

CALPLUG SIMLab and Tier 2 APS



Arthur Zhang

California Plug Load Research Center

California Institute for Telecommunications and Information Technology

March 4th, 2015

www.calplug.org



Creating Connections. Powering Innovation. Boosting Efficiency.



CalPlug
CALIFORNIA PLUG LOAD RESEARCH CENTER

Outline

- **Go-to-Market Roadmap for Emerging Technology**
- **CalPlug SIMLab testing methodology**
- **Tier 2 APS Draft Definition**
- **Tier 2 APS SIMLab tests**
- **Conclusion**

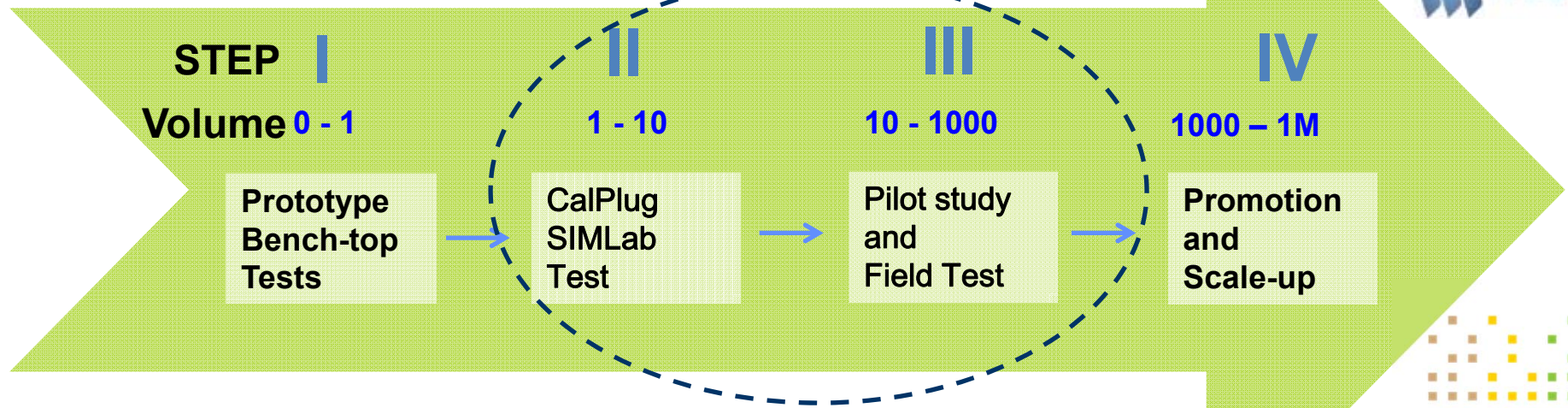


Go-to-market Roadmap for Emerging Technologies

Manufacturers



Neutral 3rd Parties



Utilities



Creating Connections. Powering Innovation. Boosting Efficiency.



Bench-top Power Test



CEA
Consumer Electronics Association



Creating Connections. Powering Innovation. Boosting Efficiency.



CalPlug SIMLabs

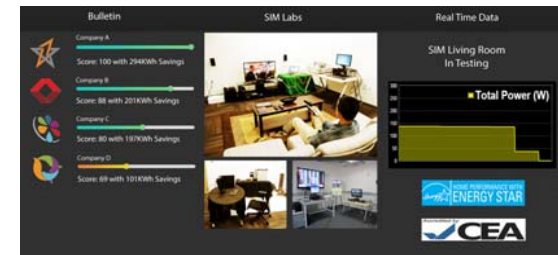
SIM Living Room



SIM Office



SIM Home



Purpose

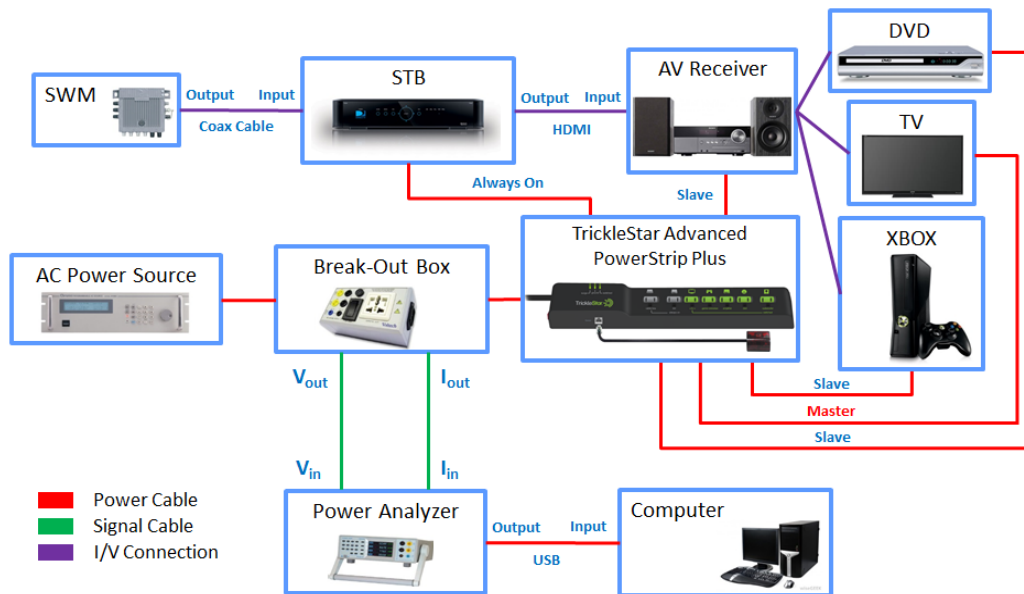
To bridge the gap between bench-top tests and large scale market trials



