Testbed Initiatives

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Cross-Cutting Effort: Testbed Initiatives

**Testbed Development**
- Hardware and software integration to support research
- Coupled system interaction
- Generic visualization of experimental results
- Automated power specific device configuration

**External Involvement**
- DETER Enabled Federated Testbeds (DEFT)
- Utility testbed interactions
- Vendor services
- Hardware and software procurement
Overview

The Big Picture Goals:

• Provide support to experimental TCIPG work
• Automate remotely requested assembly and execution of scripted experiments for broader customer base
• Coordinate with other testbeds for joint experiments

The Problems:

• Practical: integrate hardware, software, simulators, humans, testbeds
• Theoretical: manage time-scales/abstractions, accuracy

It Matters!

• Realistic evaluation of large systems in the lab
Approach

• Expand testbed facilities through purchase & donation
• Support TCIPG user community with staff support in lab
• Develop testbed federation technology
• Industrial interactions w.r.t. testbed capabilities
• Develop new tools for emulation / simulation in testbed
Impact

- Significantly increased use of facilities by TCIPG researchers
- New areas of experimental research are enabled
- Vulnerability assessment of Smart Grid protocols
- Extended capabilities of doing experimental cyber-physical system research
Impact
Activity Highlights

• Equipment acquisitions
  – AMI meters, relay, head-end
  – Hardware extension to RTDS for integrated PMU simulation
  – PDC simulation tools
  – Protocol software (DLMS/COSEM)

• New industrial donors
  – Electric Power Group, Bayshore Networks, Kalkitech
Activity Highlights

• Smart Grid Experiment Management
  – Developed generalized support for VMs
    • Servers now support 100+ general protocol stacks
  – Integration of specialized devices/simulators into DETER experimental setup

• Testbed Federation
  – Led integration of ISI/PNNL/UIUC testbeds
Federated Testbed
Illinois Component

8 Virtual PMUS
1 Hardware PMU
3 PDC Simulators
- 100 PMUS each

Federated Experiment Setup & Control
Planned Research for Coming Year

• Generalized power simulation + emulation + communication simulation
• Software controlled experiments including analog inputs/outputs
• Increased automation and usability of testbed resources
• Exploration of more cyber physical system topics (security)
  – Microgrids
  – Energy management systems