

# CEA-2045

## Emerging Technologies Showcase

September 23, 2014

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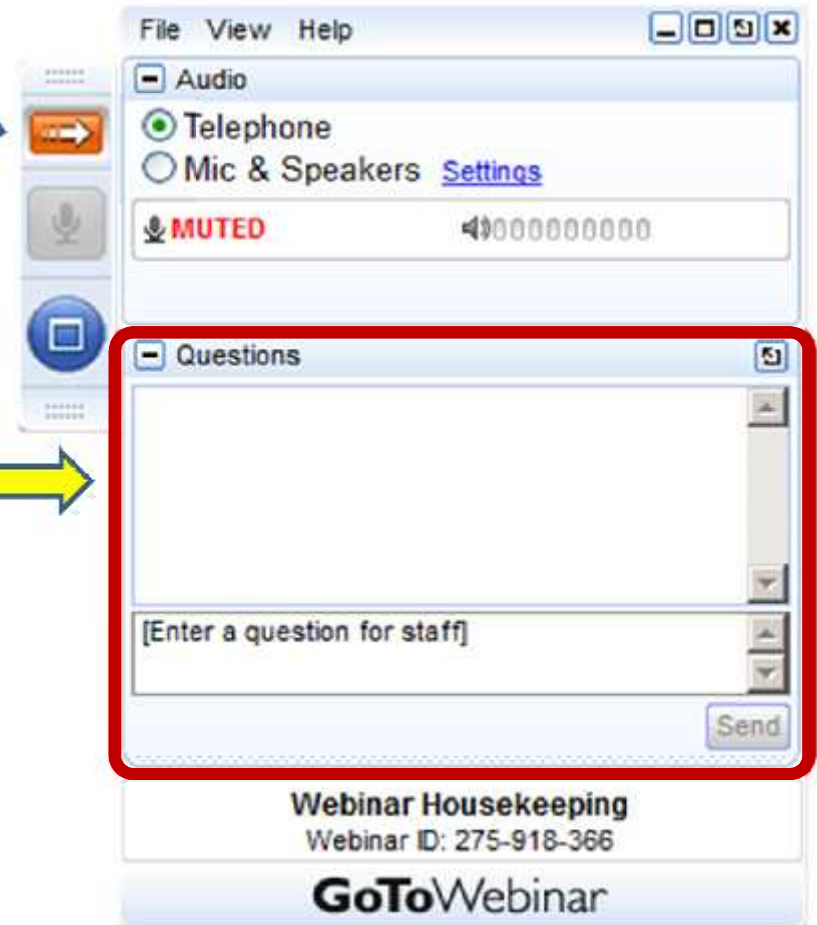


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- Minimize or maximize control panel
- Phone lines are muted
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# “Socket” as Lost Opportunity for Energy Savings

**Conrad Eustis**

**Director Retail Technology Strategy**

**Portland General Electric**

**September 23, 2014**



**Portland General Electric**



# Why Energy Efficiency Programs?

1. Create Customer Satisfaction and Bill Savings
2. Advance Sustainability (reduce fossil fuel use; reduce CO<sub>2</sub>)
3. Least Cost Strategy:
  - Reduce bill for non-participants compared to building new generation

# Once Upon A Time....

- Only significant renewable was hydro
- No hydro generation went unused (still true today, **But**)
  - ➡ EE programs always reduced fossil fuel use
- PNW energy constrained– didn't need capacity resources
- Demand side programs only to reduce peak demand
- **All of these are false statements now**

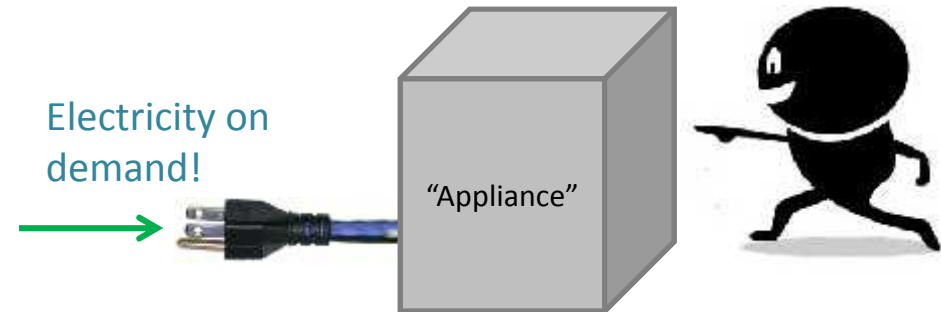
# Flexible Loads Required for a Renewable Future

