

California Plug Load Research Center Workshop

SIM Home – Home of the Future

May 12, 2016

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California Institute for Telecommunications and Information Technology



Creating Connections. Powering Innovation. Boosting Efficiency.



Challenges in Residential Plug Loads Efficiency

- **Aggregated Energy: Devices are becoming more efficient, but the number of devices are increasing**
- **Complex and fast evolving landscape:**
 - **Diverse user groups in ownership and preferences**
 - **IOT edge devices**
 - **Age of the devices**
 - **Home of the future**
- **Actionable information (Decision science) for decision makers at all levels:**
 - **End users**
 - **Policy makers**
 - **Incentives**



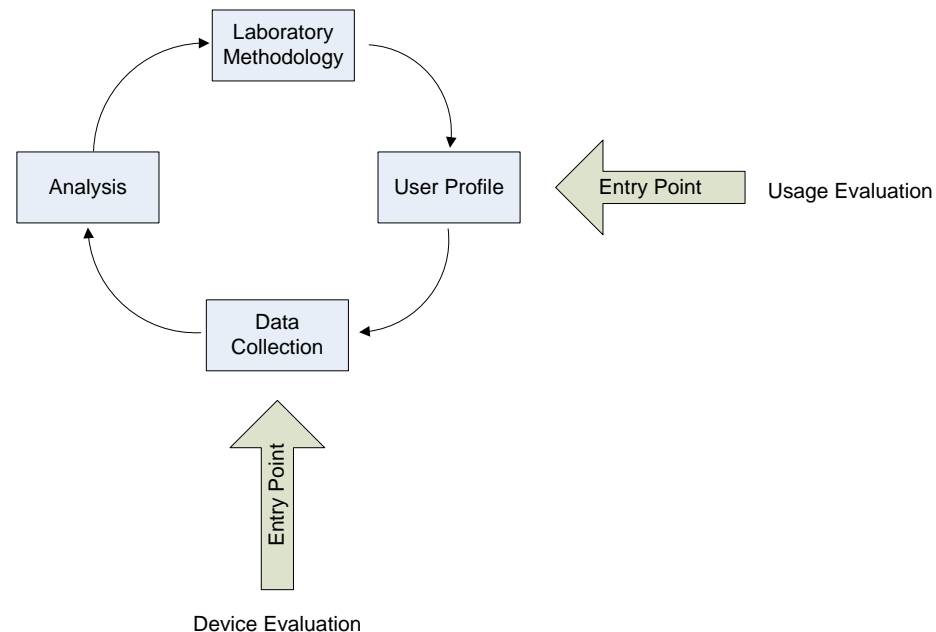
Typical Approaches

- **Modeling:**
 - No widely accepted tools
 - No widely accepted models
 - Normalized profiles are nonexistent.
- **Testing:**
 - Power consumption are intensively examined
 - Difficulties in energy consumption estimation and measurement



