

Energy Efficiency in Smart Buildings through IoT Sensor Integration


Keynote Speech

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ICAICT Conference, Dhaka, Bangladesh, 28-29 Nov 2020

1




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).

2

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2

An Open Architecture Platform for Building Energy Efficiency

BEMOSS is a Building Energy Management Open Source Software solution that is engineered to improve sensing and control of all IoT-enabled equipment in commercial buildings

www.bemcontrols.com

Monitoring and control:

- Heating, Ventilation, AC
- Lighting loads
- Plug loads

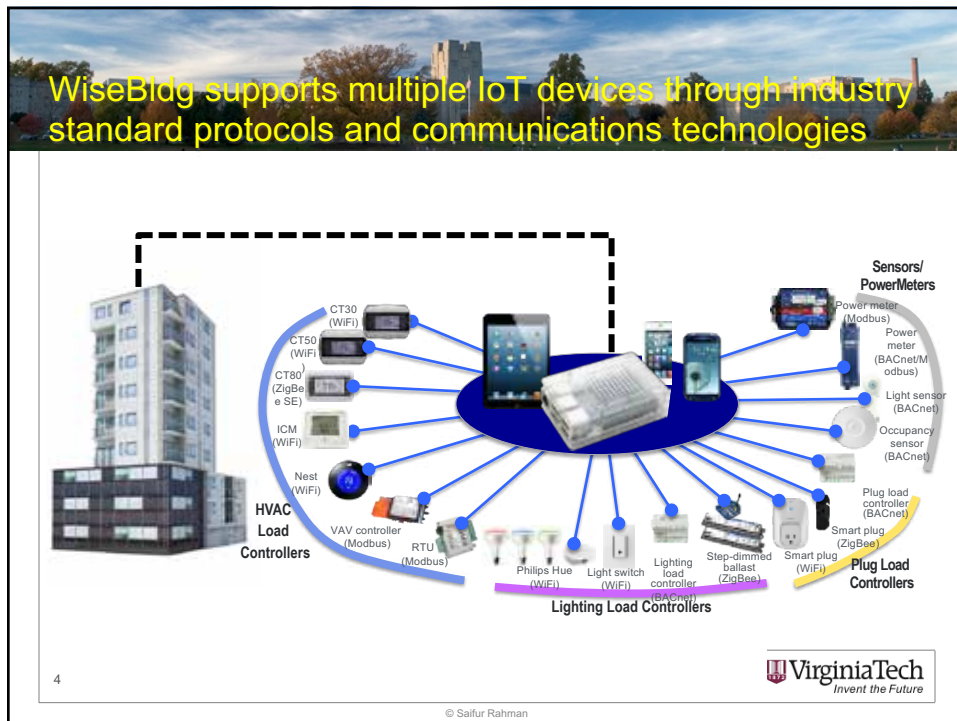
Value: Improves energy efficiency and facilitates peak load savings in buildings

3

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4

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)