- PNW has hours where **Wind** resources are **curtailed**
- California at **40% renewables** will have **more** renewable **generation** at noon in April **than load** in the entire state
- Do we want to get to 80% renewable generation?
- What we need are loads with flexibility to
  - Absorb excess renewable generation
  - **Add** or subtract demand to deal with wind/solar output variation or forecast error:
    - Day-ahead, hour-ahead, in-hour

# New Concept

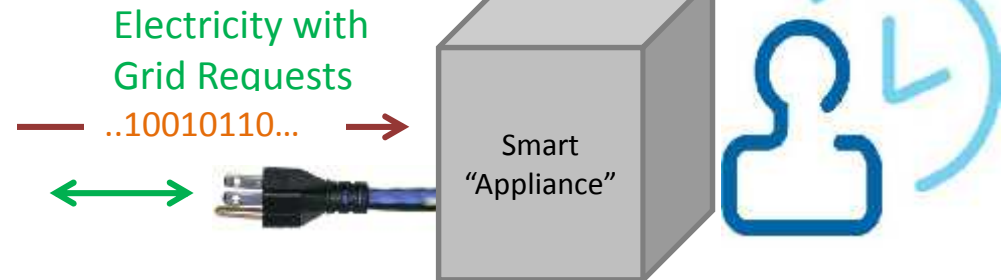
- **For first 120 years**
  - Energy flows one way to customer
  - Customer loads and generation serve best interests of customer
- By 2008, renewables at scale everyone talks about storage
- By 2010, Idea: many loads can respond to price and control signals to help integrate renewable generation.
- **No word describes concept**

Then: 1890 to 2010



Customer commands; device giveth

2015 to 2050



Customer inputs flexibility → device serves customer & grid!

# Word for an Emerging Concept

- In 2050 need most loads and distributed generation to be *alonetic*



- Opposite of alonetic is *egonetic* which is the behavior of today's devices

***Alonetic***, adjective  
ăl • ō • nēt' • ĩk

- **alo-** from Latin “to **support**”
- “**net**” as in the “electric grid **net**work”;
- **-ic** of, or **pertaining to**

