Requirements for Hierarchical Coordinated Control and Protection of the Smart Grid

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Research Objectives

Define the overall concept for hierarchical coordinated control and protection of the smart grid.

- Examine individual control and protection schemes and determine applicability to more generalized, system wide schemes.
- Merge protection and control schemes from wide areas and various voltage levels in a hierarchical fashion.
- Determine communication system and high speed computing requirements for control and protection implementation.
- Integrate control, protection, and communication system models into a unified, but distributed structure.
- Define generalized requirements for above structure.

Importance for the Future Grid

As the grid becomes “smarter” with more data acquisition and control capabilities, a system-wide framework for designing control and protection schemes becomes increasingly important.

•System reliability can be improved through the coordination of individual control and protection schemes in a hierarchical manner.

•Integration of control, protection, and communication system design will reduce development time and engineering costs.

•Development of a protection, control, and communication framework will speed the adoption of smart devices throughout the grid.

Research Deliverables

First Year Deliverables: The communication and computation models and simulation will be completed. A white paper describing the framework developed in this thrust will be completed.

Final Deliverables: The simulation package that can simulate the IT infrastructure integrated with the power grid simulation. Test results from simulations. A final report describing the results from this task.

Research Approach

Define the communication infrastructure (Task 1):

•A publisher-subscriber communication network is assumed and its requirements for the various control and protection applications are determined.

•The most flexible communication network is defined such that all applications can be accommodated with room for growth and expansion.

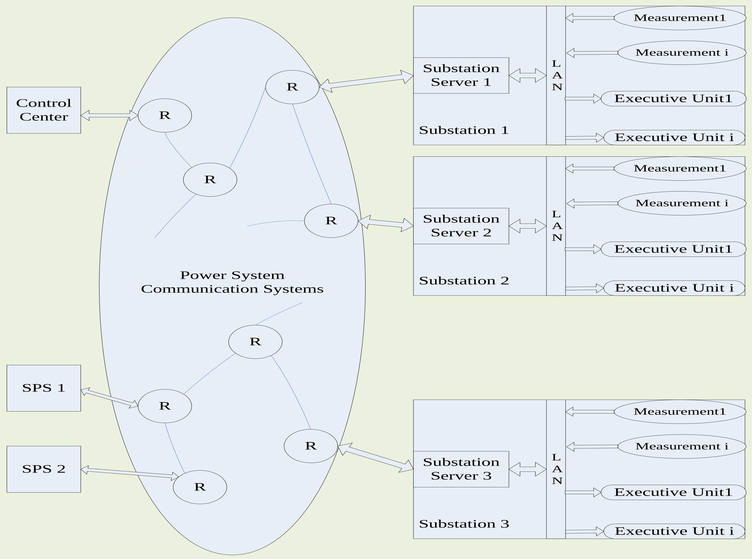


Figure 1: Proposed communication system structure

Define the computation infrastructure (Task 2):

•The computation process can be centralized to one processor or distributed over many geographical locations (substations, generating stations, etc.).

•Whether the computation for any control/protection scheme is centralized or distributed depends on the scheme itself. Thus the most flexible infrastructure needs to be developed.

Develop the simulation of the communication/computation infrastructure (Task 3):

•Such simulation packages are available but they were either developed for specific industries or are very generic packages with high overheads. It is necessary to develop this simulation to serve specifically the simulation of the power grid.

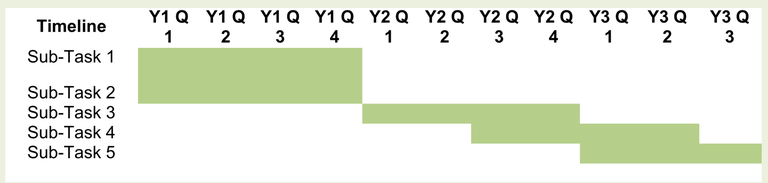
Test the IT Infrastructure simulation (Task 4):

•Such testing should be done with specific applications that are realistic.

•The purpose is to determine whether the developed simulation package can coordinate with the simulation of the power grid.

Test specific control/protection schemes from other tasks (Task 5):

•Tasks 2, 3, 4 are all developing concepts of hierarchical coordinated control and protection schemes. Some examples of these can be tested in concert with the IT simulation to test whether they work.

Project Schedule

- The sub-tasks of the project shall be completed according to the following timeline: