



AI-Enabled IoT-Based Platform to Deliver Energy Efficiency and Grid Services for Commercial Buildings

Srinivas Katipamula, Robert Lutes, Roshan Kini, Ronald Underhill, Linda Sandahl and Terry Herr*

Field Validation Challenge

As much as 30% of the 18 Quads (19 EJ) that commercial buildings in U.S. consume is considered excess due to inefficient building operations:

- Automation systems that control building systems often are not operating optimally.
- Inefficient operation increases energy consumption and may also impact occupant comfort.
- Re-tuning™ of automation systems offers substantial energy-savings opportunities—at little or low cost

Many cities and states mandate periodic “tune-ups” or Re-tuning to eliminate excess energy consumption.

Approach

- Recruited Intellimation, a firm providing services to commercial buildings with automation system.
- “Taught” Intellimation staff to deploy the IoT platform, Eclipse VOLTTRON™, and EE and GS applications.
- **EE**: Automated Fault Detection and Diagnostics (AFDD) for air-handlers and Automated Identification of Re-tuning or Retro-commissioning (AIRCx) measures.
- **GS**: Intelligent Load Control (ILC).

Impact

- Showed EE applications (AFDD and AIRCx) and GS application (ILC) can be scalably deployed.
- In an office building, implementing the measures (e.g., supply-air temperature and pressure reset, managing schedules) identified by AIRCx would result in 17% whole building energy savings.
- In a high school, implementing the measures identified by AIRCx would result in 20% whole building energy savings.
- Successfully implemented ILC to manage peak electricity consumption but could not document peak load reduction due to lack of whole building meters.

Lessons Learned

Even though both buildings have BASs, we noted several issues:

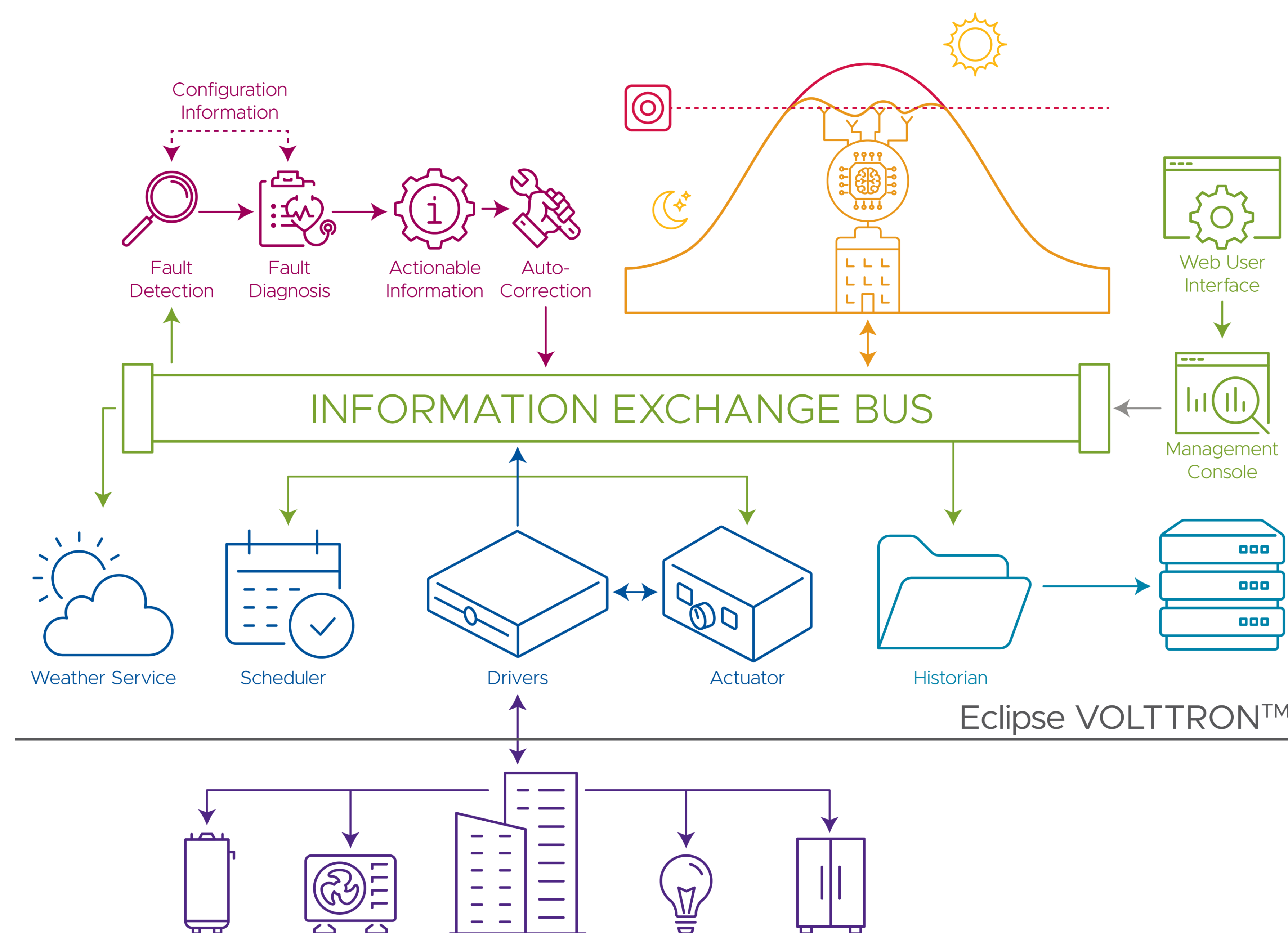
- Lack of standard BAS point naming convention
- Lack of use of advanced control sequences
- Sometimes each zone controller had several virtual set points; it was not clear which of the set points controlled the damper.
- Lack of whole-building power impedes PLM.
- Lack of net meter in a building with solar impedes PLM.

Goals

Show that IoT-based platform can host applications to identify energy efficiency (EE) opportunities and deliver grid services (GSs) cost-effectively and support climate change mitigation.

Offer a technology solution to improve operating efficiency of commercial buildings 10%-30% and simultaneously reduce energy cost 10%-20% through peak load management (PLM). An IoT-based solution to meet “Tune-Up” mandates will:

- Be more cost-effective and result in persistence of building operations.
- Increase the ROI, as PLM application can also simultaneously provide grid services.
- Address workforce shortage.



PNNL's Eclipse VOLTTRON™ platform enables deployment of automated diagnostics, automated Re-tuning and automated grid services

*Project Partner: Intellimation

Status

Field validation of IoT-based platform to deliver EE and GS in two buildings in Washington, D.C., has been successfully completed. The pilot showed EE applications can identify opportunities to improve operating efficiency. The GS application was also successfully deployed but magnitude of demand reductions was not quantified.

