Integrated Fire Safety Response in SCADA-LTS for Smart Engineering Facilities

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***Abstract*—This paper presents the deployment and configuration of SCADA-LTS as a supervisory control and data acquisition platform for managing critical safety infrastructure within the Engineering Building and Lecture Hall at Some State University. The primary objective of the deployment was to create an integrated, real-time monitoring environment capable of automating emergency responses—particularly fire safety protocols—across both academic and technical zones.**

Our implementation focuses on coordinated alerting, access control lockdowns, and HVAC isolation during fire events, using the server room as a high-priority case study. The server room's door interlock was configured to respond dynamically to smoke detection events by releasing magnetic locks and disabling power to sensitive equipment. These control sequences were managed centrally through SCADA-LTS using a BACnet-over-IP network architecture.

Initial results demonstrate a significant reduction in manual intervention time during simulated fire drills, enhanced traceability of alarm events, and a flexible foundation for future facility-wide automation. This case study underscores the benefits of open-source SCADA solutions in academic infrastructure environments, balancing customization, safety, and cost-effectiveness.

I. Introduction

The increasing complexity of modern educational facilities has led to a growing demand for intelligent building management systems that go beyond basic monitoring. At Some State University, recent expansions to the Engineering Building and adjacent Lecture Hall introduced new infrastructure challenges, particularly in the domain of life safety, environmental control, and equipment protection. To address these needs, we deployed SCADA-LTS, an open-source supervisory control and data acquisition system, as a unified platform for automating and overseeing safety-critical operations.

SCADA-LTS was selected for its robust support of BACnet, scalability for future building integration, and its active community-driven development. Unlike proprietary solutions that often require vendor lock-in, SCADA-LTS provided our team with full access to backend logic, enabling the implementation of complex conditional behaviors across subsystems—critical for fire safety compliance and testing.

One of the focal points of our deployment was the server room located in the south wing of the Engineering Building. This room houses network core switches, rack-mounted compute resources, and departmental file servers—all of which require both fire suppression systems and controlled access. Given the potential risks associated with electrical fires, the room was configured to execute a coordinated response sequence triggered by either smoke detection or alarm activation elsewhere in the building.

In this paper, we describe the design, deployment, and functional validation of SCADA-LTS across the engineering complex. We emphasize the fire response logic built around BACnet-connected detectors, door controls, and power panels, using the server room as a demonstrative case. Our aim is to provide a replicable model for other institutions seeking an affordable, standards-compliant approach to smart campus safety.

II. System Architecture

The SCADA-LTS deployment at Some State University was architected to support modular integration, real-time event propagation, and centralized logic management for all major building systems. The architecture followed a BACnet/IP hierarchical structure, with field devices (sensors, actuators, controllers) grouped by building zones and supervised by SCADA-LTS running on a Linux server hosted on the third floor of the engineering room. Interaction with the BACnet devices was accomplished through provided samples from the BacPypes Python library public repository.

A. Network Topology

All devices—including smoke detectors, access controllers, HVAC units, lighting panels, and door interlocks—were connected over a segmented VLAN dedicated to building automation. SCADA-LTS was assigned a static IP with unrestricted read/write privileges to the BACnet network. Device discovery was performed using BACnet global broadcast management, and all point mappings were imported into SCADA-LTS using direct UI entry.

A dedicated Modbus-to-BACnet bridge was used to integrate legacy HVAC components, while weather sensors were exposed through a local MQTT broker, feeding data into SCADA-LTS via scripted OPC nodes. Alarms, overrides, and interlocks were modeled using SCADA-LTS's native tag logic system, with write-through capabilities for event-triggered commands. The integration was tested and confirmed to be

