



Emerging Technologies for IoT Applications in Buildings

Invited Lecture

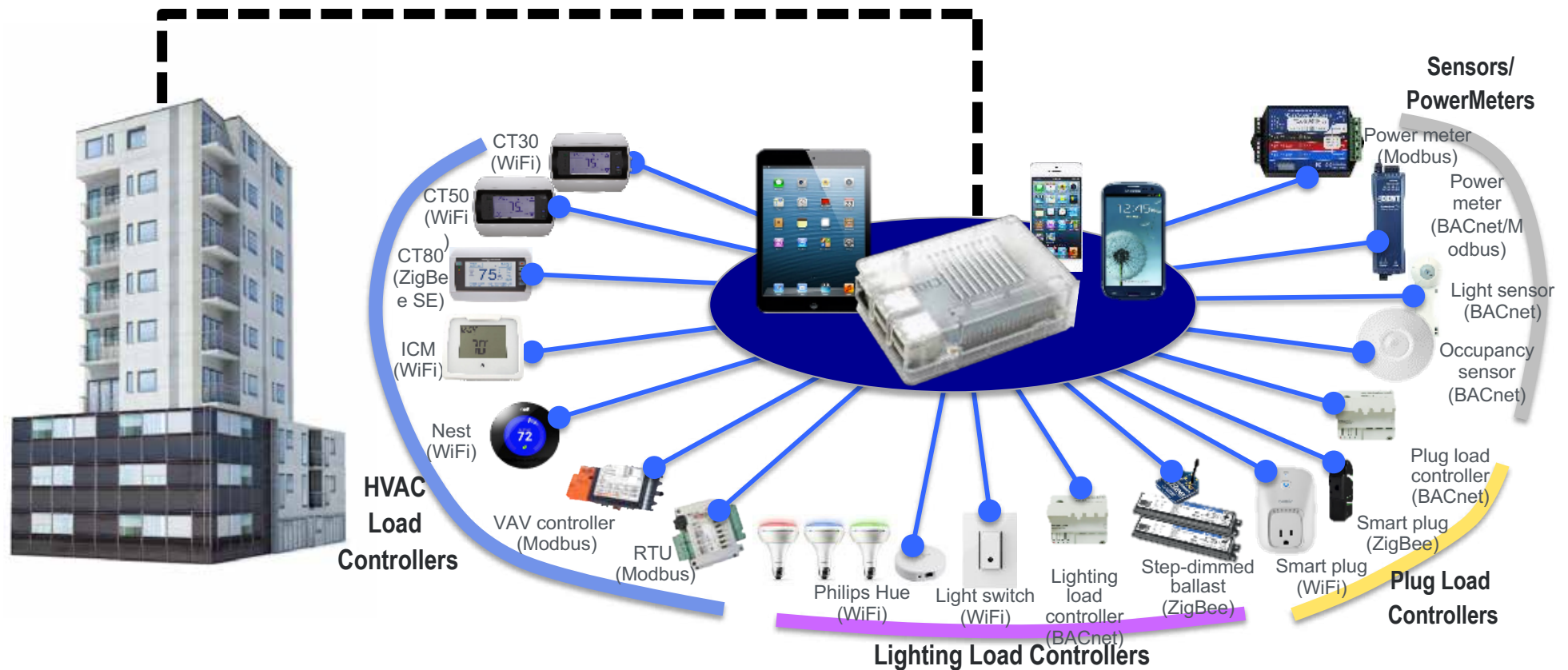
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Director, Virginia Tech Advanced Research Inst., USA

President, IEEE Power & Energy Society 2018 & 2019

IEEE Norway Section AGM, 15 January 2021

BEMOSS 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)