**Definition:** The ability of an electric device to beneficially support operation of the electric grid

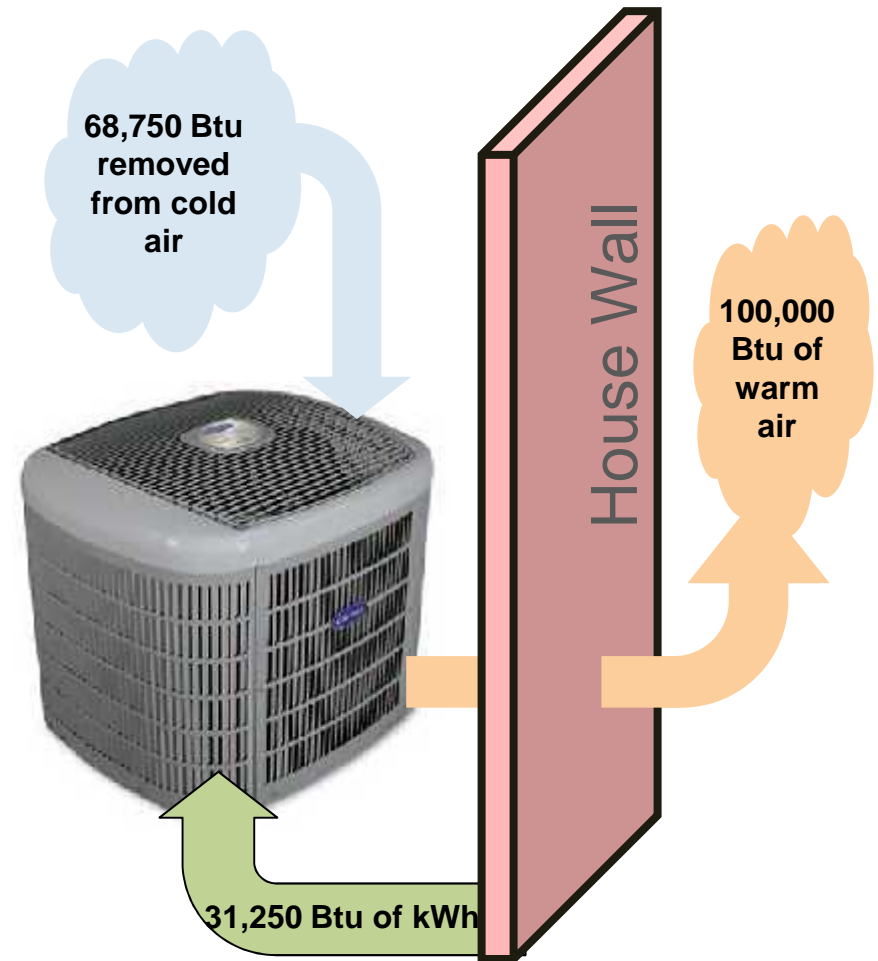


# Low Cost Alonetic Loads

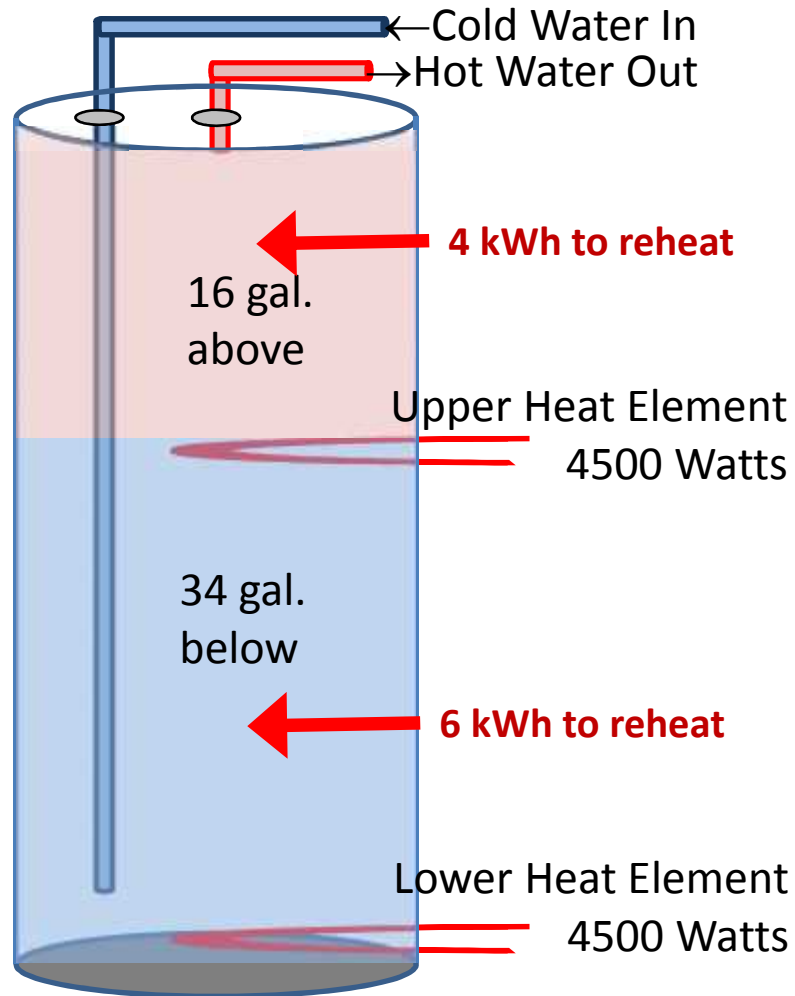
Electric Device	Alonetic Design	Egonetic Design
PV System	Customer's Smart PV Inverter provides voltage support	Customer with Net Metering
Whole House Battery Backup	Battery serves: customer in outage, utility to reduce peak	Expensive asset used 0.02% of time
Water Pumping	Variable speed pumps vary output . renewable output	Tanks maintained between low/high set points
Com' HVAC: Fans/Chillers	Variable speed compressors/ fans vary output . renewable output	Temp maintained between low/high set points
PEVs	Charge rate renewable output	Charge after evening commute
Heat Pumps	Variable speed compressors vary output . renewable output	Temp maintained between low/high set points
Com'l Refrigeration	Pre-cooling before peak causes reduced load during peak	Temp maintained between low/high set points
Water Heater	Always has hot water in top-third; bottom reheat to serve grid	Reheat after each cold water draw

