

**DOCKETED**

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**SkyCentrics Comments on Section 11012 with other parties**

*Additional submitted attachment is included below.*

## How OpenADR and CTA-2045 can support the California grid



Dear Commissioner McCallister and Energy Commission Staff:

### **Comments Related to CEC 2022 Building Energy Efficiency Standards Section 110.12 for Both Non-Residential and Residential**

#### **The problem we are trying to solve**

The electrical grid is moving quickly to integrate more renewables and thus needs more flexibility due to their variability. The “new” demand response is a key element to taking advantage of this new dynamic grid. The new demand response delivers 24/7 load flexibility, providing what LBNL has described as “shed, shift, shape, and shimmy.” OpenADR has been a good solution to date for large interconnected loads in industrial and commercial applications, but the grid needs more distributed and diverse assets to rapidly scale up the amount of “new” demand response.

California is actively moving away from fossil fuels to heat buildings and water with new highly efficient assets (electrical loads). Many of these assets come in the form of discrete appliances or loads that are not connected to a server, hub, node, and/or the internet. Good examples of these loads and appliances include water heaters, pool pumps, EV chargers, inverters, residential HVAC, multi-family and commercial HVAC and water heaters and chillers (85% of commercial buildings do not have a Building Management System to connect to or to coordinate these loads), pumps, fans, and compressors. OpenADR is a robust solution (especially for large interconnected loads in industrial and commercial applications) as long as there is a solid connection to the load and there is sufficient infrastructure to support the “connected” load. In cases where the load is small, distributed, and diverse, OpenADR is generally too expensive and inappropriate.

In fact, since OpenADR was introduced in 2010, virtually zero individual machines sold to the residential or small commercial market have OpenADR resident inside them. Even in the large industrial and commercial sector, almost no machines have OpenADR inside them. In their place are hundreds of on-premise gateways, Building Management Systems (BMS), specialized third-party OpenADR “add-on” boxes, and networking systems that are OpenADR VEN-certified. A very few OEMs have implemented OpenADR VEN clouds which then control their proprietary machines through a single communication pathway (physical layer) chosen by them, which cannot be changed. This pathway is often Wi-Fi, and utilities have shown repeatedly that, aside from thermostats with their compelling reasons for almost

daily interaction from the homeowner, no other residential loads will reliably stay on the homeowner's Wi-Fi connection.

For these reasons, we are trying to guarantee the availability of an inexpensive, reliable, and flexible (easily changed) way to get to these residential and small commercial electric loads. This flexible communication pathway solution can only be inexpensively done at scale through a universal port such as the CTA-2045 port, as demonstrated by the example use case at the end of this document, in which the OpenADR functionality to a commercial building load is enabled only by a \$1500 third-party add-on box. Finally, OpenADR can be added to the CTA-2045 module at the appliance, when cost-justified.

**The most important thing to know is that thanks to Washington state law SB1555**, Rheem currently has more than 80 water heaters on the NEEA Tier 4 QPL that have CTA-2045 ports, and AO Smith, across all its brands, has over 100 models of CTA-2045-compatible water heaters. Essentially, the ship has sailed and the OEMs that manufacture more than 80% of water heaters have already committed to CTA-2045, as has CA Title 24 JA13 for new construction. Why not leverage this advantage and support the rapid growth of CTA-2045 for the more detailed benefits stated below?

*Proposed 2022 code language for reference:*

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## **SECTION 110.12 – MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT**

Buildings, other than healthcare facilities, shall comply with the applicable demand responsive control requirements of Sections 110.12(a) through 110.12(d).

**(a) Demand responsive controls.**

1. All demand responsive controls shall be either:
  - A. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification; or
  - B. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node by automatically implementing the control functions requested by the Virtual End Node for the equipment it controls.
2. All demand responsive controls shall be capable of communicating to the VEN using one or more of the following: Wi-Fi, ZigBee, BACnet, Ethernet, or hard-wiring, or any other bi-directional communication pathway.
- ~~3. Demand responsive controls may incorporate and use additional protocols beyond those specified in Sections 110.12(a)1 and 2.~~
4. When communications are disabled or unavailable, all demand responsive controls shall continue to perform all other control functions provided by the control.
5. Demand responsive control thermostats shall comply with Reference Joint Appendix 5 (JA5), Technical Specifications For Occupant Controlled Smart Thermostats.