SIM Home Proposed Approaches

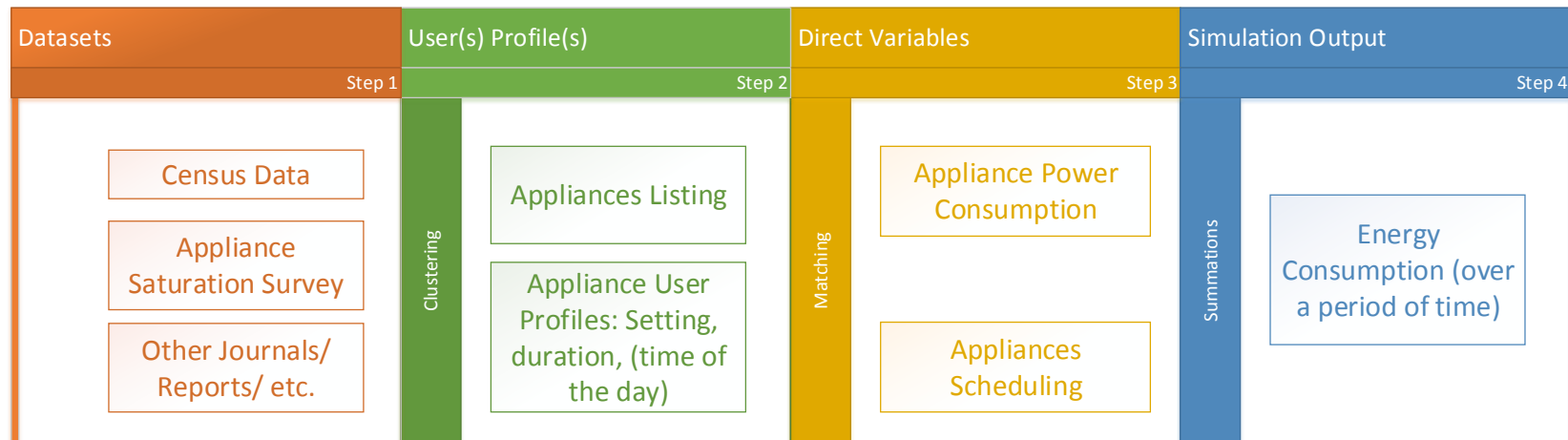
- Literature researches
- Setup and implementation of IOT enabled devices
- Aggregated testing by appliance groups
- User experience design to better convey the energy related information*
- Machine learning data analytics*
- Information for decision makers via multiple media platforms*
- Home level simulation*



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* Items are out of the scope of the SCE sponsored project

Device Ownership and Use Profile Research



- **Datasets:**

- **RASS: Residential Appliance Saturation Survey 2003, 2009**
- **RECS: Residential Energy Consumption Survey 2009**
- **CLASS: The California Lighting and Appliances Saturation Survey 2012**
- **SKA: The Small Kitchen Appliances Study 2015**
- **PASUS: The portable Appliances Saturation and Usage Study**



Device List

- **Home Office:**

- Desktop computer
- Laptop computer (and charger)
- Multifunction inkjet device
- Computer speakers
- Charger for mobile device

- **Kitchen*:**

- Automated drip coffeemaker
- Pod coffee maker
- Thermo-pot

- **Home Entertainment:**

- Television, LCD
- HD cable and/or HD satellite box
- Blu-ray or HD DVD player
- Video game console



Testing and Verification

- **What we are NOT testing:**

- Features and performance
- Power consumption by operation mode
- Durability and robustness
- Comparison with similar products
- And more.....

- **What we are testing:**

- Variation in device groups
- Boundary conditions for device use time durations
- Power management*
 - NOT the effectiveness, but impacts of user alteration of such settings
- Windows of IOT solutions



