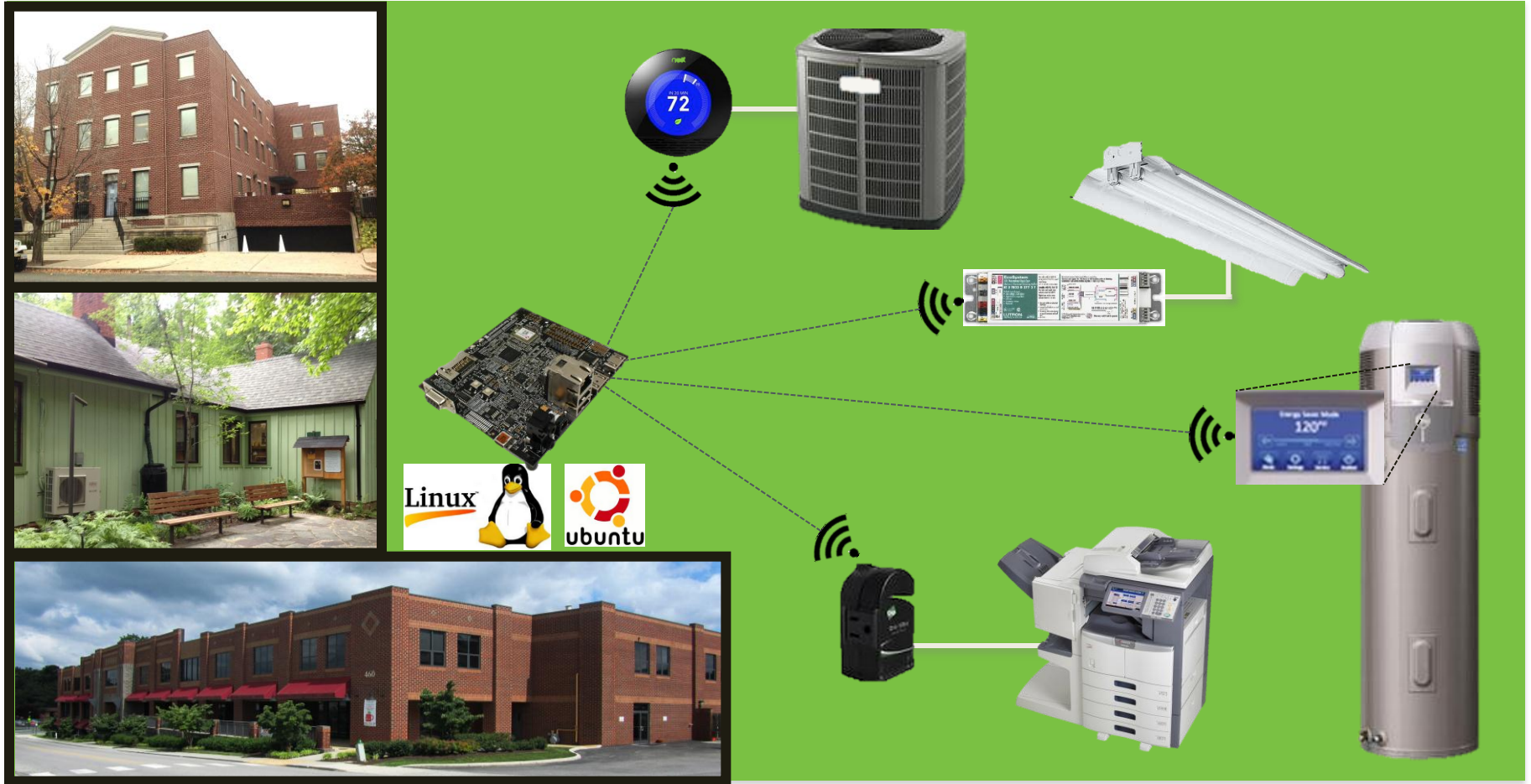


Building Energy Management Open-Source Software (BEMOSS)

2014 Building Technologies Office Peer Review



Project Summary

Timeline:

Start date: [November 1, 2013](#)

Planned end date: [October 31, 2014](#)

Key Milestones

1. First cut of the BEMOSS software – 10/31/2014
2. User interface app – 10/31/2014
3. Functioning plug & play compatible controllers – 10/31/2014

Budget:

Total DOE \$ spent to date: [\\$163,454](#)

Total future DOE \$: [\\$336,491](#)

Target Market/Audience:

[Small- and medium-sized commercial buildings](#)

Key Partners:

Arlington County, VA

Danfoss Corporation

Virginia Tech Foundation

Project Goal:

To develop the **Building Energy Management Open Source Software (BEMOSS)** platform, along with the user interface for three plug-and-play compatible controllers – one each for HVAC, lighting and plug load control. The BEMOSS platform is expected to improve energy efficiency in buildings and facilitate demand response implementation.