### **Draft proposed alternative 110.12 language**

Buildings, other than healthcare facilities, shall comply with the applicable demand responsive control requirements in section 110.12 (a) through 110.12 (d).

**(a) Demand responsive controls.**

1. All demand responsive controls shall:

- a. For loads under 5 kW, have a certified physical CTA-2045 port.
- b. For loads over 5 kW, be able to communicate by either:
  - i. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in applicable OpenADR 2.0 Specification, or
  - ii. Certification by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node by automatically implementing the control functions requested by the Virtual End Node for the equipment it controls.
2. All demand responsive controls for loads over 5 kW shall be capable of communicating to the VEN using: CTA-2045, Wi-Fi, Zigbee, BACnet, Ethernet, hard wiring, or any other bi-directional communication pathway.
- ~~3. Struck through~~
4. When communications are disabled or unavailable, all demand responsive controls shall continue to perform all other control functions provided by the control.
5. Demand responsive control thermostats shall comply with Reference Joint Appendix 5 (JA5), Technical Specifications for Occupant Controlled Smart Thermostats.
6. Demand responsive heat pump water heaters shall comply with Reference Joint Appendix 13 (JA13), Qualification Requirements for Heat Pump Water Heater Demand Management Systems, which requires a CTA-2045 port.

## **Background and supporting information**

We will continue to refine this submittal with relevant stakeholders.

### **History**

OpenADR 2.0a and 2.0b have been promoted for years in California as a method for automatic control of electric loads to support the grid. It is well-established as a working method. While we have no data regarding its cost effectiveness or its net value to the grid, it works.

CTA-2045 has been piloted and demonstrated by utilities nationwide (ironically not so much in California) for more than seven years, and it has also been proven as an effective method. It is promoted as potentially the most cost-effective solution for residential appliance control, where the loads are small in comparison to industrial and commercial building loads—where OpenADR has had more “traction.” Based on the results of a pilot in the Northwest, Washington and Oregon have mandated the inclusion of CTA-2045 ports in all new electric water heaters (heat pump on Jan 1, 2021, and electric resistance by Jan 1, 2022 [Oregon will do both in 2022]). In addition, the CEC has committed to Title 24, JA13, requiring NEEA Tier 3 v7, which itself requires a CTA-2045 port for all new water heaters in new construction in California.

As with many things, when comparing OpenADR to CTA-2045, the devil is in the details.

**Why OpenADR and CTA-2045 are NOT equivalent, yet are quite complementary**

OpenADR is a specification about software only. It is hardware agnostic, and it assumes connectivity through various routes. Every piece of equipment that is OpenADR-capable can choose how it connects to the outside world and the OpenADR VTN. However, it must support TCP/IP (standard internet protocol), so the typical options are Ethernet (wired) or Wi-Fi (wireless). Ethernet connections could potentially use a proprietary dongle that provides an alternative communication path (cellular, LoRa, Zigbee, etc.), though to date that has been very rare. Wi-Fi-only connections have no hardware “port” to plug into, a condition that will exist for the life of the appliance, and thus limit that appliance to “Wi-Fi only” communications. Many utilities have expressed concerns about Wi-Fi being not reliable for equipment for which customers have very little interest in regular adjustment and communication, such as water heaters, in contrast to thermostats, which people adjust often.

CTA-2045 is an open standard specification about hardware and software. The hardware portion of the specification guarantees a standard, common hardware port, similar to the concept of a USB port on a computer. The software portion of the specification guarantees a rich set of commands that must be enabled (for water heaters—three levels of shed and two levels of load up, customer override, prices to devices, etc.), and data from the device that must be delivered (power usage, storage capacity, operational state, etc.). The existence of a hardware communications port is the only way of guaranteeing physical layer<sup>1</sup> flexibility over the life of the appliance, as shown in Item 1 of the second list below.

Since OpenADR does not specify the communication pathway, each OEM can choose any one of many communication pathways, creating a wide variety of implementations that create havoc for a utility trying to implement and market a demand flexible solution at scale. Potential OEM solutions to provide OpenADR are shown in the following table, in the left column; the CTA-2045 solution (right column) can provide all of the equivalent benefits.