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What makes a Building Smart



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

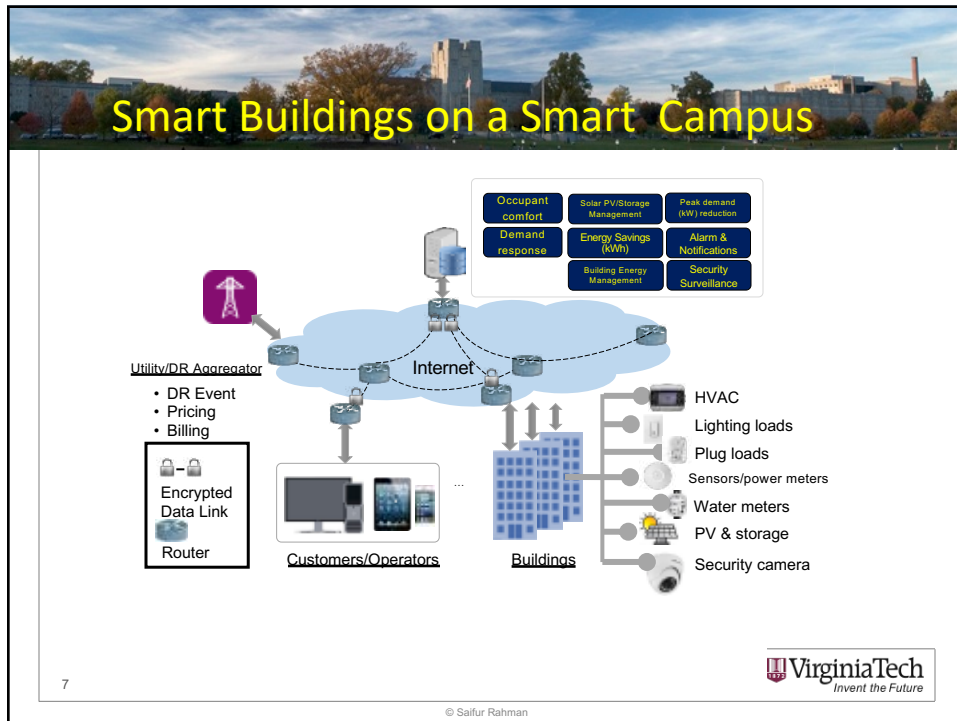
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Source: Smart Building Market To Grow 30% by 2020, <http://www.itsolutionprovider.com/smart-building/smart-building-market-to-grow-30-by-2020>, December 2015.

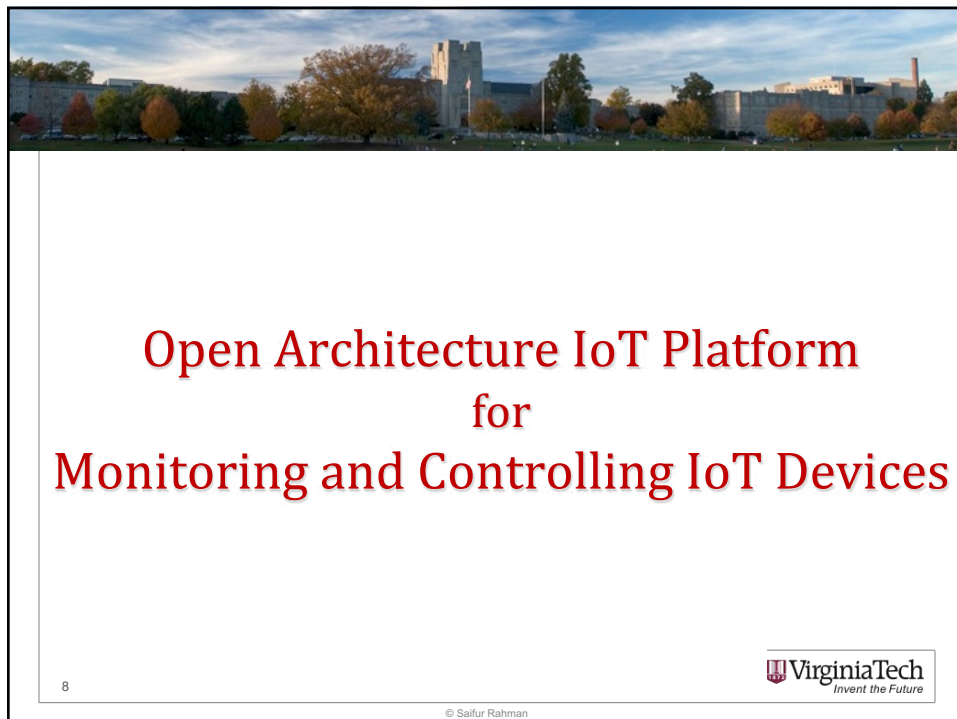
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6



7



8

Benefits Beyond Energy Savings

Improved operations and maintenance: Smart IoT 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 the IoT platform 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).