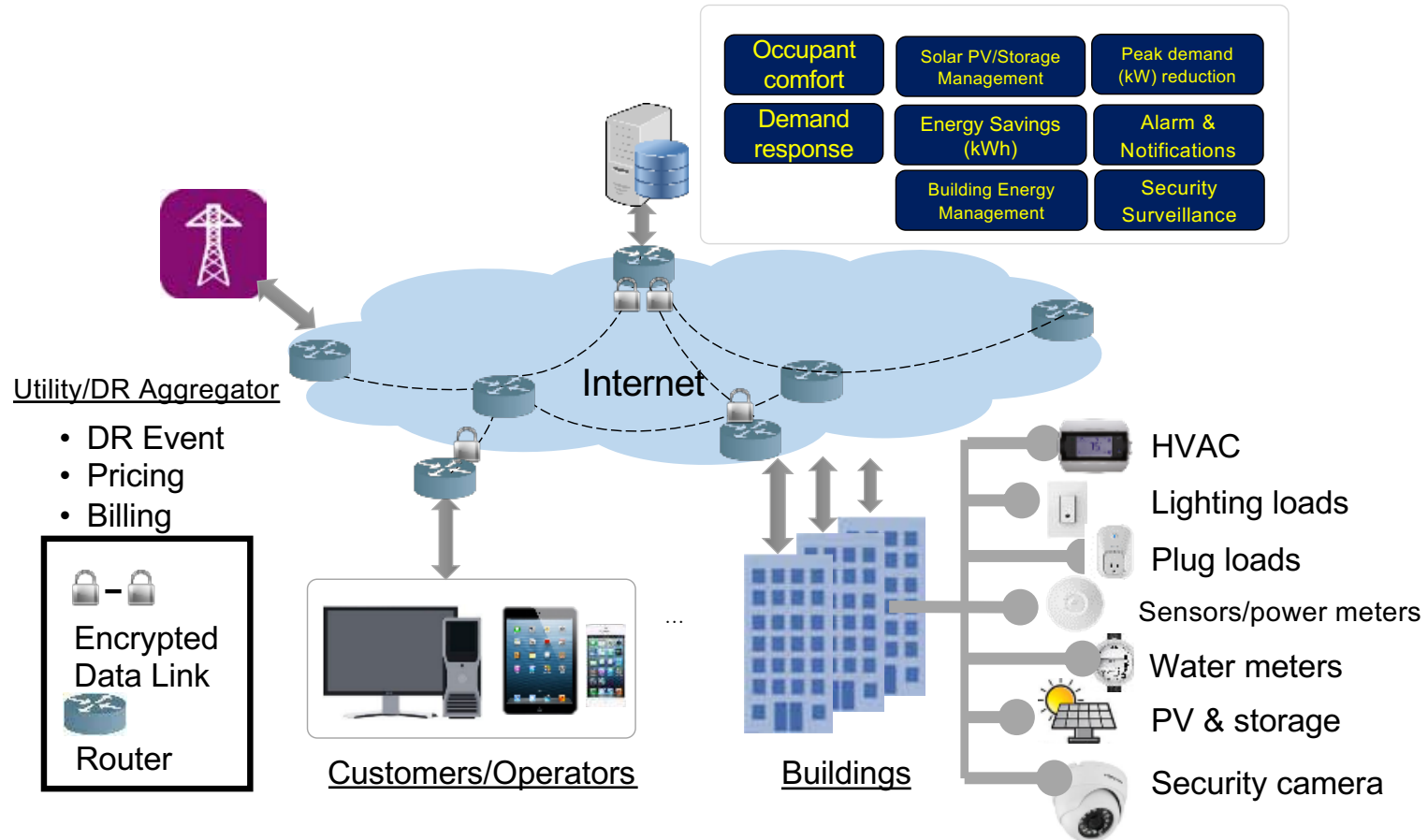


Data Exchange Protocols

- ☐ 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)