# Why End-to-End Energy Calc. Matters

- Today's variable speed heat pumps have efficiencies 320%.  
[PNW better & baseload gas plant is 0.86]
- In WECC with 0.92 lb. CO<sub>2</sub>/kWh (gen mix increased for T&D loss), a **therm of heat** takes 9.2 kWh → **8.4 lb. CO<sub>2</sub>**
- Compare to: **therm of heat** from 95% gas furnace → **12.2 lb. CO<sub>2</sub>**
- Same story for Ht. Pump Water Heaters
- As percent of renewable on grid increase CO<sub>2</sub> savings keep increasing!
- **NEW:** variable speed heat pumps with a **CEA-2045 interface** and **alonetic controls** could provide gigawatts of real time loading following capability in winter and summer seasons.



# Water Heater 101



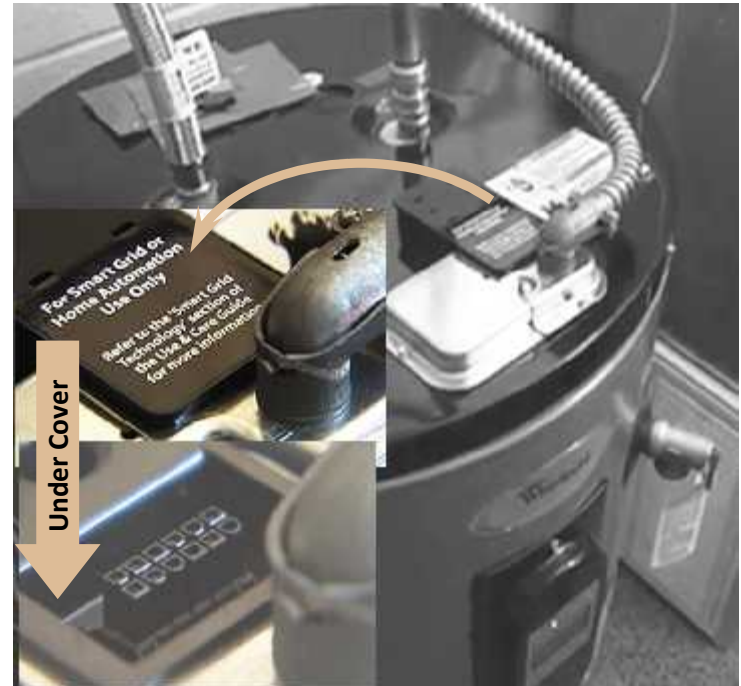
- Top element has priority
- Cold water dense, stays on bottom
- **Basic Idea: Keep top third of tank hot**
- Cycle heating on bottom element via **alonetic** control
- For Wind response:
  - 300 watt average for 24 hours
  - But adjust in real time 0 to 600
- For load shift:
  - 1,200 watts for 6 hours

# Energy Efficiency based on System Savings

- Water Heaters under onnetic control are an effective **energy savings** measure!
- PNW has about 3.4 million electric water heaters; in a renewable future they save energy 3 ways because we can control *WHEN* a kWh heats cold water at bottom of tank:
  - When the wind blows need power plant to firm forecast error. Heat rate for flex power plant (8,750 to 12,000) higher than 6,800 for baseload gas plant
  - Everyday load shift savings: Avg. night heat rate 7,400 versus avg. daytime heat rate of 9,000 (includes T&D savings)
  - ~70 kWh from reduce heat loss through lower tank wall since water at bottom of tank is cold a large part of day

