Purpose and Objectives

• Buildings consume over 40% of the total energy consumption in the U.S. Over 90% of the buildings in the U.S. are either small-sized (<5,000 square feet) or medium-sized (between 5,000 sf and 50,000 sf). These buildings typically do not use Building Automation Systems (BAS) to monitor and control their building systems from a central location.

• Building air quality - beyond energy efficiency. Covid related concerns.
An Open Architecture IoT Platform for Building Energy Efficiency

A Building Energy Management Open Architecture Software solution that is engineered to improve sensing and control of all IoT-enabled equipment in commercial buildings.

Monitoring and control:
Three major loads in buildings
• Heating, Ventilation, AC
• Lighting loads
• Plug loads

Improves building air quality and provides energy efficient operation

Platform supports multiple IoT devices through industry standard protocols and communications technologies
Multiple-protocol Interoperability

Communication Technologies
- Ethernet (IEEE 802.3)
- Serial Interface (RS-485)
- ZigBee (IEEE 802.15.4)
- WiFi (IEEE 802.11)

Data Exchange Protocols
- BACnet (IP and MS/TP)
- Modbus (RTU and TCP)
- Web (e.g., XML, JSON, RSS/Atom)
- ZigBee API
- Smart Energy (SE)
- OpenADR (Open Automated Demand Response)

A Cloud-based Platform for Campus-wide Applications
IoT Platform Deployments in Four Buildings

**Building 1 – VT Classroom Building**
- Location: Alexandria, VA
- Demonstration: HVAC, plug load control

**Building 2 – Equipment Bureau Building**
- Location: Arlington, VA
- Demonstration: Lighting control

**Building 3 – VT Lab Building**
- Location: Blacksburg, VA
- Demonstration: HVAC control

**Building 4 – PG County Community Building**
- Location: Camp Springs, MD
- Demonstration: HVAC control

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**Building 1 – VT Building in Alexandria, VA**

- **Alexandria, Virginia, USA**
  - Area: 25,000 SF
  - Energy: 14-25 MWh/mo.
  - Peak load: 61 kW
Classroom under Real-time Monitoring

- Power meter
- Environmental sensor (CO2, noise, temperature, RH)
- BEMOSS core
- Plug load controller
- Thermostat
- Motion sensor
- Environmental sensor

Indoor Environmental Monitoring

- Bemoss Core: Weather_Sensor21
- Indoor Environment Status:
  - Temperature: 71.4°F
  - Humidity: 22.0%
- Outdoor Environment Status:
  - Temperature: 74.3°F
  - Humidity: 49.0%
Commercial Building Ventilation

IoT sensors Indoor Air Supply Lines

Outdoor Air Intake

Using WiseBldg, Building Operator saved 27% on HVAC consumption alone

| Location: Alexandria, VA  
| Area: 25,000 square feet  
| Deployed Devices:  
| • 6 Thermostats  
| • 6 Power meters  
| • 1 Li-ion battery  
| • 1 Environmental sensor  
| Summer Months (June-July-August)  
| Compressor consumption 2014 (Before WiseBldg) | 8,340 kWh  
| Compressor consumption 2016 (After WiseBldg) | 6,071 kWh  
| Average savings | 26.8% savings  

Energy and Peak Savings from HVAC Control

- **Base case (w/o WiseBldg):**  
  - Setpoint: 74 deg F  
  - Energy usage = 2.72kWh  
  - Max demand = 3.98kW

- **Managed by WiseBldg:**  
  - Setpoint: 77 deg F  
  - Energy usage = 1.42kWh  
  - Max demand = 0.5kW
Office Building, Arlington, Virginia

Energy Savings from Lighting Control

Location: Arlington, Virginia
Area: 5,000 sqft.
Deployed Devices
- 3 Lighting controllers
- 1 Power meter

An average energy savings of 35% was achieved through dimming control

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Solar PV System Monitoring and Control

User Interface
Managing Battery Storage

Battery Storage Data Access
Battery Storage Monitoring & Control

What makes a Building Smart

A single platform for monitoring and control of HVAC, lighting, water supply, sensor networks, security camera & fire emergency

Additional Benefits Beyond Energy Efficiency

**Measured energy savings across deployments**

- **20%** HVAC Energy Savings  
- **25%** Lighting Energy Savings

**Improved operations and maintenance:** WiseBldg analytical platform enables operators to detect faults when devices operate outside standard thresholds enabling building operators to investigate prior to device failure.

**Occupant satisfaction:** spaces controlled by WiseBldg have been more comfortable due to more consistent temperature profiles and healthier air quality through consistent monitoring of environmental factors (CO₂ levels, PM 2.5, SARS Cov-2).
Thank You

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IEEE President Election
www.ieee.org/elections

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