WiseBldg Platform Built by BEM Controls



www.bemcontrols.com

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

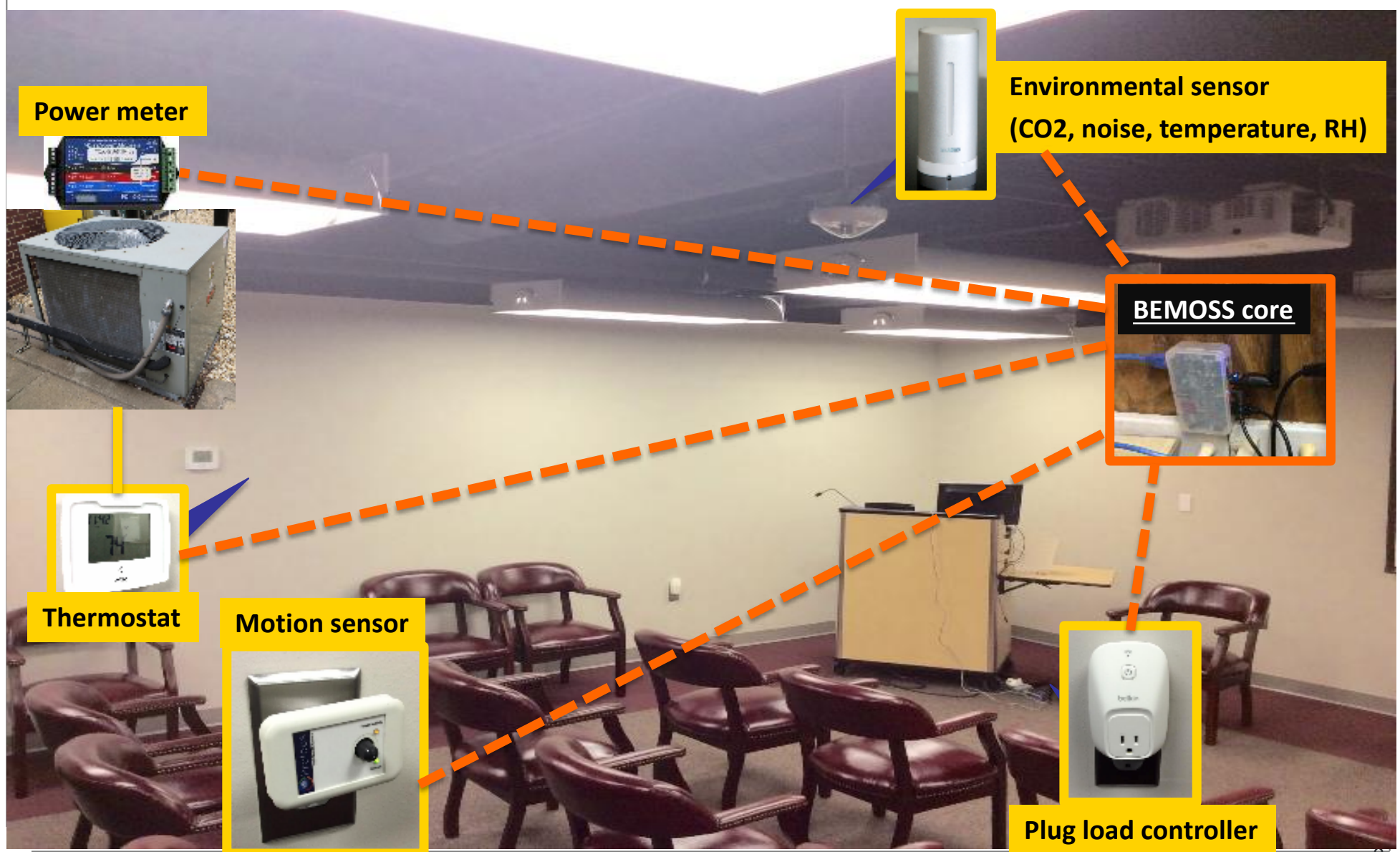
Building 1 – VT Building in Alexandria, VA

Alexandria, Virginia, USA



Area: 25,000 SF
Energy: 14-25 MWh/mo.
Peak load: 61 kW

Classroom under Real-time Monitoring



Indoor Environmental Monitoring

BEMOSS

15 Admin Log Out

- HOME
- DISCOVER NEW DEVICES
- DISCOVER/MANAGE 6
- NETWORK STATUS
- ALARMS & NOTIFICATIONS
- MANAGE USERS 1
- MISC SETTINGS
- BEMOSS CORE