Total about 680 kWh/yr per tank under onnetic control (~20% of total use)

- AO Smith Energy Smart<sup>®</sup> Water Heater
  - Power relay, electronic control, and communication interface
  - In EPRI managed pilot with twelve utilities (PGE, BPA, SCE...), AO Smith provides a CEA-2045 interface
- **CEA-2045** Standard established Dec 2012
  - CEA-2045 is USB-like standard that allows a **customer** to connect a communication device
  - USNAP is to CEA-2045 as Wi-Fi is to IEEE 802.11



# You Should Take Away This:

Alonetic devices at the premises are the key to **sustainability**

Join the future now:  
Learn about, then mandate,  
CEA-2045 on all water  
heaters

If you care about a sustainable future, define your programs by energy savings at the System level!

## Think Alonetic!



# Questions?

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# CEA-2045 for Demand Response

**Tony Koch, PE, CEM**  
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# CEA-2045 EPRI Project

- Engage with leading manufactures of appliances to factory install CEA 2045 port
- Engage with AMI companies and other vendors to build functional prototype communications modules
- Install 100 – 200 appliances across all participating utilities in the EPRI project in actual end-use locations
- Execute 2-way DR event commands
- Schedule:
  - Late 2014 – Fabricate and install in the field
  - All 2015 – Commissioning and run DR events
  - Early 2016 – Final report

# Residential DR – Water Heating

## Traditional water heater direct control switch

- Installed cost ~\$400 each (project goal <\$40 each)
- Usually requires electrical permit
- Requires electrician in customer's home
- Utility-owned box hangs on the wall  
(stranded investment - customers can disable)

## Water heating load is becoming smaller

- More efficient use of water (faucet, shower heads)
- Better heating efficiency (heat pump water heater)
- More use of cold water for washing
- Smaller-sized households and families

# Residential DR – Water Heating

DR capacity per tank is reducing over time

Approximate hourly average demand available at 7-8a

Time →

2000: ~ 0.8 kW

2010: ~ 0.6 kW

2020: ~ 0.4 kW ?



# Residential DR – HVAC

## Challenges in space heating/cooling

- Home owners usually not happy with the need to change thermostat to participate in DR program
- Thermostats starting to become proprietary with the HVAC equipment they control
- Increased efficiency in space heating also is driving lower DR capacity per home
- Occupant comfort issues (temperature control)

**A solution is needed to address these challenges in future DR programs**

# Modular Approach to DR Control

## Consumer Electronics Association (CEA) 2045 Standard, issued: Feb 2013





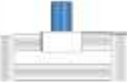



### CEA 2045 Standard:

An open protocol language and physical port

Intent is to have consistency and repeatability for end use equipment manufacturers (physical port)

Offers a wide variety of communications option for utilities triggering DR commands