Purpose and Objectives

Problem Statement: Lack of inexpensive open-source building energy management (BEM) software solutions that allow seamless integration with device controllers (HVAC, lighting and plug loads) from various manufacturers.

Target Market and Audience: Small- and medium-sized commercial buildings

Impact of Project: Improve energy efficiency and help implement demand response in buildings

1. Project endpoint: Open-source software platform that allows automatic discovery and control of HVAC, lighting and plug load controllers
2. Expected achievements after Year 1:
 - Successful operation of HVAC, lighting and plug load controllers in a simulated environment
 - Successful integration of all three hardware controller interfaces with BEMOSS
 - Software apps that display sufficient maturity to allow testing BEMOSS functionality
 - Plug & play capable hardware controller interface devices

Approach

Approach:

- ❑ Task 1: BEMOSS open source software development in consultation with Industry
- ❑ Task 2: BEMOSS user interface and software tool design
- ❑ Task 3: Plug & play device integration

Key Issues:

- ❑ Availability of Application Programming Interface (API)

Distinctive Characteristics:

- ❑ Discovering and controlling device controllers without any user inputs

Progress and Accomplishments

Lessons Learned:

- ❑ As many smart devices, together with associated APIs, are becoming available in the market, our BEMOSS platform will provide the space for application developers and device manufacturers to integrate building load controllers with smart devices for remote and automated monitoring and control.

Accomplishments: From the start of the project in Nov 2013, the following tasks have been carried out:

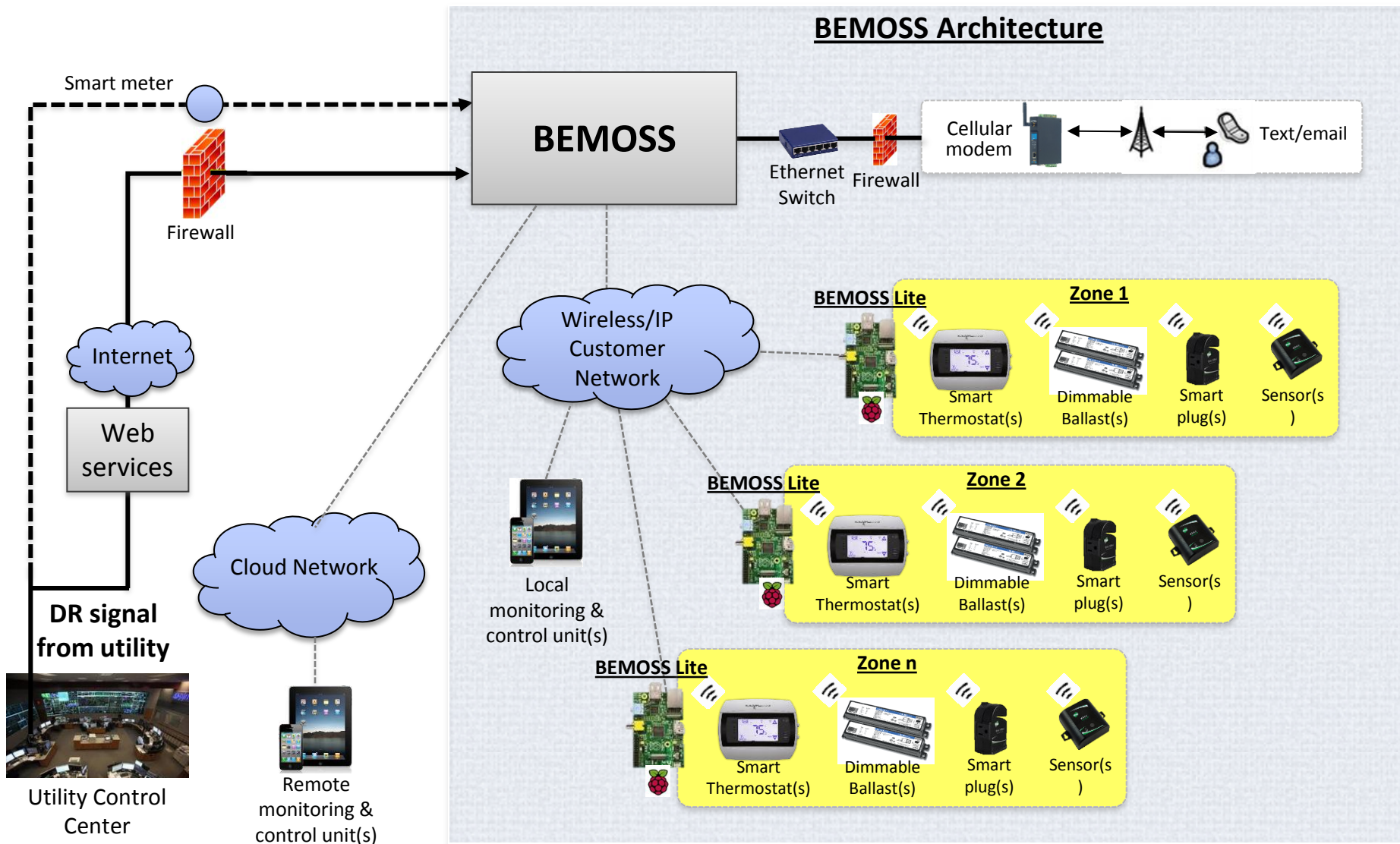
- ❑ Establish BEMOSS advisory board
- ❑ Design preliminary BEMOSS software architecture
- ❑ Develop BEMOSS open source software (on-going)
- ❑ Design user interface (on-going)
- ❑ Perform hardware selection/evaluation (on-going)
- ❑ Interface selected load controllers with BEMOSS (on-going)