9



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Field Deployments



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

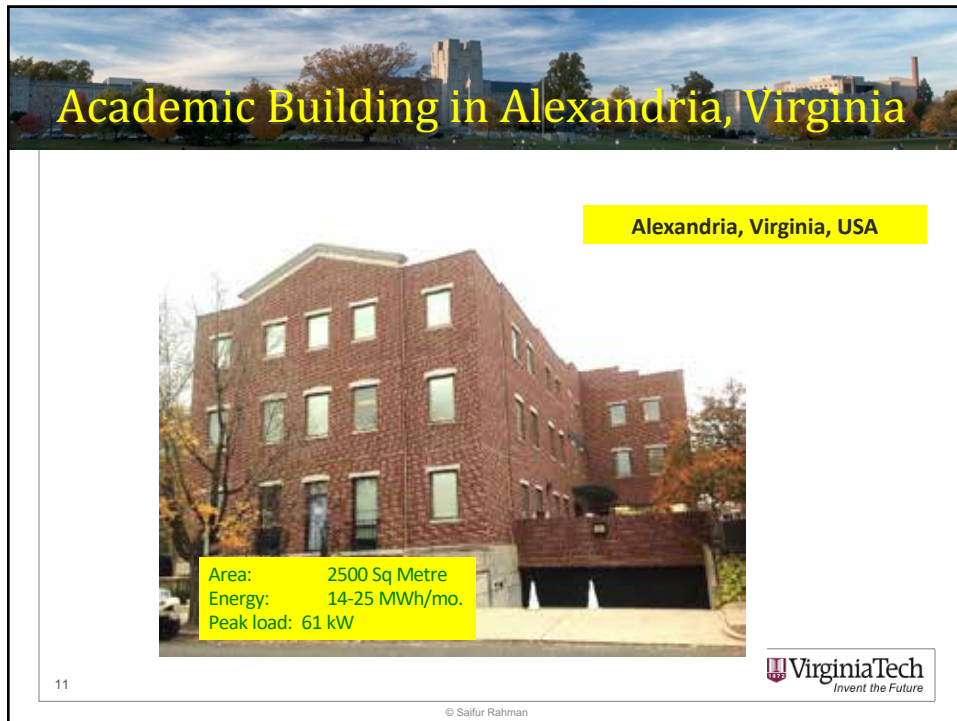
- Location: **Camp Springs**, MD
- Demonstration: HVAC control