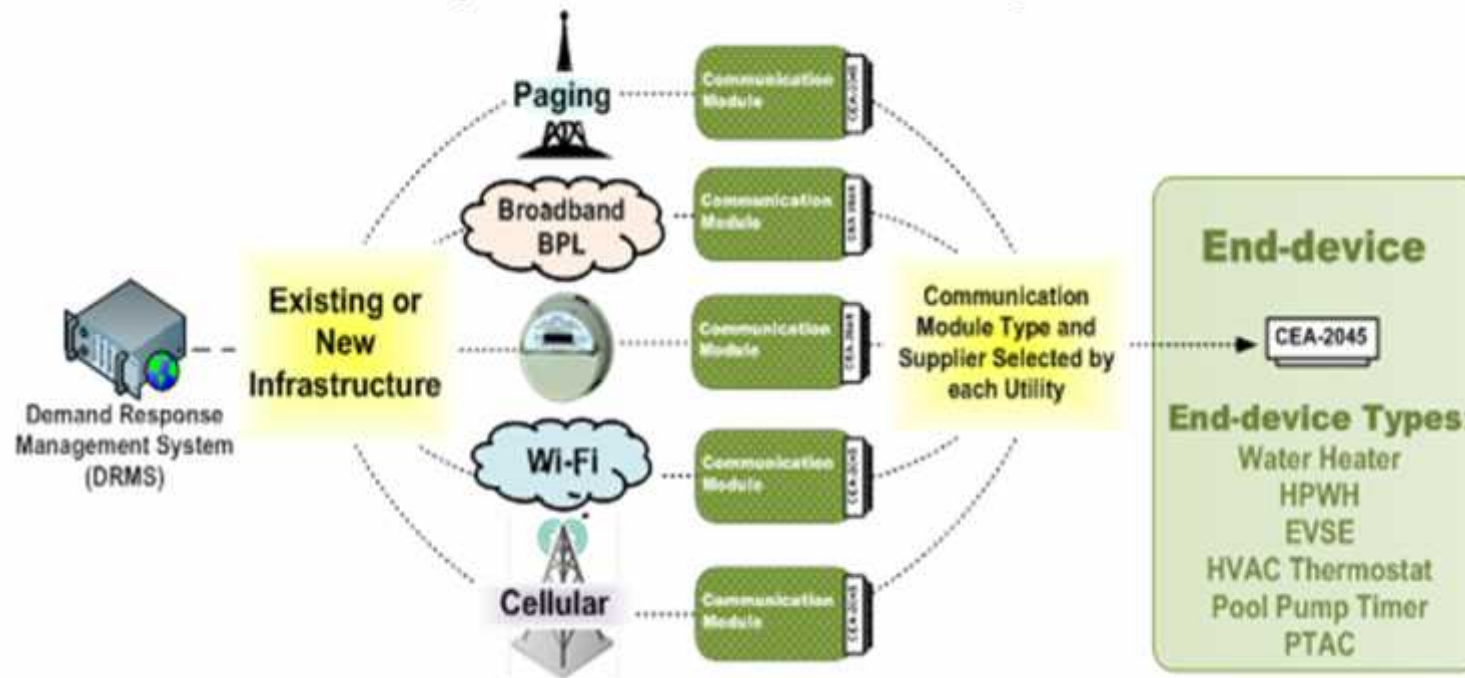
# Demonstrate CEA-2045 (EPRI Project)

		End-use Equipment Matrix							
									
Form Factor		DC	AC	AC	AC	AC	AC	AC	AC
Utility		Tstat / HVAC	Window AC/PTAC	Water Heater	EVSE	Pool Pump	Load Switch	Heat Pump	PV Inverter
EPRI		✓	✓	✓	✓	✓		✓	✓
Ameren		✓		✓	✓	✓			
American Electric Power		✓		✓	✓	✓			
Bonneville Power Authority								✓	
Duke Energy				✓	✓	✓	Evaluating	✓	
Hydro One		✓							
National Grid			✓						
Portland General Electric				✓	TBD				
Tri-State G&T				✓					
Southern Company		✓		✓					
Tennessee Valley Authority		✓		✓	✓	✓		TBD	
Southern California Edison									✓
SMUD									✓