Bemoss Core : Weather_Sensor21

Indoor Environment Status

TEMPERATURE

71.4°F

HUMIDITY

22.0 %

PRESSURE

30.65 Pa

CO2

484.0
ppm

NOISE

47.0 db

Outdoor Environment Status

TEMPERATURE

74.3°F

HUMIDITY

49.0 %

MAXIMUM RECORDED
TEMPERATURE

74.3°F

MINIMUM RECORDED
TEMPERATURE

74.3°F

Date Recorded: Wed, 15 Jun 2016,
16:25

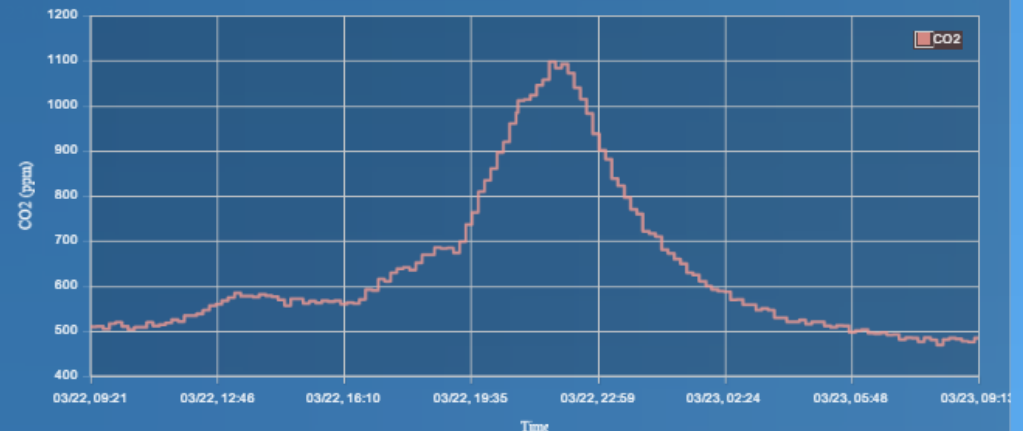
Date Recorded: Wed, 15 Jun 2016,
16:25

MINIMUM RECORDED
TEMPERATURE

71.4°F

Date Recorded: Wed, 15 Jun 2016,
16:25

Weather_Sensor21 : CO2



Office Building, Arlington, Virginia



Office building size: 5,000 sqft

Energy Savings from Lighting Control

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

Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	AVERAGE
33.7%	33.9%	34.4%	33.4%	35.9%	36.2%	35.0%	36.0%	36.3%	34.5%

Energy Savings by controlling light intensity

Month	Total Measured Energy Consumption (kWh)	Total Calculated Energy Consumption without Dimming (kWh)	Energy Savings by Dimming (%)
October 2016	264.37	399.90	33.89%
November 2016	278.13	423.78	34.37%
December 2016	280.76	426.40	34.16%
Total (October-December)	823.26	1250.08	34.14%

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



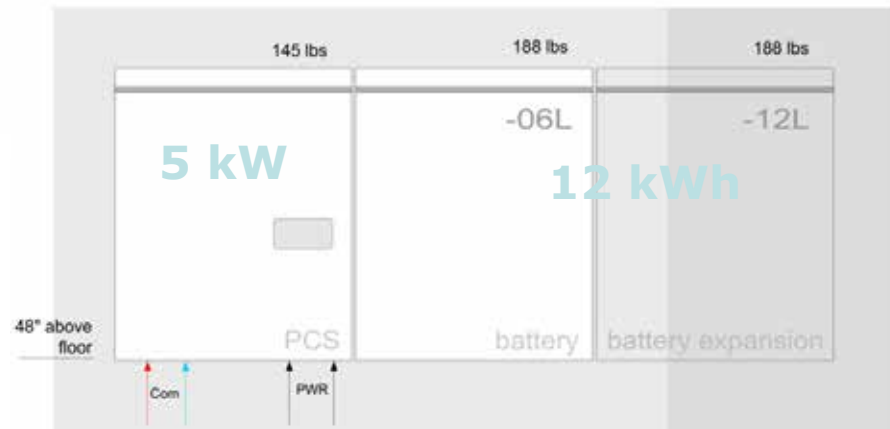
WiseBldg User Interface



Managing Battery Storage from WiseBldg Platform



Battery Cells  **LG Chem**



Battery Storage Data Access from WiseBldg



Battery Storage Monitoring & Control



IEEE President-elect 2022 Signatures for Petition

IEEE Petitions Available for Signing

Welcome **Saifur Rahman** IEEE Member Number: **06871909** Region: **2**

<u>Position</u> ↑	<u>Name</u>	<u>Sign</u>
2022 IEEE President-Elect	Thomas M. Coughlin	Click here to sign petition
2022 IEEE President-Elect	Saifur Rahman	Click here to sign petition

1 - 2

Logout From Petitions