Market Impact:

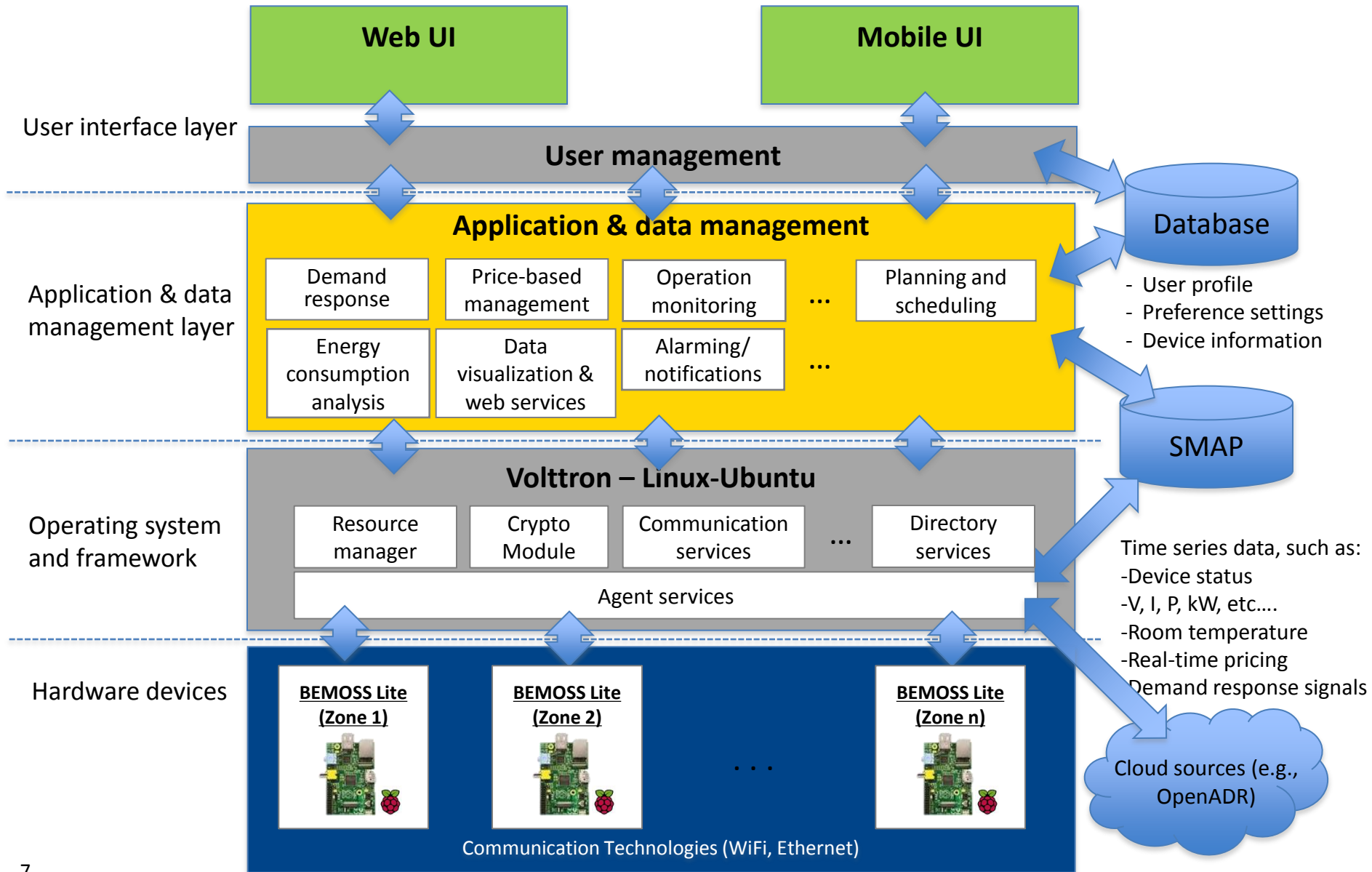
- ❑ Software/hardware under development

Awards/Recognition: N/A


BEMOSS System Architecture




BEMOSS Software Architecture



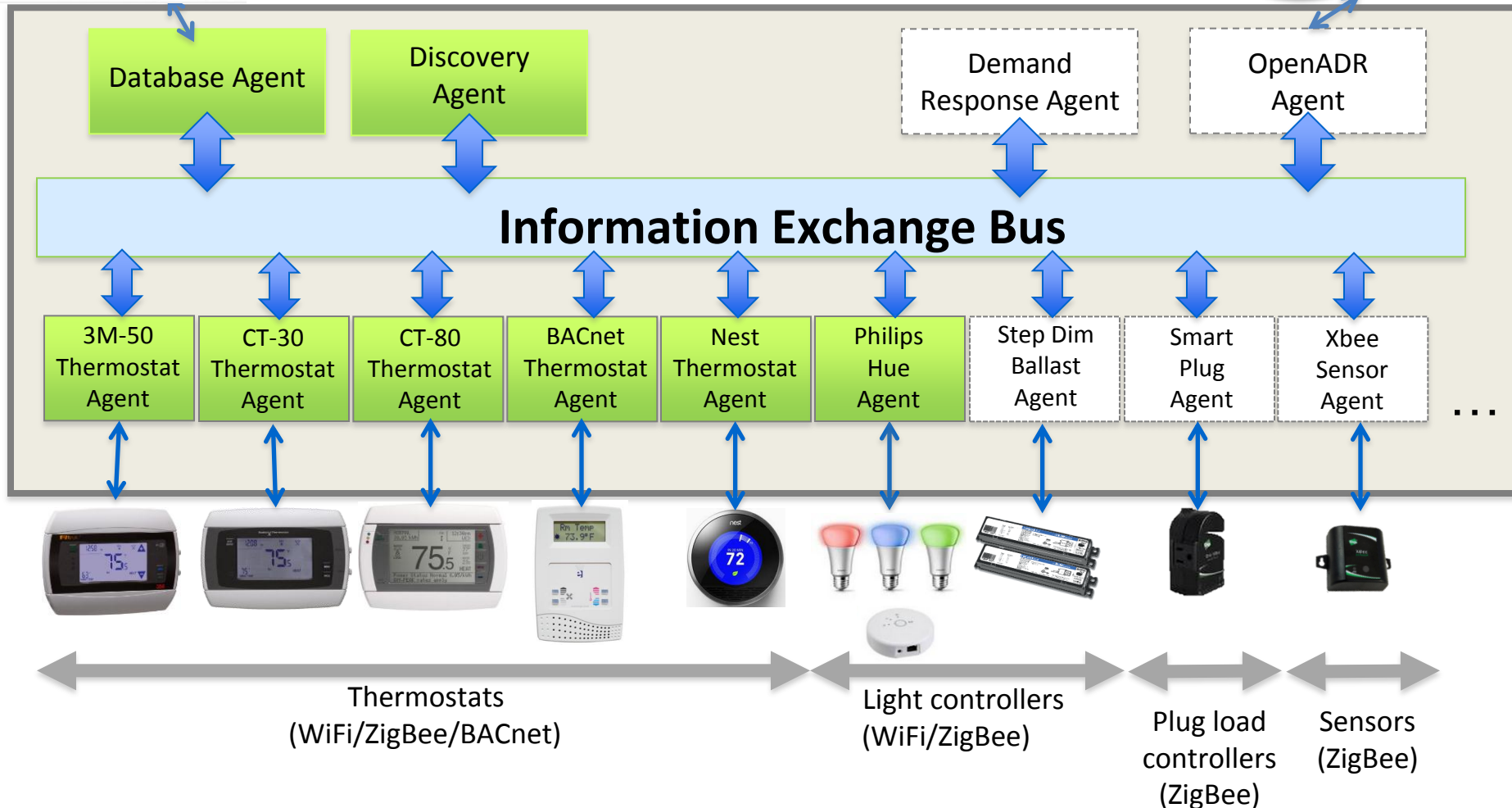
BEMOSS Agent

 Agents already developed

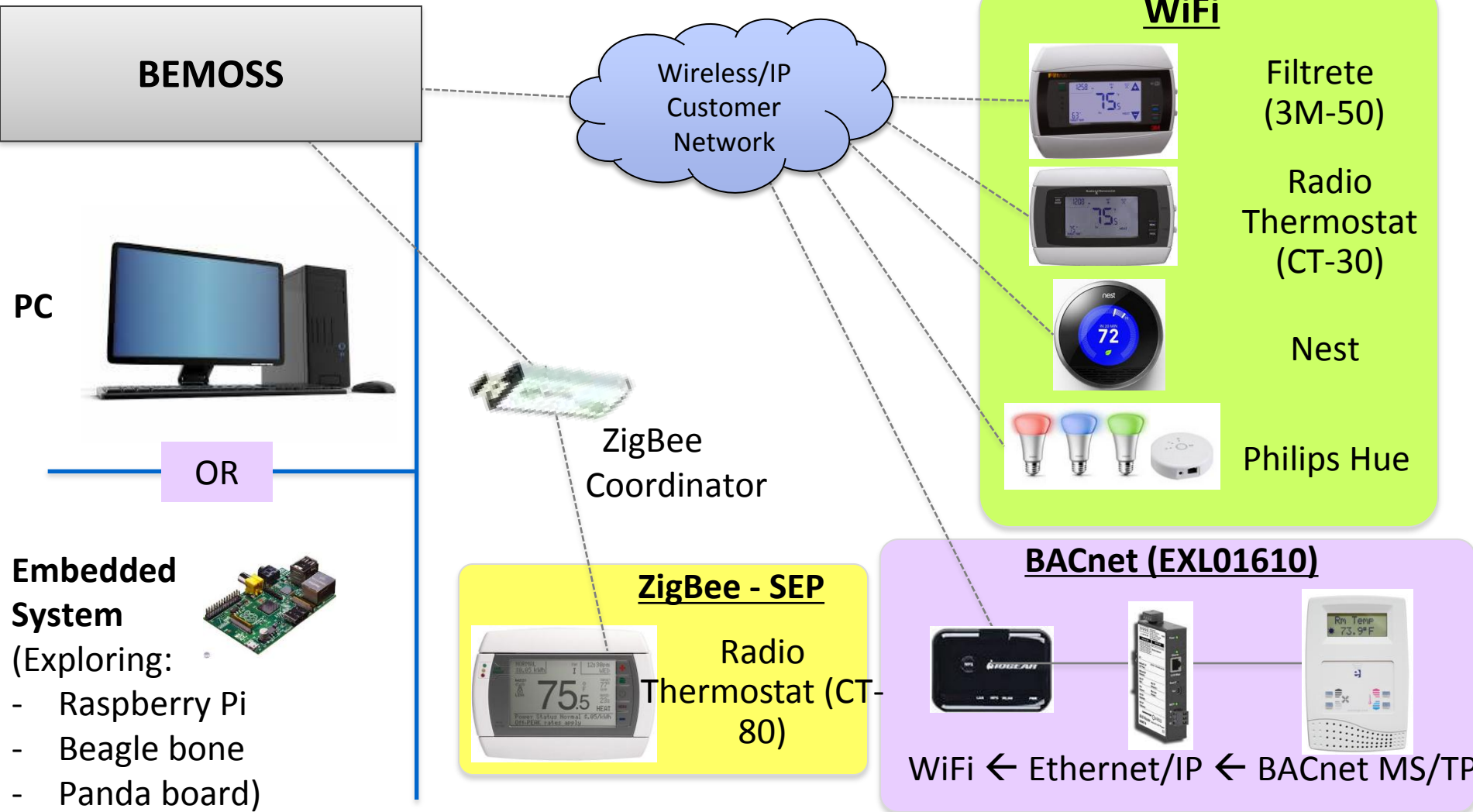
 Agents to be developed




Adopted from Voltron Lite



BEMOSS Successfully Integrated with Five Thermostats and One Light Controller



BEMOSS Progress To Date

	 3M-50 WiFi	 CT-30 WiFi	 Nest WiFi	 CT-80 ZigBee	 BACnet	 Philips Hue
Interface with IP/MAC address						
Interface with Volttron						
Device discovery			API to be released			

Project Integration and Collaboration

Project Integration:

- The BEMOSS advisory committee with 15 individuals from government and Industry has been established. The advisory committee members meet face-to-face on a quarterly basis with additional email exchanges based on work at hand.

