



Low-Cost Open Platform For Monitoring and Control of Buildings (VOLTRON)

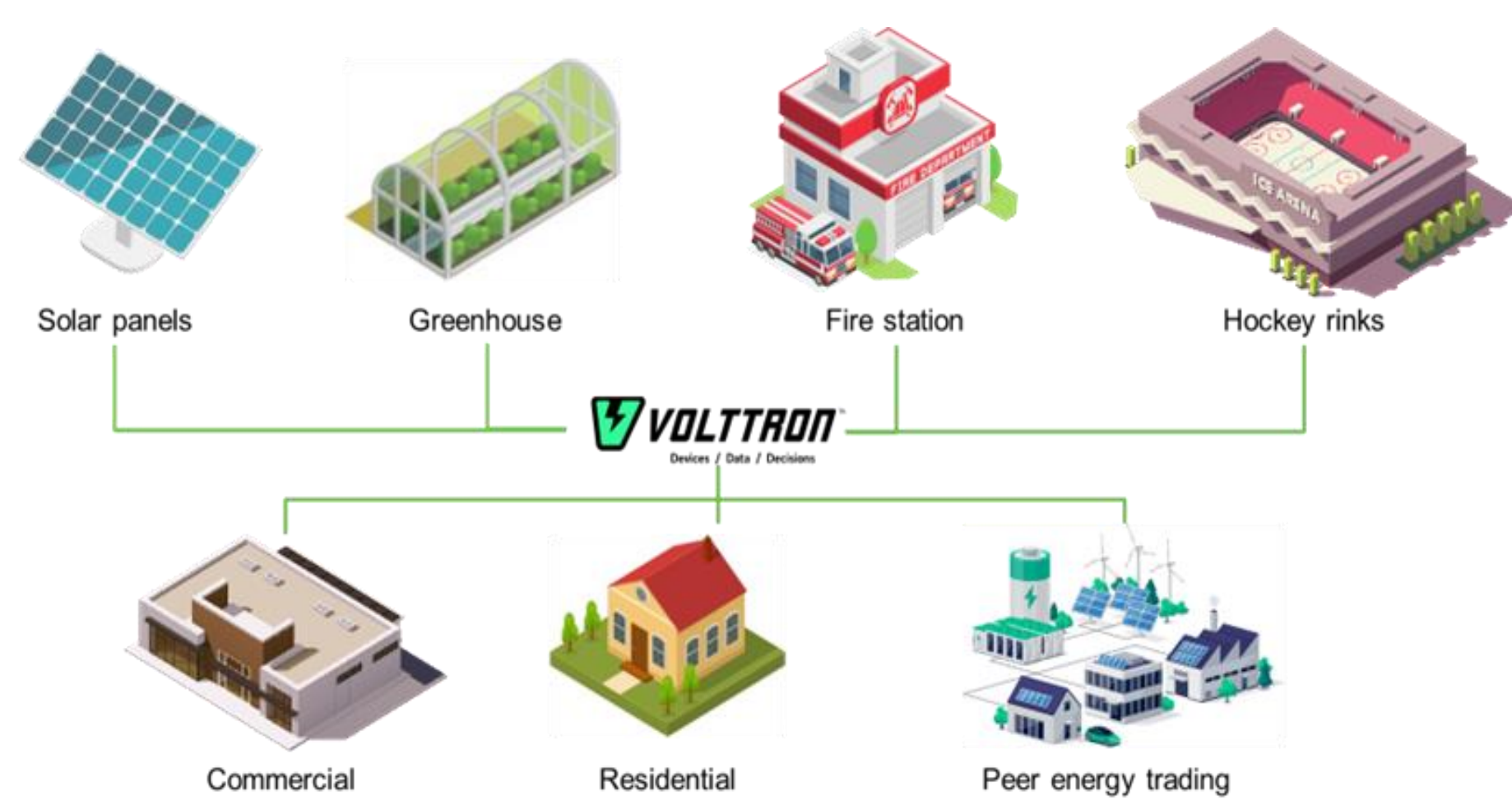
Shwetha Niddodi – Principle Investigator; Jereme Haack – Project Manager