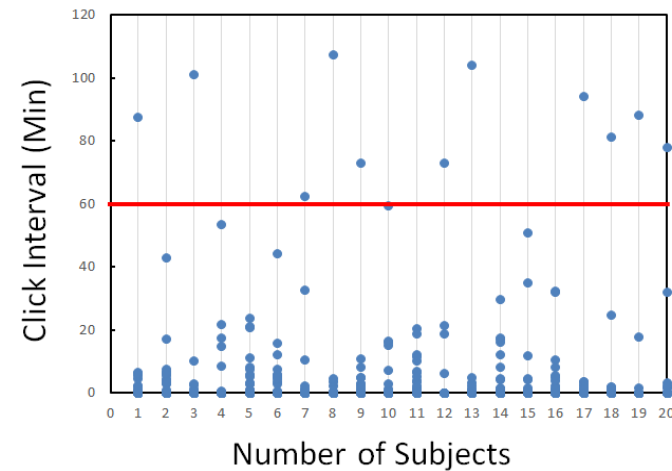
Creating Connections. Powering Innovation. Boosting Efficiency.

SIMLab Test

SIMLabTest Setup



Behavior Test



CONSUMER STUDY: Frustration threshold

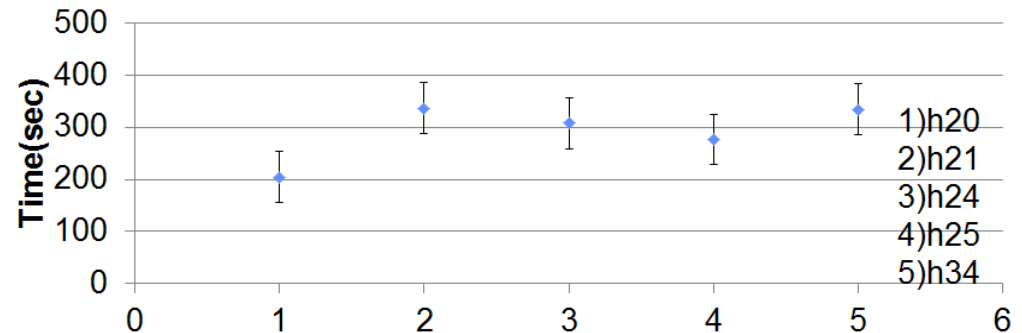
Efficient, on-demand designs
always have tradeoffs in system
response time

“Frustration threshold” study

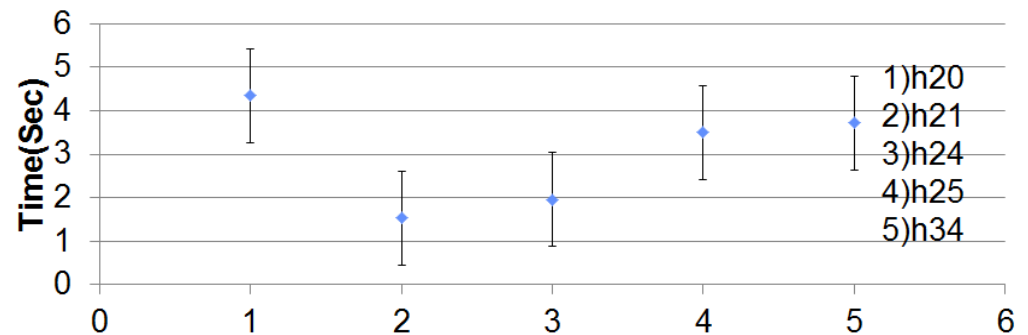
How to reduce consumer
perceived “Delay”?



Recovery time for STB Unplug



Recovery time for STB Stanby



Creating Connections. Powering Innovation. Boosting Efficiency.

