Towards Highly Dependable and Flexible SCADA Enterprise

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Motivations

- While the overall quality index of the U.S. GDP has been improving, the quality index of the manufacturing production has been on decline since early 2000 – competitiveness and productivity
- Power
  - Increasing need to monitor distribution transformers and T&D lines for real-time control and reconfiguration of power systems
  - Monitoring of power quality (harmonics, peak-to-peak values, etc.) for real-time pricing
  - Condition and event monitoring for anticipatory actions
- Healthcare – ICU, surgeries over the Internet, etc.
- Homeland security and First Responders
- Environmental monitoring
- Defense
- Nano/micro-satellite clusters

Status and Needs

- Need in shift in SCADA design paradigm
  - Cannot respond reliably under unusual conditions – blackouts – Northeast in 2003 and parts of Europe November 5, 2006
  - Not geared for large quantities of data and dense sensor networks
  - Overall dependability issues
  - Sensors and other components perform under resource constraints, harsh environments over wide geographical areas for extended time
  - Base system with different capabilities “added-on” leading to highly non-optimal systems
  - Typically does not lend itself well for distributed environments
  - To be used over many years, but not highly flexible for changing environments

Research

- Development of a comprehensive framework for dependable and flexible SCADA systems that enables incorporation of related strategies as an integral part of the design process of the system as opposed to an “add-on” components
  - Dependability – reliability, availability, safety, maintainability, performability, and testabilty
  - Flexible – modular, scalable, extensible
- Increased distributed computing power – computer and data intensive – use of reconfigurable computing
  - Inherent redundancy
  - Ease of reconfiguration to match environment
  - Cheap and lower power requirement
  - Substantial reduction in data transfer by local processing capabilities
  - CAD framework
- Hierarchical strategies for dependability

Research

- Plug-and-play capabilities for sensors and actuators – IEEE 1451 family of standards. Address dependability issues.
- Design of new sensors for real-time monitoring and control. For example, nano-sensors that can be embedded in transmission lines for temperature and monitoring other parameters. Effective automated scene analysis – changes, etc.
- Consistency of information and communication between field operators, engineers, and corporate management
- Facilitates reconfiguration of the system and controls meeting hard/soft real-time constraints
- Reconfigurable and flexible network topologies
- Visualization for effective decision making by operators, engineers, management
- Replace RTUs by WAN with local processing capabilites
- Need for both evolutionary approach for existing systems and revolutionary approach for the future systems