Challenge

- Achieving BTO's vision for a net-zero U.S. building sector by 2050
 - Addressing **small and medium commercial buildings (SMCBs)** without “built-up” multi-component HVAC and Building Automation Systems (BAS). These are 82% of commercial buildings, 55% by floor area.
 - Promoting energy equity by enabling energy savings and improved performance in SMCBs in underserved communities (including schools)
 - Increasing building demand flexibility and improve building participation in decarbonization, energy efficiency, and grid response strategies
- Monitoring and control can be part of the solution, but addressing this market will require
 - Reducing cost of developing and deploying new monitoring and control products
 - Reducing barriers to entry associated with proprietary platforms: vendor lock-in, data ownership questions, and high costs

Project Goals

- Enable control in SMCBs to accelerate deployment of energy efficiency and grid service application to support decarbonization
 - Provide a secure, functional platform that can act as a starting point for solutions
 - Reduce solution development time and effort
 - Jumpstart developers who can focus on turning their algorithms into deployable applications
- Lower barrier of entry for non-software-focused companies
 - Streamline and simplify the platform's remote configuration and monitoring capabilities
 - Build up a collaborative community of users who inform and contribute to the development of the platform and its use cases



Approach

Flexible Deployment Solution

- Enable easy and flexible VOLTRON platform deployment options for RTU, non-BAS, BACnet, and many other use cases

Simulation Integration

- Integration with simulation tools (BOPTest) for easy testing before field deployment

Data Collection and Storage

- Framework for adding new protocols for communication with a range of devices
- Integration with utility signals allowing the applications to participate in utility strategies

Security

- Community engagement to educate on security best practices
- Develop Threat Profiles for community deployment use cases

