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.

• WiseBldg platform facilitates energy efficiency applications in commercial buildings using a very simple and scalable building automation system (BAS).
BEMOSS is a Building Energy Management Open Architecture Software solution that is engineered to improve sensing and control of all IoT-enabled equipment in commercial buildings.

- **Three major loads in buildings**
  - Heating, Ventilation, AC
  - Lighting loads
  - Plug loads

- **Monitoring and control:**

- **Value:**
  - Improves energy efficiency and facilitates peak load savings in buildings

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)

Software Platform for Campus Applications

- DR Event
- Pricing
- Billing

- HVAC
- Lighting loads
- Plug loads
- Sensors/power meters
- Water meters
- PV & storage
- Security camera
We can make an old building smart

Customers controlling buildings optimized for savings

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).
WiseBldg 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

Building 1 – VT Building in Alexandria, VA
- Area: 25,000 SF
- Energy: 14-25 MWh/mo.
- Peak load: 61 kW

Alexandria, Virginia, USA
Classroom under Real-time Monitoring

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

Indoor Environmental Monitoring

- Bemoss Core: Weather_Sensor21
- Temperature: 71.4°F, 74.3°F
- Humidity: 22.0%, 49.0%
- Pressure: 30.65 Pa, 30.65 Pa
- CO₂: 484.0 ppm, 484.0 ppm
- Noise: 47.0 db, 47.0 db
Using WiseBldg, Building Operator saved 27% on HVAC consumption alone.

Summer Months (June-July-August)

<table>
<thead>
<tr>
<th>Description</th>
<th>Energy Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor consumption 2014</td>
<td>8,340 kWh</td>
</tr>
<tr>
<td>Compressor consumption 2016</td>
<td>6,071 kWh</td>
</tr>
<tr>
<td>Average savings</td>
<td>26.8% savings</td>
</tr>
</tbody>
</table>

Temperature profile BEFORE WiseBldg Demand Reduction
Temperature profile AFTER WiseBldg Demand Reduction

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

Office building size: 5,000 sqft
Using WiseBldg the building operator reduced HVAC consumption by 27%.

**Location:** Arlington, VA  
**Area:** 5,000 sq ft

**Deployed Devices**
- 3 Lighting controllers
- 1 Power meter

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

<table>
<thead>
<tr>
<th>Month</th>
<th>Total Measured Energy Consumption (kWh)</th>
<th>Total Calculated Energy Consumption without Dimming (kWh)</th>
<th>Energy Savings by Dimming (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2016</td>
<td>264.37</td>
<td>399.90</td>
<td>33.89%</td>
</tr>
<tr>
<td>November 2016</td>
<td>278.13</td>
<td>423.78</td>
<td>34.37%</td>
</tr>
<tr>
<td>December 2016</td>
<td>280.76</td>
<td>426.40</td>
<td>34.16%</td>
</tr>
<tr>
<td><strong>Total (October-December)</strong></td>
<td><strong>823.26</strong></td>
<td><strong>1250.08</strong></td>
<td><strong>34.14%</strong></td>
</tr>
</tbody>
</table>

**Note:** Scheduled dimming level from 6:30am to 9:00pm. Open office area A: 50%; Open office area B: 45%; Chief office’s desk area: 60%; Chief office’s meeting area: 50%; Conference room A: 50%; Conference room B: 45%. Lights are off after 9:00pm.
Solar PV System Monitoring and Control

User Interface

Smart inverter control
Managing Battery Storage

Battery Storage Data Access
Battery Storage Monitoring & Control

Thank You
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IEEE President-elect Candidate 2021