Internet2 Proposal for SmartGrid Infrastructure Testbed

Executive Summary

Internet2 offers a unique opportunity to SmartGrid researchers to utilize a unique, adaptable, advanced, national-scale, dark-fiber based production networking infrastructure to create an ideal prototyping environment for their research. Internet2 has the ability to support multiple DARPA projects at scale for the development of technologies and to investigate the design considerations for creating the SmartGrid environment of the future. The Internet2 network has pre-existing high-capacity private connections to research universities, government labs , industry players and leading HPC environments for advanced simulation and analysis

Internet2 Value Proposition for U.S. Smart Grid Testbed

Internet2 offers a unique resource that can be used as a foundational component to many SmartGrid infrastructure or command and control projects that may be funded by DARPA. We can create a common base networked infrastructure that can be reused and adapted to support a variety of operational requirements, while offering the opportunity to control for unwanted variability. Internet2 networking offers a number of key functions and advantages:

- A well-defined national high-speed network core based on over 15,000 miles of owned dark fiber which is lit with next generation optical equipment capable of delivering 17.6Tb/s of data, and is *separate from the commercial Internet*
- Represents an in-place ecosystem of robustly privately connected, globally leading computational resources including Department of Energy labs and top university HPC environments for ready access to advanced modeling, simulation and analysis resources
- A highly flexible, capable and robust environment that can serve as an ideal live, national-scale prototyping environment for a variety of technologies that would inform the final development of the SmartGrid in a cost-effective manner
- A testbed to address the design challenges of a national electrical grid system that responds intelligently to changing user demands, efficiently accepts and utilizes inputs from a variety of non-traditional generation sources and, critically, supports highly resilient operation in the face of disaster whether natural or manmade with end to end trust, reliability and security.

Internet2 as Prototyping Environment

Internet2 has the potential to work with the rural electrical cooperatives, which as a group control 43% of the electrical distribution miles in the US, to create a project-specific network infrastructure that is both private and extensive by leveraging the fiber resources of the cooperatives to deliver fiber-based networking to the key resources in the electrical generation and distribution system. This is a ready-made environment for real-world prototyping at scale for the development of key technologies designed to support the

command and control of the electrical grid. Because of the fiber-based networking facilities that would be deployed, the amount of data that could be transported within this system for control, management and analysis is practically limitless.

A crucial area of focus in developing the SmartGrid is the ability to secure the system. This has multiple aspects that start by eliminating the reliance of the availability of the commercial Internet for service and having a well understood accounting of the networking infrastructure. Internet2 working in concert with electrical providers and interconnecting with their fiber infrastructure can achieve these early goals. Moreover, we have ongoing dialogs with some Independent System Operators (ISOs) and with the North American Electric Reliability Corporation (NERC) about power grid regulations and security requirements to ensure relevance in our environment. Further, any network traffic that would run over the Internet2 optical network for SmartGrid projects can be isolated at the photonic level – the highest level of traffic separation and closest approximation to a purely dedicated dark fiber network that is technically possible in a system that uses a shared fiber infrastructure.

Our network environment has the benefit of being easily and absolutely quantifiable in terms of knowing the equipment and resources that would be utilized to deliver traffic, providing a key component to system security. Further, Internet2 uses optical transport equipment that has an assured supply chain where no parts are sourced from countries of concern and is JITC certified, including DOD Information Assurance testing. Internet2 can also support an optical transport card within these certified devices that includes in-flight encryption and has undergone NEBS Level 3 testing.

The network ecosystem that is represented by Internet2 with participation of the rural cooperatives, creates a completely isolated fiber-based network that could be selectively hardened, including the use of hardened EMP-resistant integrated enclosures that exceeds Mil Standard 188-125 and TEMPEST requirements for core networking equipment, throughout the prototyping phases to inform final designs and requirements. The investigation into the physical hardening aspects of a potential prototyping project would have direct relevance to developing a final implementation design, as Internet2 utilizes commercial telecommunications colocation facilities, which would be a likely component in any final design.

Next Steps
If you are interested in partnering with Internet2 as a smart grid testbed, please contact the Internet2 SVP and Chief Innovation Officer, Florence Hudson, at CINO@Internet2.edu.