CONSUMER STUDY: Consumer Engagement

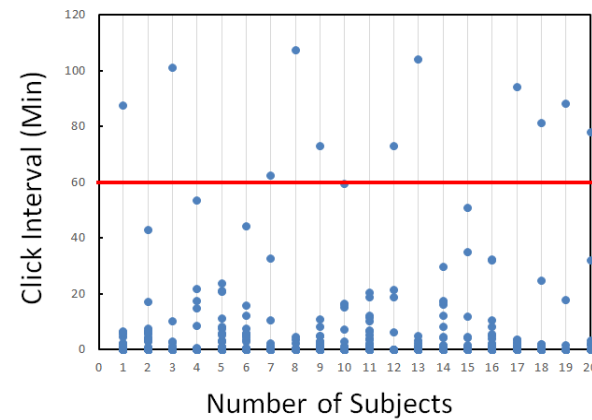
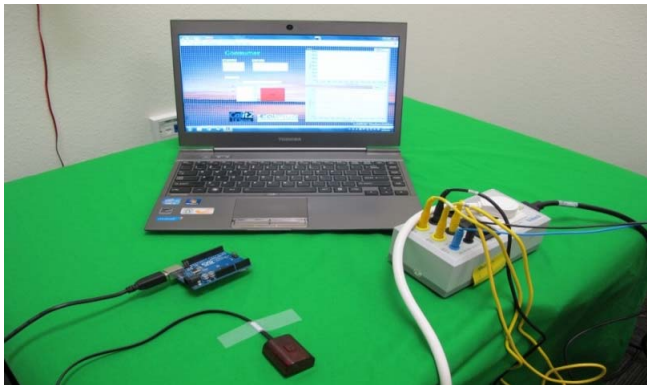
Behavior Study in SIM Living Room



US Weekly Time Spent Hours: Min

	K 2-11	T 12-17	A 18-24	A 25-34	A 35-49	A 50-64	A 65+	P 2+	BLACK 2+	HISP. 2+	ASIAN 2+
On Traditional TV	24:37	21:22	23:24	28:53	34:18	44:09	49:21	34:11	47:09	28:17	19:43
Watching Timeshifted TV	2:06	1:39	1:46	3:27	3:42	3:40	2:28	2:54	2:12	1:52	2:00
Using a DVD/Blu Ray Device	2:05	1:07	1:13	1:35	1:22	1:02	0:37	1:17	1:26	1:15	1:07
Using a Game Console	2:25	3:24	3:08	2:20	0:56	0:19	0:05	1:30	1:47	1:36	1:06
Using the Internet on a Computer	0:27	0:58	5:31	6:35	6:42	6:02	3:26	4:38	4:30	3:00	3:45
Watching Video on Internet	0:16	0:29	2:05	1:50	1:16	0:51	0:23	1:01	1:16	1:01	1:18
Watching Video on a Mobile Phone	-	0:25	0:27	0:23	0:13	0:04	0:01	0:13	0:20	0:19	0:25

Data Acquisition/Analysis



Creating Connections. Powering Innovation. Boosting Efficiency.

CalPlug's Draft Definition for Tier 2 APS

- **Tier 2 Advanced Power Strips recommended feature groups:**
 1. **Usage Sensing** – to provide at least one method to sense and determine consumer utilization and usage pattern;
(eg. IR sensing with filtering, motion sensing, geofencing)
 2. **Advanced Power Analysis** – to perform advanced power analysis in addition to voltage and current sensing.
(eg. true RMS power, power factor analysis and other load signature detection methods)
 3. **Control Algorithms** - to perform automated power management of connected devices based on data and information acquired.
(eg. masterless control, behavior adaptive control)



SIMLab Test Setup for Tier 2 APS

	TV Set (W)	XBOX (W)	DVD (W)	STB (W)
User Engaged	90.0	100.0	5.3	18.0
User Absent	90.0	93.0	5.3	18.0
Standby	/	/	1.0	/
Off	<0.2	<0.2	<0.2	<0.2

SIMLab Test Setup for Tier 2 APS

Typical Configurations in US Household [1] & [5]

Number of Households with Each Configuration		
Total # of Households(US Census 2011)	100%	132,312,404
DVD + TV	86%	113,788,667
Game Console + TV	56%	74,094,946
STB + TV	85%	112,465,543

SIMLab Methodology: User Absence for Tier 2

Conventional Definition of Device Operation Modes

- Active Mode: The television is turned on and is displaying an image.
- Standby Mode: The television is turned off by the remote control and is not displaying an image but still remains plugged in.
- Off Mode: The television is turned off by a power button/switch on the television and is not displaying an image but still remains plugged in.