Partners, Subcontractors, and Collaborators:

Partner	Role
Arlington County	Offers access to Long Branch Nature Center for energy consumption data
Danfoss Corp.	Supports in modeling the performance of HVAC units under different operating conditions
VT Foundation	Offers access to buildings in Alexandria and Blacksburg, VA for BEMOSS demonstration

Communications:

- “Open-source approaches to building energy management,” seminar by Prof. Saifur Rahman at the Rutgers University Center for Green Buildings, NJ, Feb 10, 2014.

Next Steps and Future Plans

Next Steps and Future Plans:

- Continue the development of BEMOSS open source software
- Continue user interface design
- Interface selected load controllers with BEMOSS
- Perform user acceptance and software tool evaluation
- Deploy BEMOSS in a living laboratory

REFERENCE SLIDES

Project Budget

Project Budget: **\$499,945** (for Y1: Nov 1, 2013 – Oct 31, 2014)

Variances: N/A

Cost to Date: **\$198,873** (from Nov 1, 2013 to Mar 31, 2014)

Additional Funding: N/A

Budget History

FY2013 (past)		FY2014 (Nov 1, 2013 – Mar 31, 2014)		FY2015 – Oct 31, 2014 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
-	-	\$163,454	\$35,419	\$336,491	\$34,442

Project Plan and Schedule

Project Schedule											
Project Start: November 1, 2013	Completed Work										
Projected End: October 31, 2014	Active Task (in progress work)										
	◆ Milestone/Deliverable (Originally Planned)										
	◆ Milestone/Deliverable (Actual)										
	FY2014							FY2015			
Task	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Oct-14
Current/Future Work											
Task 1: BEMOSS open source software development in consultation with industry											
1.1) Establish BEMOSS advisory committee		◆									
1.2) BEMOSS advisory committee meeting			◆								
1.3) Design BEMOSS preliminary architecture				◆							
1.4) Develop BEMOSS open source software											
Task 2: BEMOSS user interface and software tool design											
2.1) User interface and tool design											
2.2) User acceptance and software tool evaluation											
Task 3: Plug & play device integration											
3.1) BEMOSS hardware selection/evaluation			◆								
3.2) BEMOSS hardware acquisition				◆							
3.3) Plug & play device interface											
3.4) BEMOSS deployment in living laboratory											
Submit deliverables to DOE											