Safe and Secure Integration of Automation Systems and Enterprise IT Infrastructure Using Cloud

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Instead of a Talk Outline

Essentially about 2 things:

- Integration of Automation & Enterprise IT in the Cloud
- How do Safety and Security play in it?
Typical Automation System (SCADA) Architecture

Source: NIST SP 800-82, June 2011
Typical Enterprise IT Architecture

Source: www.caci.com/fcc/eit.shtml
Problems with Separate SCADA and IT Infrastructure

- IT system maintained by corporate IT
- Typically CS/CIS/IT/MIS graduates
- SCADA system maintained by process control engineers
- Typically EE/ME/ChE graduates
- Two separate maintenance hierarchies
- SCADA engineers not very familiar with IT problems and vice versa
Similarities Between SCADA and IT Systems

- Both are monitored 24x7x365
- Both have availability, reliability, safety, and security requirements
- Both have distributed nature
- Both have centralized hubs: servers in the case of IT and master terminal unit in the case of SCADA
- and ...
Similarities Between SCADA and IT Systems

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- Both can be integrated to run in the cloud
Integrating IT & SCADA using Cloud

Enterprise IT
- Laptop
- Workstation
- Intranet

Cloud
- RTU1
- RTU2
- RTUn
- Pressure
- Valve
- Flow
- Historian
- Master
Integrated Cloud-based Infrastructure

Enterprise VMs (Push Data to Clients)
Web Server
Database
Master Control
Historian
DCS VMs (Pull Data from Devices)
Virtual Machine Router

Internet

Enterprise Devices

FGCU
Integrated Architecture Advantages

- All operations handled through cloud service provider
- SCADA components and IT components integrated through the cloud
- IT components need middleware (running in cloud data center) to link them to the correct servers
- SCADA components need middleware (running in cloud data center) to link them to the correct master and historian
- Security becomes more affordable for the organization for both IT and SCADA infrastructure
- IT and SCADA can be interlinked in the cloud improving security of inter-system access
- Provides for better management of both IT and SCADA systems
When do you use Cloud?

Where is SCADA?

SCADA is in this region
Critical System Properties:

- Safety
- Security
- Reliability
- Availability
- Others

Can they be transferred to the Cloud?
Transferring Safety and Security to the Cloud

- Automation System (SCADA)
- Operational Environment (Plant)
- CLOUD
- Enterprise IT

Arrows indicating:
- Safety
- Security
- Dependability
Safety vs. Security: General View

- Safety is concerned when a technical or social system negatively affects the environment
  Latest example: Fukushima Nuclear Power Plant
- Security ...
Safety vs. Security: General View

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Safety vs. Security: General View

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  Latest example: Fukushima Nuclear Power Plant
- Security is concerned when an Environment negatively affects the technical or social system
  Latest example: wiki leaks release of classified information
- In both cases, the system must continue functioning
- In both cases, safety and security affect each other
Safety vs. Security: General View

- Safety and Security are negative properties
  This means that there are generally not measurable, since there are no computable functions that would map respective properties onto a number set
- Thus ...
Safety vs. Security: General View

- Safety and Security are negative properties
  This means that there are generally not measurable, since there are no computable functions that would map respective properties onto a number set
- The only practical way to evaluate Safety and Security is modeling:
  - modeling hazards for Safety assessment, and
  - modeling threats for Security assessment.
Example of a Modeling Architecture
Example of a Modeling Architecture

**Diagram:**
- Cloud to the Network
- Disturbances
- SCADA MTU Controller
  - Command signal
  - Controlled (Measured) Variable
- Database
- User Interface
- Plant
Example of a Modeling Architecture

- Timing Guard
  - Timing Violation

- Primary Controller
  - Response
  - Commands

- Exception Handler
  - Other Safety Violations

- State Guard

- Safety Shell
  - Response
  - Output Changes

- Protected I/O

- Physical Environment
Example of Modeling Security

Conclusion

There are multiple advantages of an integrated architecture
- Essential operations handle through cloud service provider
- IT and SCADA can be interlinked and integrated
- Better management of SCADA and IT systems

However ...
Conclusion

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Transferring Safety and Security to the Cloud requires attention:

- A cloud-based system should not affect the overall computing system safety – should professional management take care of data centers and associated hardware and software?
- A cloud-based system makes the overall computing system secure – should professionals take care of security issues at a central location?
- Enterprise IT and process control system divisions can focus on their core missions