User Experience Design

- **Current**

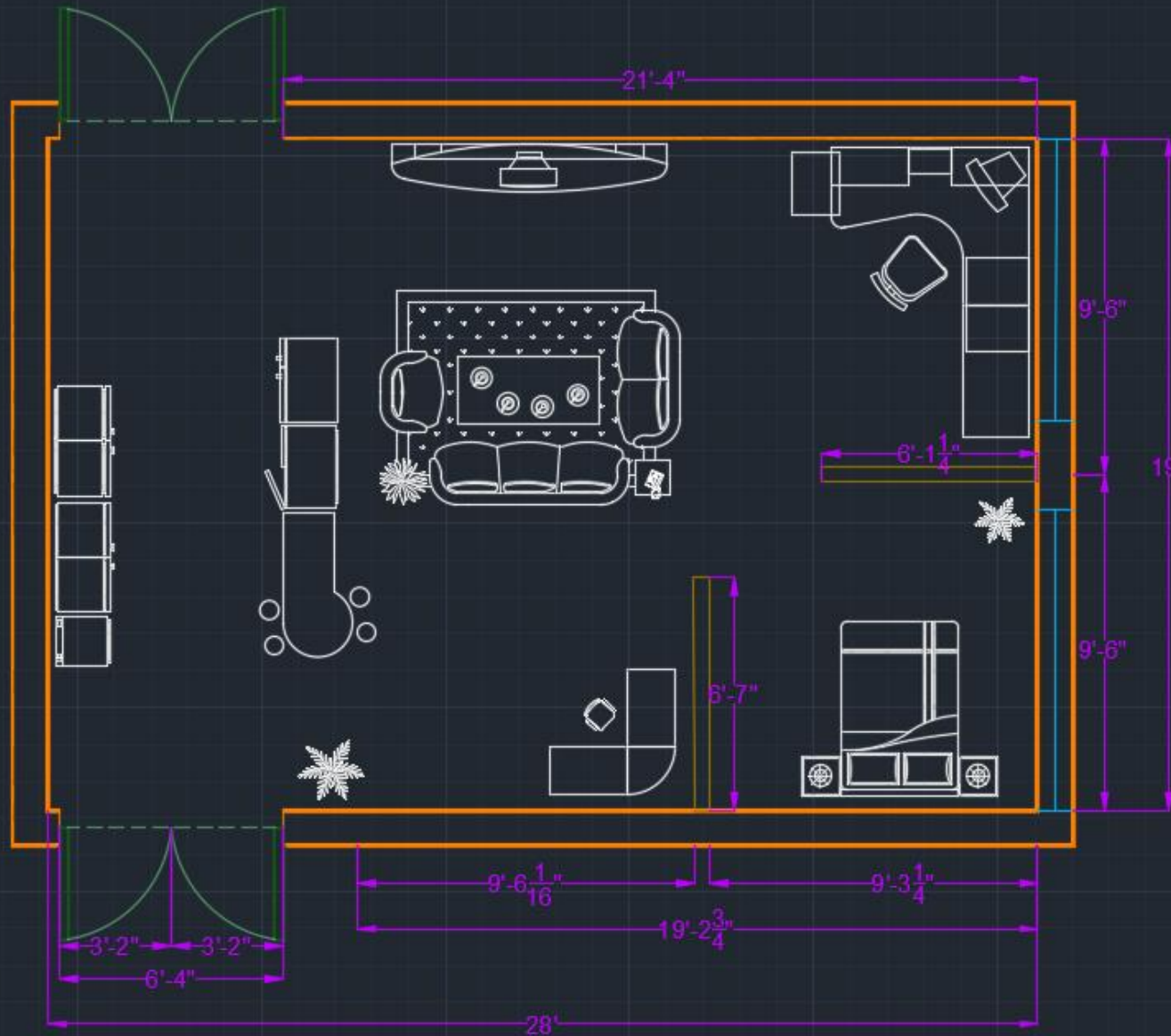
- **EMMA: Energy Monitor & Management Assistant**
- **Web App:**
 - **Data visualization**
 - **Customized device control**
 - **Data analytics for fault detection**
 - **Machine learning for over drafting protection**
 - **APIs for smart home device integration**
- **Mobile App:**
 - **Location based notification**
 - **EMMA**

