Electric Water Heaters and the Power Grid

ANSI/CTA-2045 Modular Communication Interface for Energy Management Services

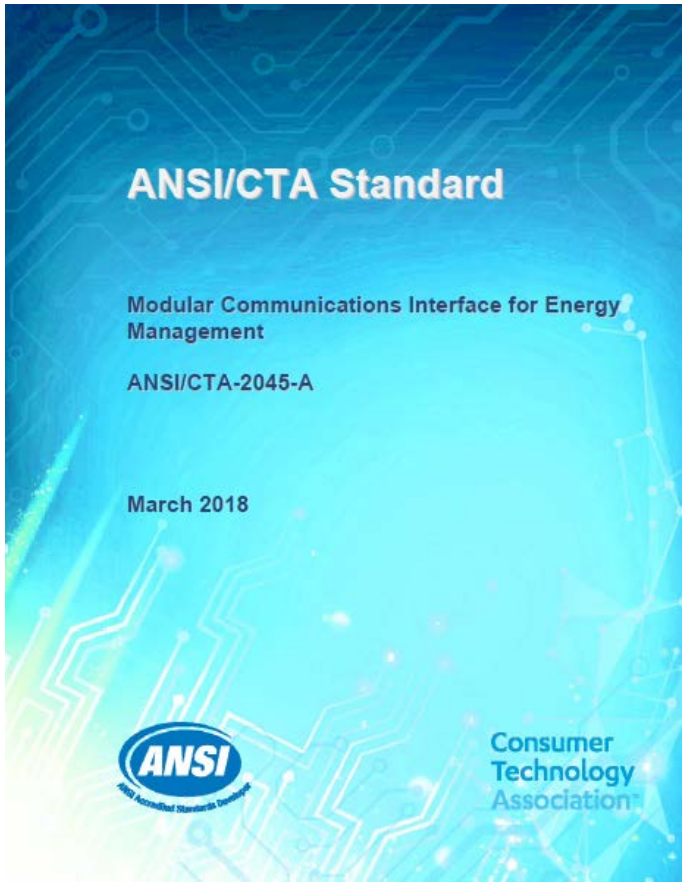
Chuck Thomas
EPRI

2019 ACEEE Hot Water Forum
Nashville, **Tennessee**
March 11th, 2019

© 2015 Electric Power Research Institute, Inc. All rights reserved.

ANSI/CTA Standard
Implementation and Revision History

- ***ANSI/CTA-2045 Released February 2013***
  - Twenty-two utilities and OEMs developed guidelines for “how to apply” CTA-2045 in electric water heaters to enables services to be provided to the grid
  - Products were built and independently tested against the guidelines
  - Communication modules were developed to manage grid services
  - Products were deployed and tested in labs and in service territories of thirteen different utilities across the US and Canada
  - Feedback from OEMs and Utilities were shared with the CTA-2045 standards working group (R7.8)
- ***ANSI/CTA-2045-A Released March 2018***
- ***ANSI/CTA-2045-B Release Date TBD***
  - To participate, contact Leslie King, Senior Manager Technology and Standards, Consumer Technology Association Lking@cta.tech



© 2015 Electric Power Research Institute, Inc. All rights reserved.

What is CTA-2045 and what it is not

What it is

- Communication Standard
  - Application Layer
  - Link-layer
  - Physical Layer
  - Connector
- Serial protocol
  - Point-to-point
  - Isolated from Cyber Threats
- Information is transmitted and received in sequential order and processed in “real-time”
- Information exchange protocol to facilitate grid services

What it is not

- A “Connector” standard
- Networking protocol
  - Peer-to-peer
  - Exposed to Cyber Threats
- Dependent on a timestamp to process information
- Command and control