CalPlug Definition of Device Operation Modes

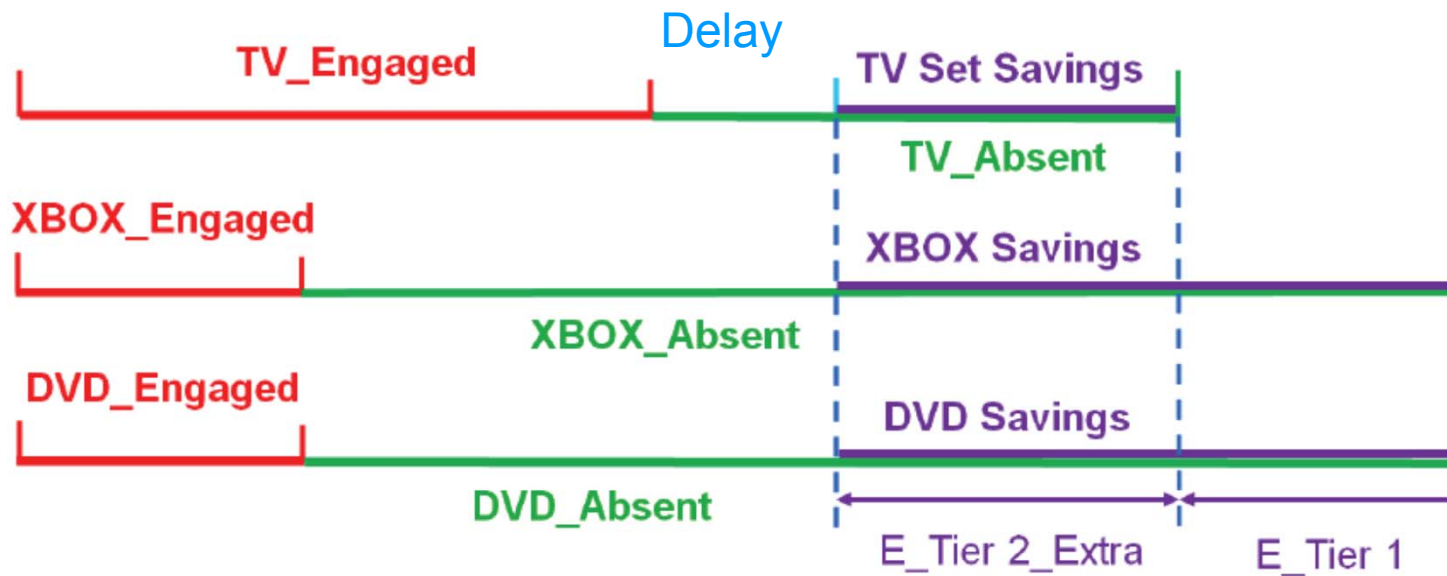
- On/Active Mode: The appliance is turned on and the user is actively engaged with the appliance (pressing buttons on the remote control)
- On/Absent Mode: The appliance is turned on and the user is not engaged with the appliance (They don't press any buttons and are not actively using the product, but the device is still displaying images)
- Standby Mode: The appliance is waiting to be turned on
- Off Mode: The appliance is turned off but is still plugged into the outlet

SIMLab Methodology: Tier 2 APS



$$TV\ Set\ Savings\ (Wh) = P_{TV_Absent}(W) \times (T_{TV_Absent} - T_{IR_Timer})(Hr/Day) \times (365.25)(Days)$$

SIMLab Methodology: Tier 2 APS



SIMLab Methodology: Tier 2 APS

$$E_{Tier2Total}(WHr)$$

$$= P_{TVAbsent}(W) \times (T_{TVAbsent} - T_{IRTimer}) \left(\frac{Hr}{Day} \right) \times (365.25)(Days)$$

$$+ P_{XBOXAbsent}(W) \times (T_{XBOXEngaged} + T_{XBOXAbsent} - T_{TVEngaged} - T_{IRTimer}) \left(\frac{Hr}{Day} \right) \times (365.25)$$

$$+ P_{DVDAbsent}(W) \times (T_{DVDEngaged} + T_{DVDAbsent} - T_{TVEngaged} - T_{IRTimer}) \left(\frac{Hr}{Day} \right) \times (365.25) = 30.9 + 166.8 + 38.8 KWHr = 236.5 KWHr/Year$$

Key Facts from CalPlug Studies

- Vendor provided sample products from three manufacturers
- Secondary studies covered Nielson consumer reports for Appliance usage statistics
- Primary studies with over twenty volunteers to understand "user absence"
- At least three week-long SIMLab test runs were performed on each product.
- Savings potential for Tier 2 APS ranging from 230 - 350 KWh, depending on the specific usage case