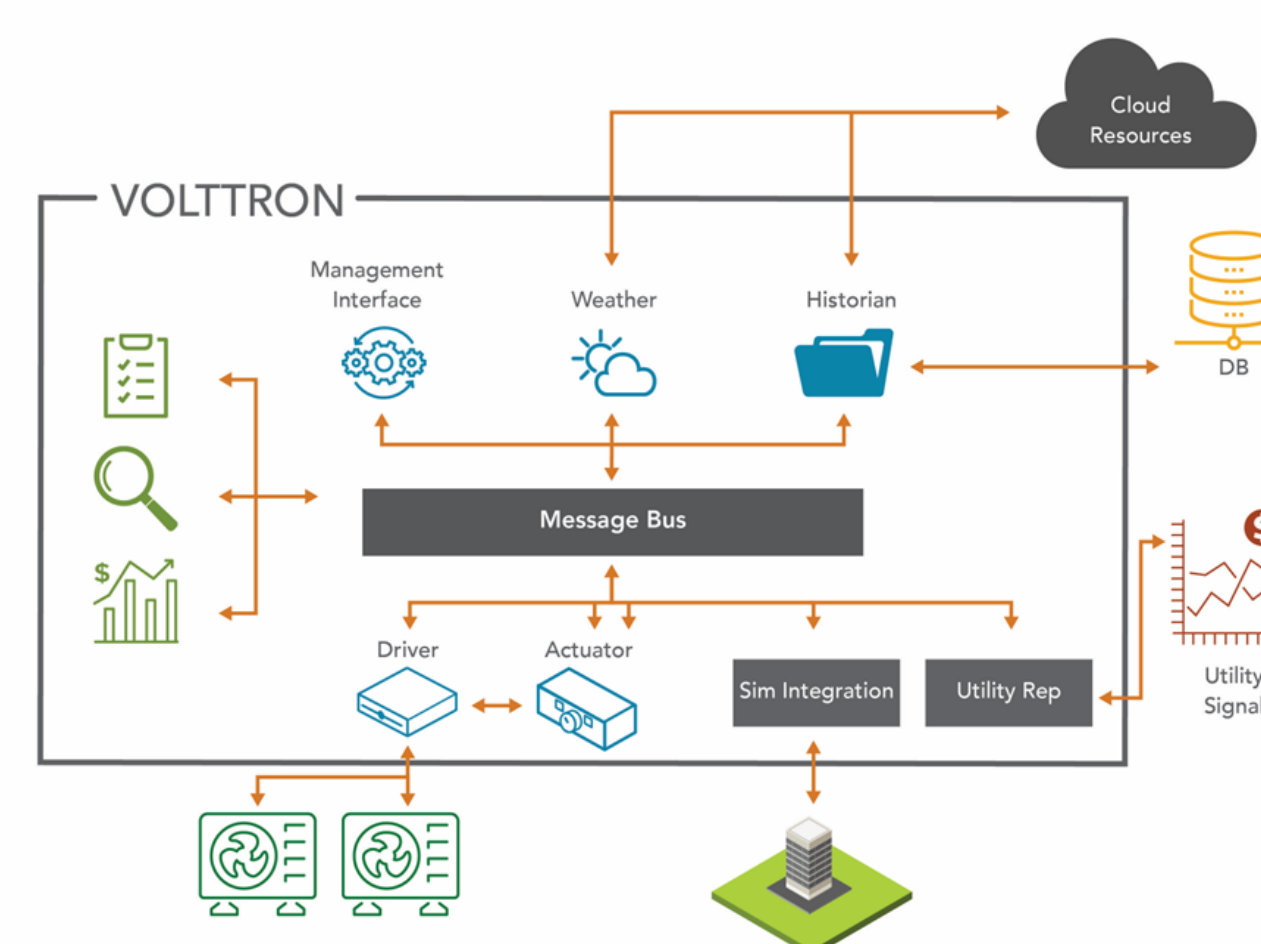
Semantic Interoperability Support

- To enable development of vendor neutral solutions with standardized data models

Outreach

- Build a community of users which can inform development directions, contribute back features, assist with testing, and collaborate

What is VOLTRON?



- **VOLTRON:** a secure “operating system” for monitoring and control applications
- Not a specific monitoring or control application itself
- Lightweight, can run on off-the-shelf, low-cost computers, e.g., Raspberry Pi
- Publish-subscribe (pub-sub) message bus architecture
- Supports aggregation of multiple instances
- Library of protocol drivers, e.g., BACnet, Modbus
- Extensible data storage, e.g., locally, database, cloud
- Library of “utility” agents, e.g., weather, historian
- Integration with simulation for pre-deployment testing
- Secure
- **Also: open-source**
- Applications contributed by labs, academia, industry
- No vendor or software lock-in, no black boxes
- Community of users ready to collaborate

VOLTRON In Research and Real-World Deployments

Utility Collaboration

PNNL-Edo-Avista Collaborative Research – Eco district field demonstration of technologies that advance commercial building energy efficiency and transactive control (TC) of distributed energy resources (DERs)

