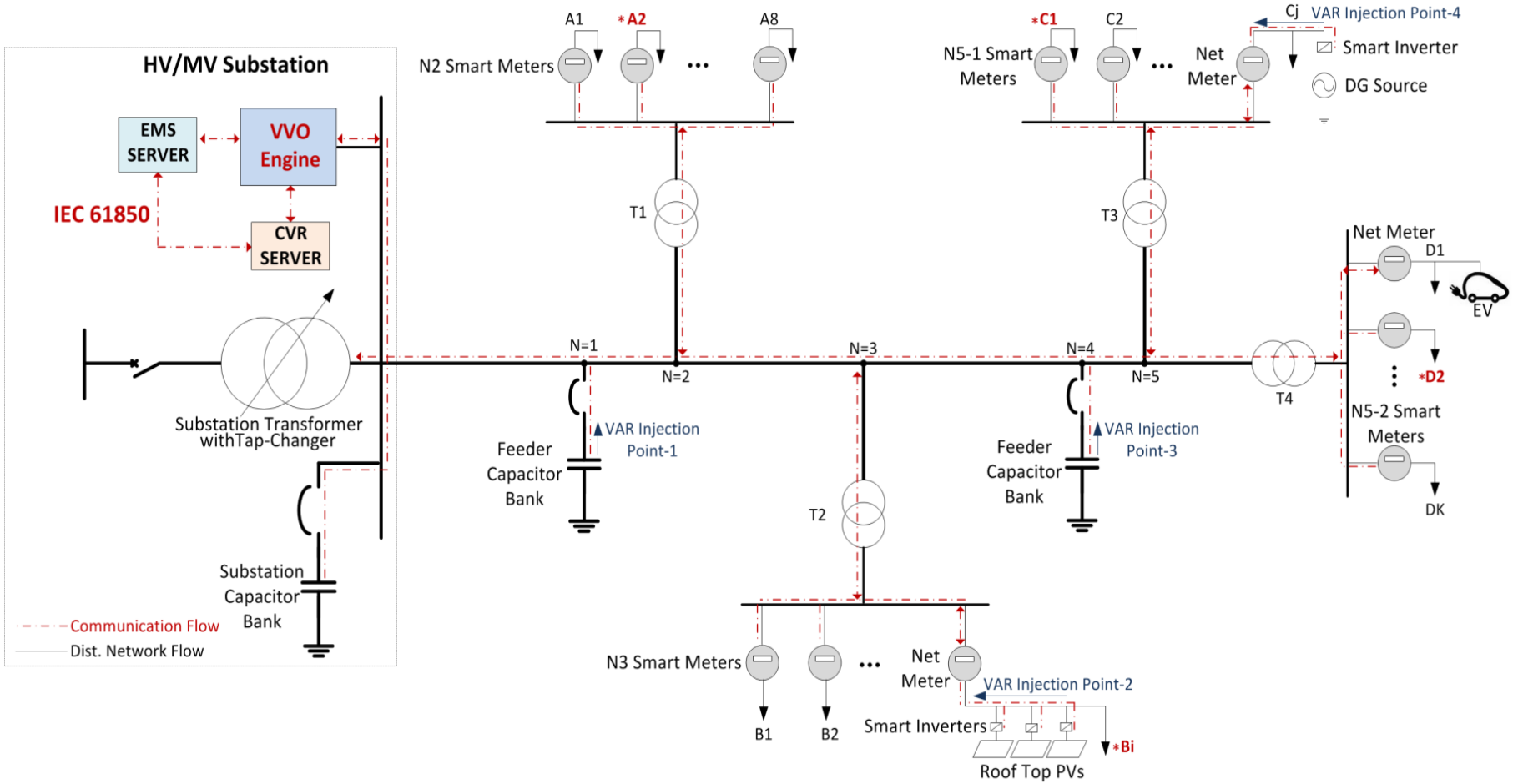
- Existing Volt/VAR Optimization Engines operate based on settings derived for Feeder Load Profiles which are Static in nature.
- The availability of real time AMI data provides an unprecedented opportunity to enhance the functionality of VVO engines based on Feeder's Dynamic Load Profile.
- Presence of distributed VVO assets across Feeders, combined with reliable two-way communication systems between VVO assets and VVO engine, enables cost-effective implementation of Real-time Adaptive VVO algorithms.

Problem:

- Most AMI systems do not provide sample points based on the requirements of Real-time Adaptive VVO algorithms
- The required data is not locally fed back to the substation
- Pole-top transformers distort and/or inhibit signal transport between termination points and the VVO engine in the substation

Solution:

- Real-Time Adaptive Optimization Engine using Multi-Agent Systems for configuration and control of VVO assets through Narrow Band Power Line Communication (NB-PLC) technology



Main structure of proposed approach for VVO

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Progress achieved todate

- Finalized the requirements for adaptive & dynamic VVO/CVR Algorithms
  - Three design assumptions based on real operating modes
  - Formulations & Equations, Objective Function & Constraints, Optimal Power Flow, Optimization Technique
  - Design VVO Engine in MATLAB
  - Pre-design of IA in MATLAB
  - Case Studies: IEEE 34 Node test feeder, BCIT Network, IEEE Standard network (CYMEDIST)
- Proposed the system of Intelligent Agents in VVO/CVR apps
- Evaluated narrow band power line communication technology for VVO/CVR application through channel characterization

Milestone

Previous Year

- Literature Review
- Know the Problems
- Find Gaps and needs
- Start working on suitable & feasible VVO algorithms
- Build partnerships with the utility industry
- Seek collaboration with private sector
- Setup supervisory team composed of university, utility and industry

This Year

- Design VVOE in 3 steps
- Optimization with GA in MATLAB
- Pre-Design IA
- Characterizing NB-PLC
- Transformer loss study
- Three Papers (IEEE Trans. Sustainable Energy, CIGRE, EPEC12)
- Studying different optimization techniques: Benders Decomposition, Gradient Function
- Considering DG impacts on VVO
- Different Case Studies

Milestone

Next Year

- Study different optimization techniques
- Study the effects of PHEVs on VVO
- Continue Transformer loss assessment
- Design Predictive VVO algorithm based on daily, seasonal and reliability factors
- Study the optimal maintenance scheduling of Volt/VAr Control devices
- Study probabilistic approaches for VVO algorithm: Monte Carlo
- Finalize NB-PLC Test
- Design IA for VVO apps
- Study VVO based on bi-directional smart meters and DGs

Final Year

- Final Design and test
- Implement the project at BCIT network
- Validate the feasibility and outcome of different algorithms
- Analysis of optimization levels for different load profiles and mixes
- VVO related to Dist. Network Planning and DMS

Partnerships with Canadian industry

- BC Hydro
  Requirements
- Maxim, ABB, Siemens
  Technologies

Links to other Projects:

- Project 3.1 Suitability of NB-PLC as Communication Medium
- Project 3.2 Goose Messaging Protocol Evaluation
- Project 3.3 Reliable Sensor Network for data capture

Team Attended:

- PES General Meeting
- Cyme Users Conference
- Utility Telecom Conference
- CIGRE 2012 Conference

Gaps and Challenges

- Access to real data
  - Utility support for access to feeder and AMI data
- Missing knowledge
  - Collaborations within and across the themes

Thank You

Questions?

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