10

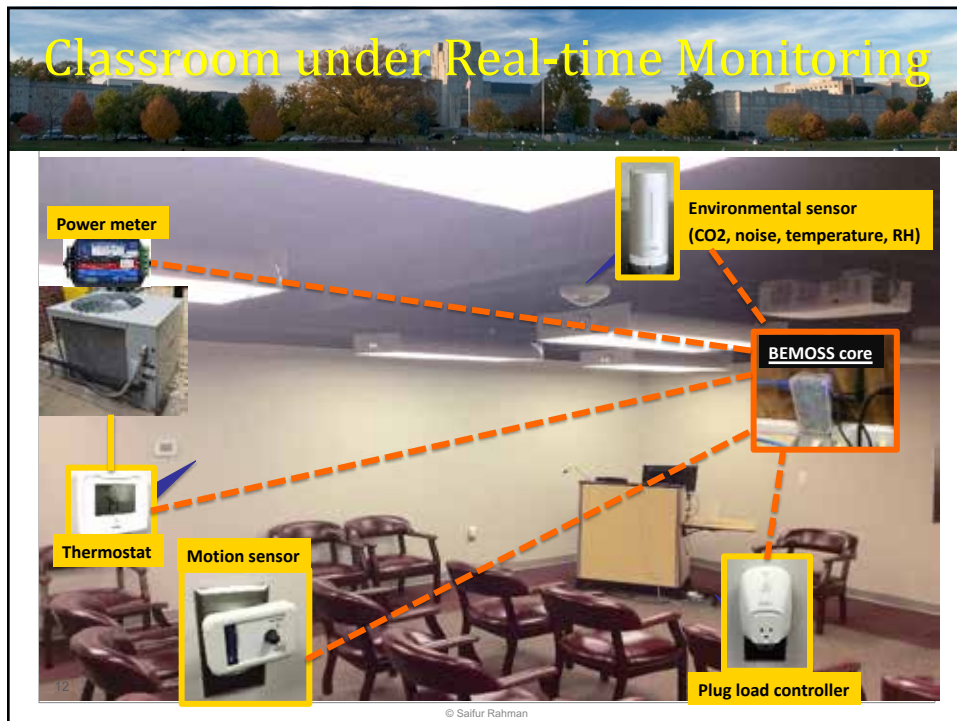


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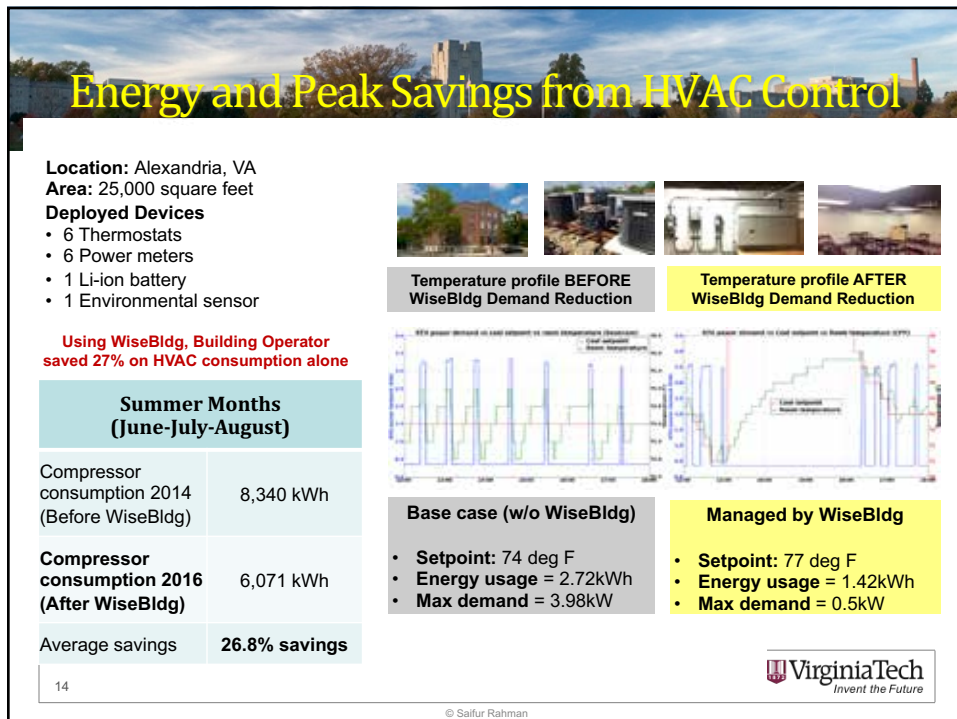
11



12



13



14

Office Building, Arlington, Virginia



Office building size: 500 sqm

15

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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%

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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%

Machine Learning Applications

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.



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Solar PV System Monitoring and Control






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User Interface



19

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Managing Battery Storage



20

20

Battery Storage Data Access



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Battery Storage Monitoring & Control



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All Buildings should be Smart Buildings

Building Automation Systems (BAS) can slash power consumption and energy bills significantly, but they are too expensive for most buildings.

BEM Controls breaks through this barrier.

Our Wise Building (WiseBldg) platform is affordable and works with any existing loads to make any building smart, no matter the size or age.

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23

23

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Thank you

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24

24