National Lab Research

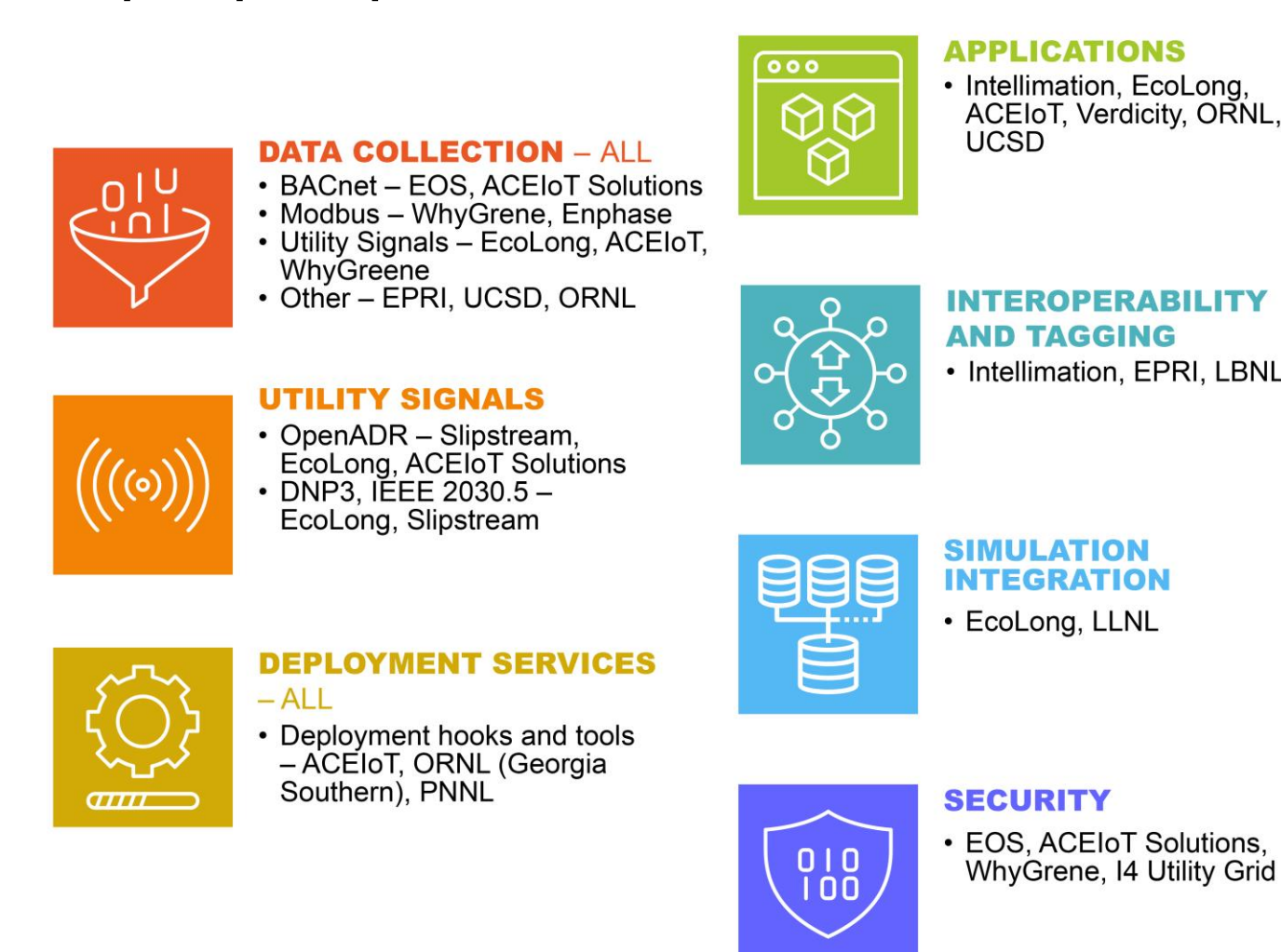
ORNL's Smart Neighborhood – Optimize each home's HVAC, water heating (WH) system to minimize cost while maintaining occupancy energy comfort. VOLTRON is used as underlying platform for data collection and control of home's HVAC and WH systems

Industry Adoption

AceIoT leverages VOLTRON on their commercial building gateway to - “provide customers with low cost approaches to acquire, access and manage data from distributed control systems and sensors”