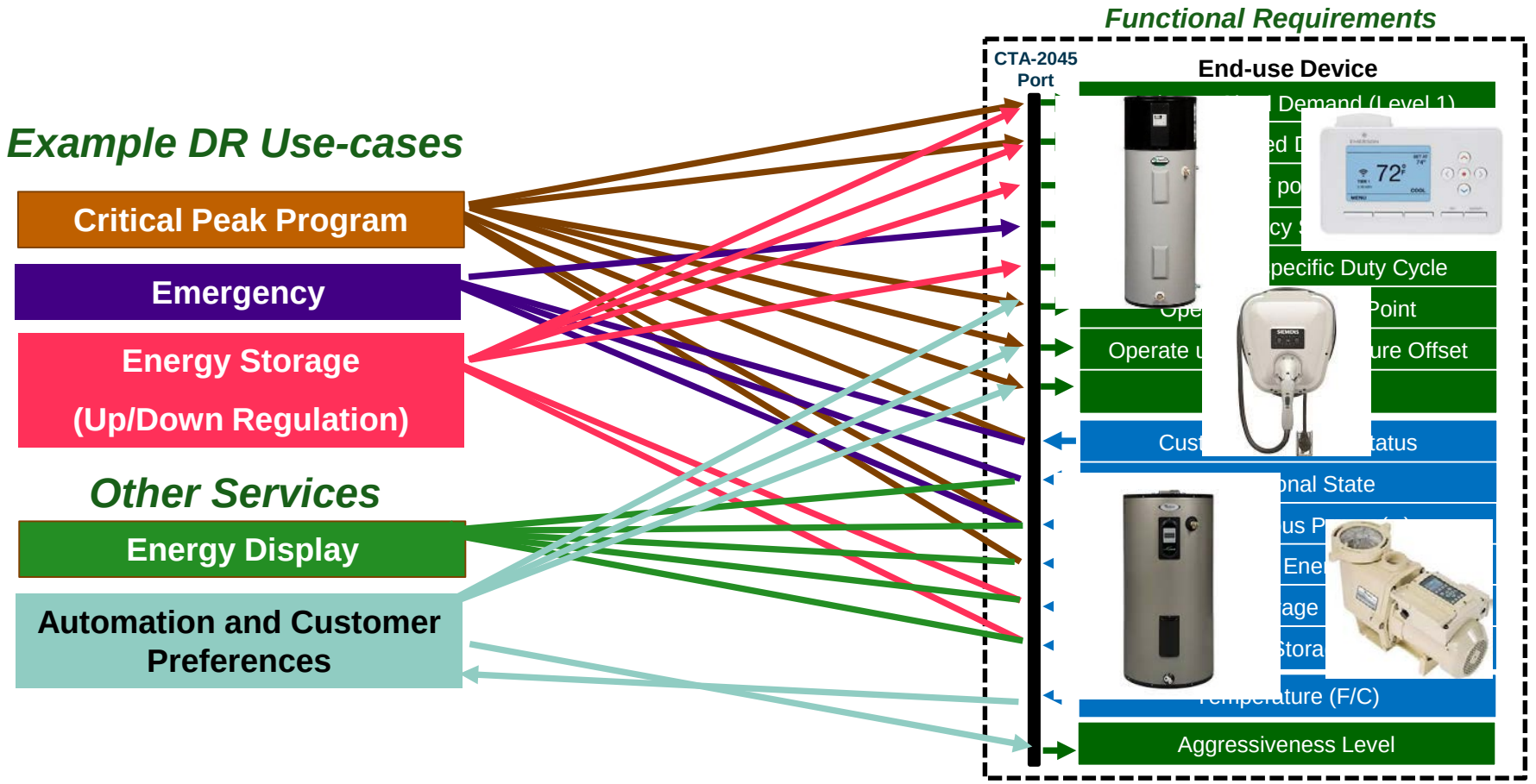
© 2015 Electric Power Research Institute, Inc. All rights reserved.

Aligning Utility Requirements, Device Capabilities and CTA-2045

Functional Requirements for CTA-2045 Devices

What information should be exchanged?

Can responses be predictable across different end-use device types?



© 2015 Electric Power Research Institute, Inc. All rights reserved.

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Functional Requirements

CTA-2045 Electric Water Heaters (overview)