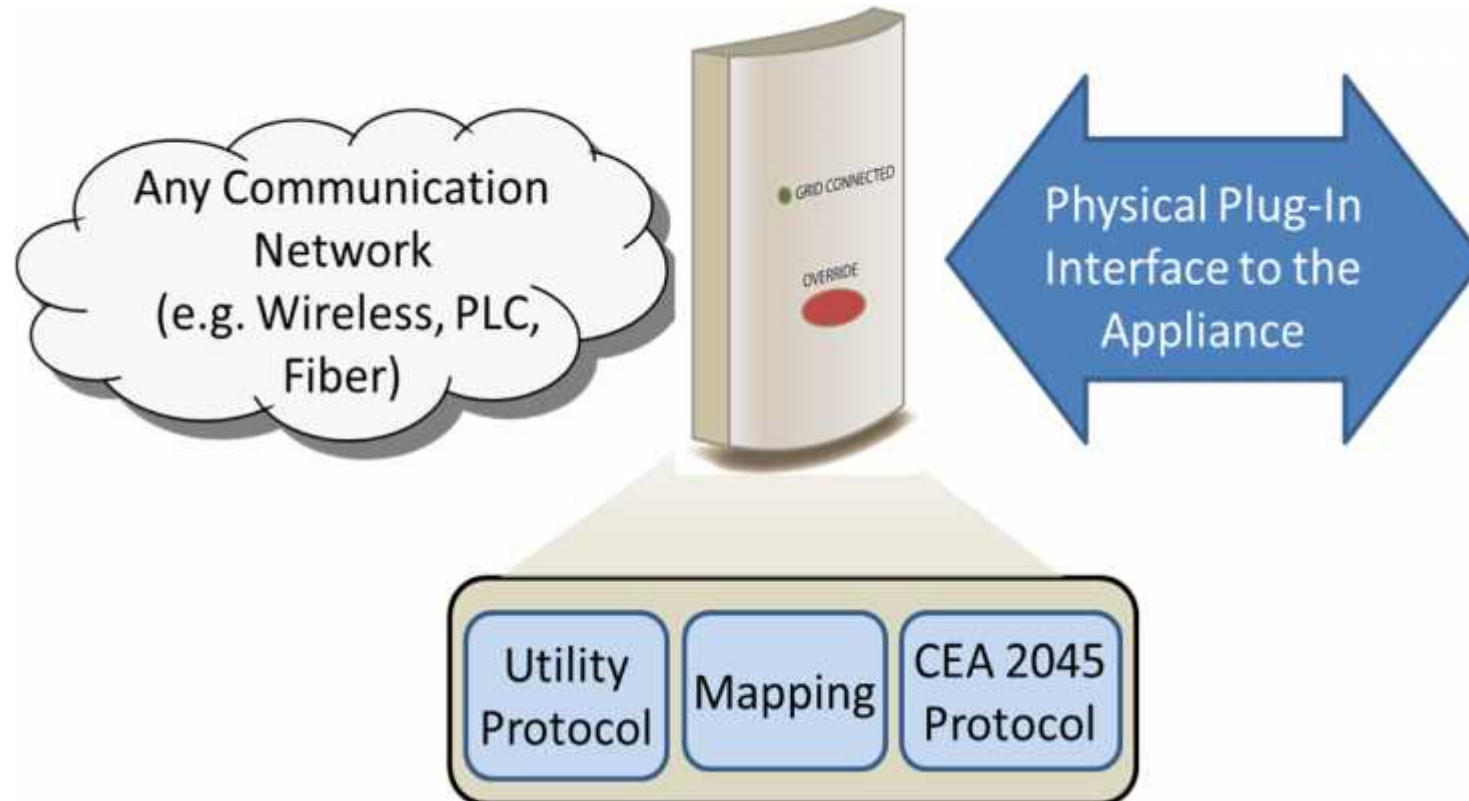
# CEA 2045 Communications

CEA 2045 is an open communications protocol and physical port: analogous to a computer USB port

- Repeatabe interface for equipment manufacturers
- Wide variety of communication options for the DR dispatch



# Universal Communications Module





# CEA 2045: Two Form Factors

DC Form Factor  
(3.3 VDC)



AC Form Factor  
(up to 240 VAC)



# CEA 2045: Two Form Factors

DC Form Factor  
(3.3 VDC)



AC Form Factor  
(up to 240 VAC)



# Sample of CEA 2045 Commands

Outside Communication Connection Status	“Heartbeat” signal repeated at least once every 5 minutes.
Shed	Reduce stored energy to minimum user comfort
End Shed	Unit returns to normal operation
Grid Emergency	Unit turns off for a maximum of one hour
Load Up	Increase stored energy to maximum user comfort
Simple Time Sync	Send time value from the UCM to SGD on the hour
Info Request	Returns whether device is an electric WH, HPWH, Thermostat, Unitary AC, Pool Pump, etc.
Consumption to Date & Present Power Use	Total use in kWh to date, and present power use in kW