- **Future**

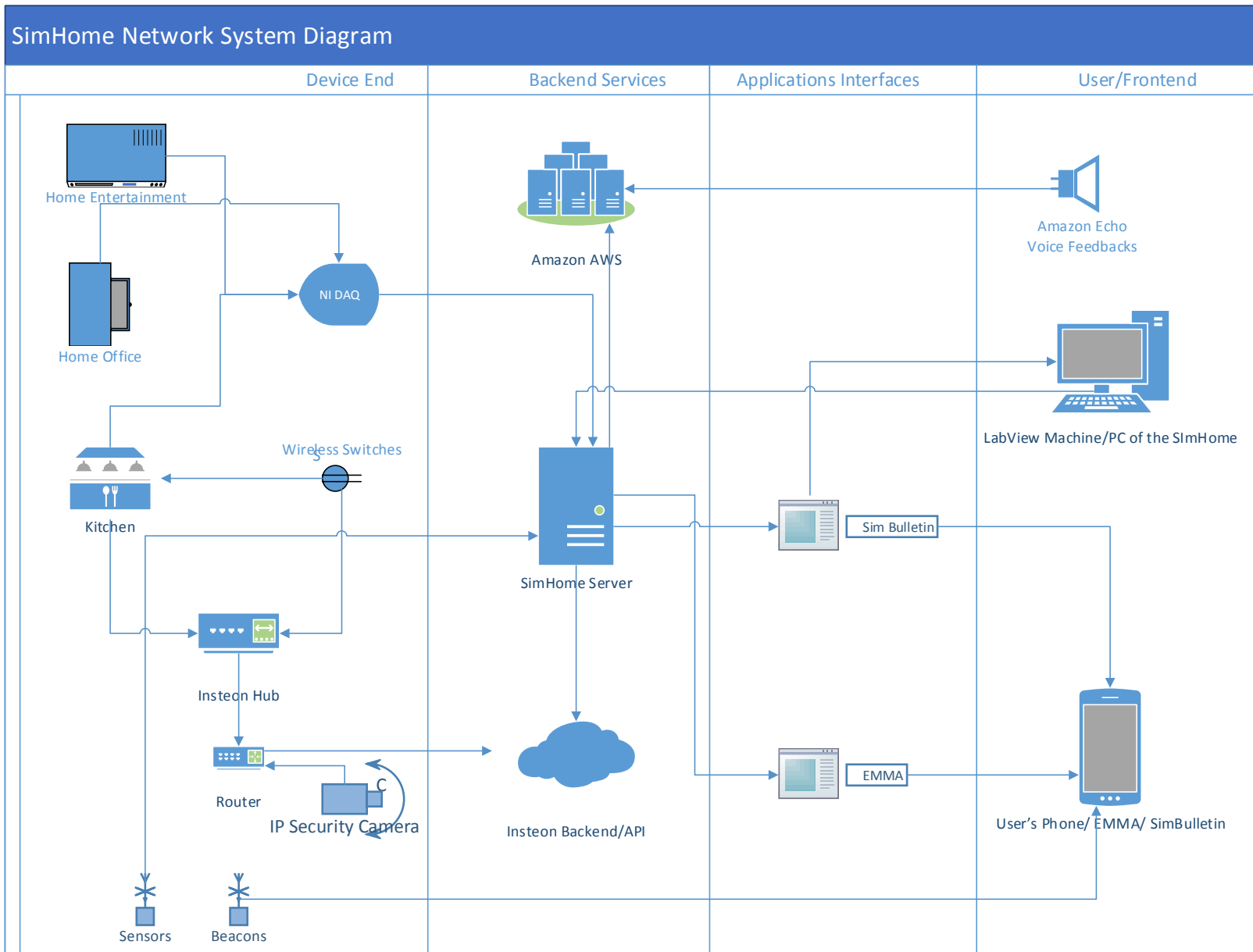
- **Human like interaction with EMMA**
- **Visualization of energy flow for:**
 - **Decision makers**
 - **Energy efficiency enthusiasts**
 - **Tips and estimations of home energy efficiency upgrades**
- **Study of effectiveness of information delivery medias**



SIM Home Design



SIM Home System Design



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Web App: SimBulletin

A Web Page
http://emma.simhome.com

EMMA
Energy Management and Monitoring Assistant

Dashboard

Energy

Temperature

Map

Control

+

Overview

Temperature

Map

Energy

Control

Ask Emma

How may I help you?

You:

SimBulletin

Dashboard

Energy

Temperature

Control

Space Heating
Space Cooling
Lighting
Refrigeration
Electronics

Device Name	Energy Consumed	Power On
1 PlayStation	10,000	✓
2 Television	8,000	x
3 Refrigerator	12,500	✓
4 Electronics	7,000	✓

60,000

40,000

20,000

0

2007 2008 2009 2010 2011 2012 2013

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SIM Home

by Linyi Xia

the home of the future

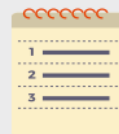


find list of appliances

From studies, surveys, reports and etc.



Create a range of Device Use Profiles



Impliment

Testing procedures



Intellegence

in data analytics and APIs



Collect useful and meaningful data in Data Storage



Setup Appliances for various profiles



Dashboard Monitor

to monitor energy and control



Educational Interaction with enhanced UX and IOT



Lead to applicable information for Energy Saving potentials

User Based Decision Science

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Thank you!



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