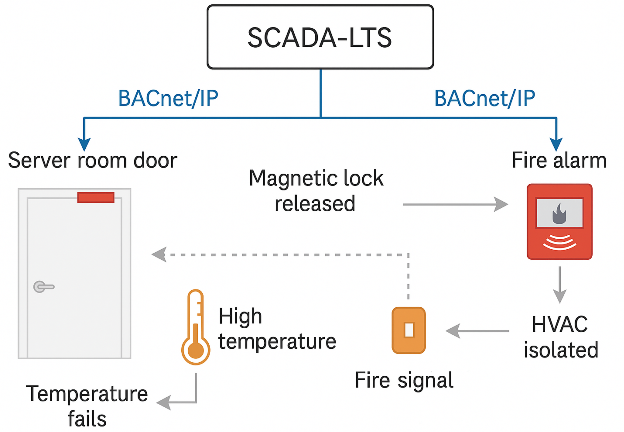

Fig. 1. Workflow for Server Room Door Opening in Emergency Personnel

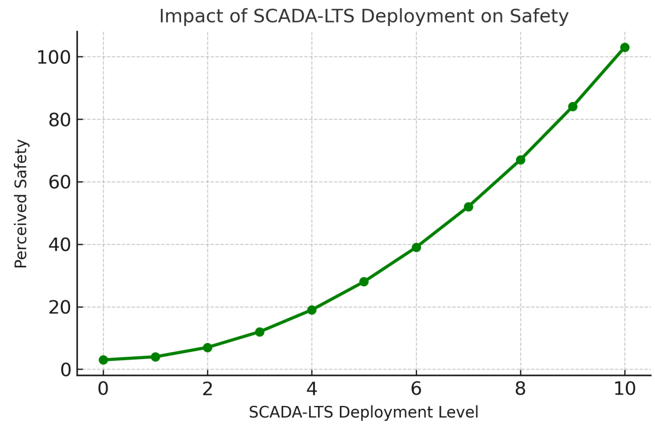

Fig. 2. Presumed Impact of SCADA-LTS Deployment on Safety

functional using the provided samples from the BacPypes Python library public repository.

B. Fire Safety Focus

The fire safety logic was distributed across multiple BACnet points but coordinated centrally. The system has been designed to automatically react in the case of catastrophic failure. The process occurs in individual steps, with corresponding actions depending on the severity. The catastrophic conditions are as follows:

1) The temperature of the server room rises above the alarm threshold.
2) A fire signal is sent (including test alerts).
3) The smoke dampers fail to deploy
4) The HVAC system fails.

If all four conditions are met, the system will be considered to have catastrophically failed. In the event of catastrophic failure, the system will release the magnetic locks on the server room. This grants access to emergency personnel and first-responders. The SCADA-LTS interface provided operators with real-time visibility of all active fire events, including zone, timestamp, and control status. All event logic was logged with audit trails, and test modes could be triggered from the UI to simulate scenarios without disrupting daily operations.

C. Visualization and Alarming

SCADA-LTS's built-in HMI editor was used to design custom screens for each floor of the Engineering Building and Lecture Hall. Symbols for alarms, door status, and temperature readings were overlaid on digital floor plans, enabling at-a-glance diagnostics. A global alarm summary panel consolidated critical events, allowing users to acknowledge or silence events and generate time-stamped reports for regulatory compliance.

III. Conclusion

The SCADA-LTS deployment at Some State University's Engineering Building and Lecture Hall demonstrates the feasibility and benefits of using open-source SCADA platforms in academic infrastructure. By integrating systems across lighting, HVAC, access control, and fire safety, we achieved a unified monitoring and response framework that is both cost-effective and adaptable.

The case study of the server room illustrates how conditional logic and BACnet interoperability can be used to create nuanced, multi-step safety procedures. In particular, the system's ability to escalate responses based on thermal and equipment failure conditions ensures a more resilient reaction to emergencies than fixed-script systems. The use of SCADA-LTS also enabled detailed event auditing, real-time status visibility, and non-disruptive test mode execution—critical for both safety assurance and ongoing campus operations.

This project underscores the value of accessible, programmable SCADA solutions in higher education environments, particularly when tailored to domain-specific risks like laboratory hazards or server room failure. Future work will explore expanding the SCADA-LTS deployment to additional campus buildings, integrating predictive analytics, and evaluating its performance during multi-zone emergency drills.