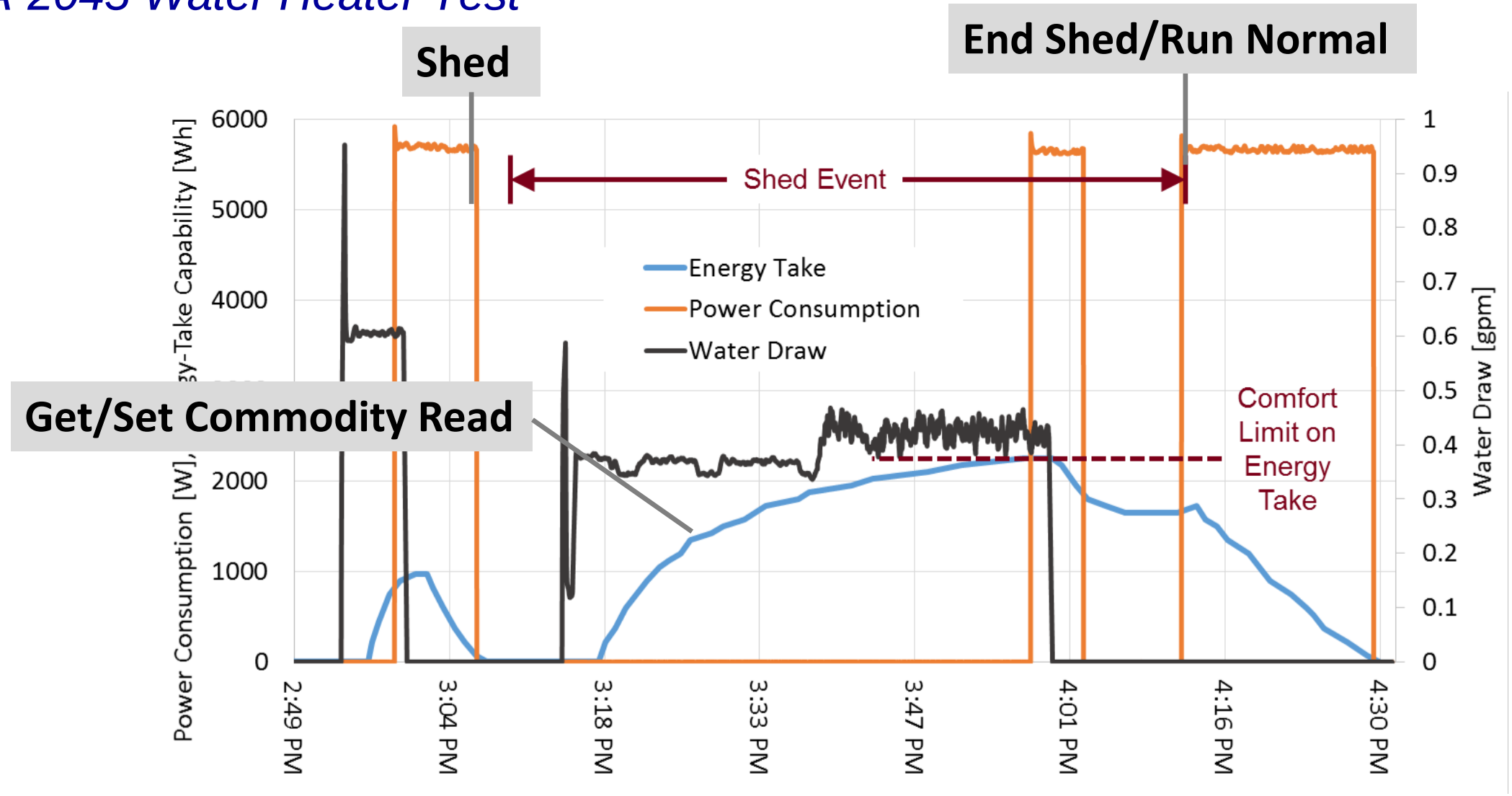
CTA-2045 Message	Water Heater Response
Link Layer	Link ACK, NAK, Max Payload Length Query/Response and Message Type Supported
Shed	Moderately reduce energy usage while maintaining customer comfort
End Shed/Run Normal	Return to normal operation
Critical Peak Event	Aggressively reduce energy usage while maintaining customer comfort
Grid Emergency	Immediately turn off (customer comfort is not maintained for up to 1-hr)
Outside Comm Connection Status	If a curtailment event is active and this message is not communicated, unit shall return to normal operating mode
Customer Override	User can override curtailment events by manually pressing a button on the unit.
Query operational state	Idle, Running, Idle Grid, Running Grid and Heightened Grid supported
Load Up	Unit will go to max set point (as determined by the user)
Info Request	Vendor ID, Device Type, Model #, SN and Firmware revision
Get/Set Temperature Offset	Not supported
Get/Set Set Point	Not supported
Get/Set Commodity Read	Instantaneous power, cumulative energy, Energy Storage Capacity, Present Energy Storage Level are estimated based on operational state, resistive element size and typical compressor energy draw
GetPresentTemperature	Not supported

Demand Response-Ready Domestic Water Heater Specification, Preliminary Requirements for CTA-2045 Field Demonstration, EPRI Palo Alto 2014 3002002710

© 2015 Electric Power Research Institute, Inc. All rights reserved.

National Renewable Energy Laboratory NREL

CTA-2045 Water Heater Test



Performance Test Results: CTA-2045 Water Heater: Testing Conducted at the National Renewable Energy Laboratory , EPRI Palo Alto AC, 2017 (3002011760)

© 2015 Electric Power Research Institute, Inc. All rights reserved.

Together…Shaping the Future of Electricity

Chuck Thomas
Senior Technical Leader
Information and Communication Technology Research
EPRI
cthomas@epri.com
office.(865)218-8031
mobile. (865)384-8578

Chuck Thomas leads EPRI's Buildings-to-Grid, Homes-to-Grid, Devices-to-Grid Integration Research

Specializes in Controls, Communications, System Integration and Field Verification of Emerging Technologies

© 2015 Electric Power Research Institute, Inc. All rights reserved.