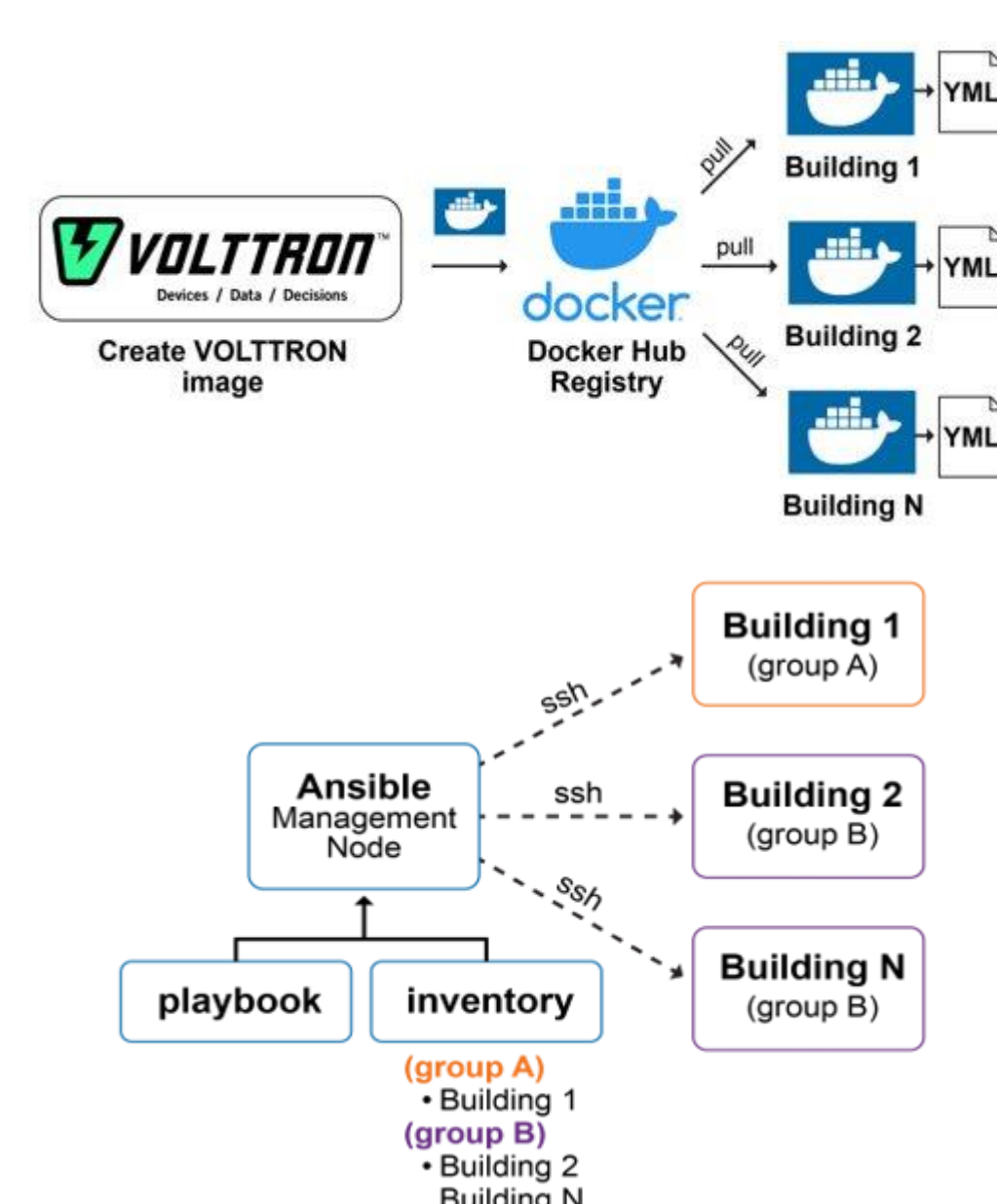
Community Outreach

- Organizations focus on varied combinations of features depending on their use case
- Regular Office Hours and quarterly User Meetings to provide technical support, showcase new features, encourage feature adoption
- Industry engagement in Working Groups helps set technical direction, contribute early feedback, assure multiple perspectives



Deployment Services

- Need standardized mechanism to install, manage and monitor scaled deployments
- VOLTRON docker images provide reproducible way to install VOLTRON and applications
- Ansible-based VOLTRON deployment provisions better infrastructure management



Follow-on Work

- Focus on enabling non-BAS buildings with legacy devices to participate in energy applications
- Identify community members for field demonstrations and early adopters
- Determine long term support strategy with community

National (and International) Impact

- Wide range of users from across industry, academia, and national laboratories
- Diverse use cases include data collection from single buildings, greenhouses, hockey rinks, etc. to multiple buildings across a wide geographic area
- Open source project allows community members to collaborate and leverage specialties.