# Challenge: Home Owner Portal

**CEA 2045 technology can be used by a utility and or home owner for home area network (HAN)**

- Utility would typically use AMI type networks
- Customer would typically use WiFi, Zigbee, etc

**Who gets to the port first? Utility or Customer**

# Possible Solutions:

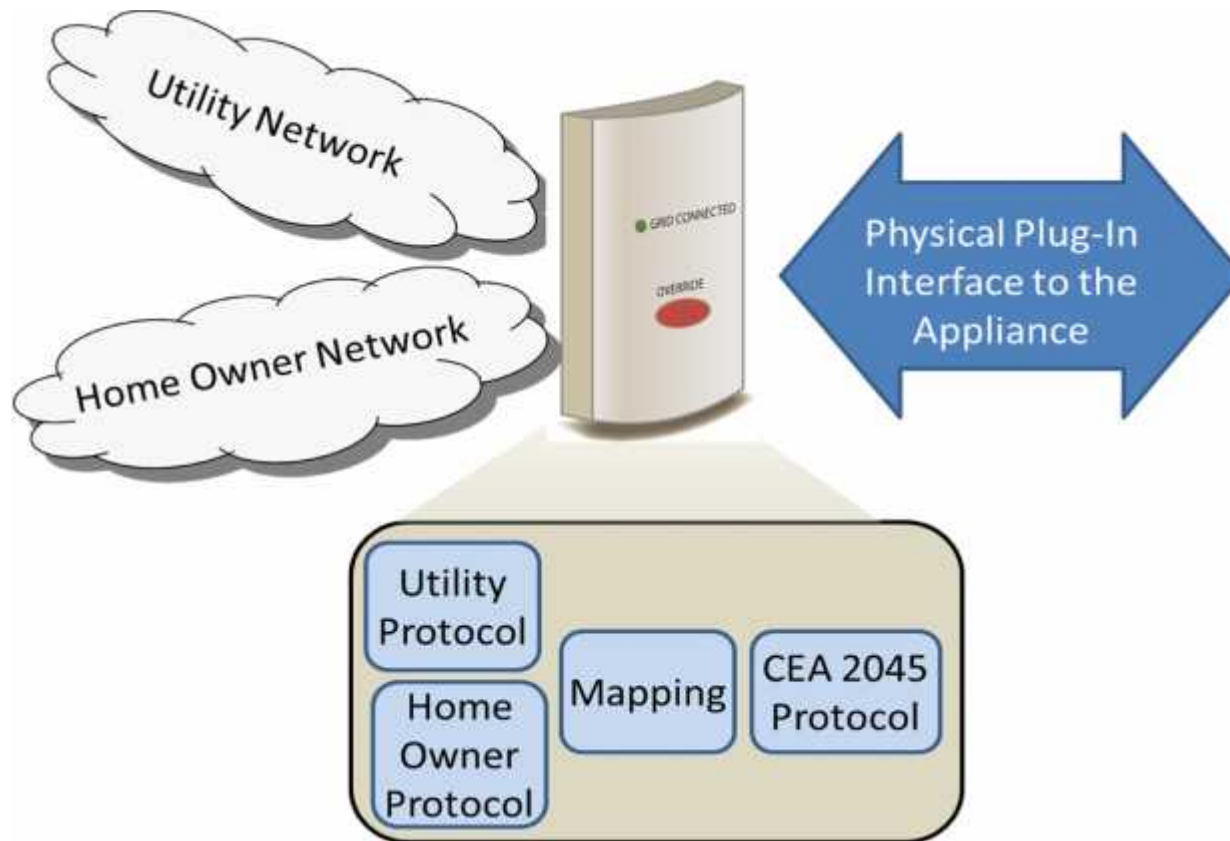
## Build two CEA 2045 ports

- Analogous to USB ports on the front of PCs
- Each communication module with different technology for network access



# Possible Solutions: *(continued)*

## Communication module with dual technologies



# Questions?

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# Upcoming Showcase Webinars

- Engine Generator Block Heaters – Wednesday, October 15, 2014

Information and registration at [www.e3tnw.org/webinars](http://www.e3tnw.org/webinars)

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