OpenADR	CTA-2045
<b>How the machine can communicate:</b>	A CTA-2045 port on the appliance guarantees the flexibility to choose any communication path, instead of the ONE communication path chosen by the OEM. <sup>2</sup>
Ethernet Port	
Wi-Fi	
Cellular	
Bluetooth	
FM Radio	
<b>Where the OpenADR occurs:</b>	
At an OEM cloud	
At a third-party cloud	

<sup>1</sup> Examples of the physical layer include Ethernet, Wi-Fi, Cellular, Zigbee, FM Radio, AMI Mesh, etc.

<sup>2</sup> To be comprehensive, the OEMs could provide proprietary dongles, which would lead to the CEC Commissioner McCallister’s expression of “we don’t want dongle-itis.” When OpenADR is needed on the device, it can be placed in the CTA-2045 module; however, while the size of the electric load of the asset will often not justify the extra expense of OpenADR, it will justify the expense of a non-OpenADR CTA-2045 module.

On the device	
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**Benefits of a CTA-2045 port that OpenADR cannot provide (specific to water heaters)**

1. Guaranteed communication path flexibility for the lifetime of the load (future-proofing)
  - a. At any time, the user or utility can choose a new and different communication path to communicate to the load (cellular, AMI mesh, FM radio, LoRa, etc.) by simply installing a CTA-2045 module with that capability. An OpenADR Wi-Fi load must remain Wi-Fi forever.
2. Guaranteed prevention of stranded assets
  - a. If a module maker goes out of business, the module can be replaced by the end-use customer at low cost (with delivery via US Mail).
3. Guaranteed performance
  - a. To be CTA-2045-B Level 2 compliant, a water heater must accept and respond to three levels of shed, two levels of load up, customer override, and 24 hour ahead time price pairs (prices to devices).
4. Guaranteed data delivery
  - a. To be CTA-2045-B Level 2 compliant, a water heater must deliver the following data points:
    - i. Current instantaneous power usage
    - ii. Storage capacity in watt-hours
    - iii. Total possible maximum storage capacity in watt-hours
    - iv. Total energy usage (like an odometer)
5. Guaranteed flexibility to have OpenADR and its general additional expense, or not
  - a. See below to see an example where OpenADR costs a lot more than CTA-2045.
  - b. OpenADR can be put on a CTA-2045 module as the below example shows.

Other end loads and resources with similar guaranteed performance and data delivery are being written for other load types (HVAC, pool pumps, EV chargers, etc.). The following table shows the OEMs currently using CTA-2045 ports:

<b>CTA-2045 AC</b>	<b>CTA-2045 DC</b>
AO Smith—Electric Resistance Water Heater	Siemens—EVSE Car Charger
AO Smith—Heat Pump Water Heater (HPWH)	Mitsubishi—Mini-Splits
IslandAire—PTAC HVAC units	GE Appliances—Heat Pump Water Heater
Pentair—Variable Speed Pool Pump Controllers	Bradford White—Heat Pump Water Heater
Rheem—Heat Pump Water Heater	Nyles—Water Heater (110V heat pump)
Mitsubishi QAHV—Central System HPWH	Emerson—30 Amp Water Heater Switch
Mitsubishi—VRF	Emerson—Thermostat

**Current use case for OpenADR**

To illustrate items 3-4 in the list above the preceding table, the following OpenADR current use case is instructive.

An HVAC appliance maker for commercial buildings has an appliance that can speak Modbus or BACnet if an extra fee is paid for the software module that enables it. Building Management Systems (BMS) traditionally use these. Its OpenADR solution consists of a hardware box that is OpenADR-compliant. It costs \$1,500 and is OpenADR only through the box manufacturer's cloud. It delivers signals to the HVAC system controller through four relays that can be either on or off, thus the HVAC system controller can only respond to four different signals. Imagine those signals to be Run Normal, Shed, More Shed, and Load Up. No data are delivered to the OpenADR hardware box, so there is no telemetry for M&V; the signal is only one-way.

- Cost of OpenADR solution with no data delivery = \$1,500 hardware box + installation (\$500–\$2,000) + **yearly** SSL certificate fee (\$40 for one, \$5–10 each for thousands) + possible cloud cost of hardware box vendor (currently there is only a cloud solution)
- Cost of CTA-2045 solution with data delivery and OpenADR on module = \$50–150 cost of module (generally at the low end) + **yearly** SSL certificate fee for the whole fleet
- Cost of CTA-2045 solution with OpenADR in cloud = \$50–150 cost of module + module maker cloud fee (less than **yearly** SSL certificate fee)
- Cost of CTA-2045 solution with NO OpenADR = \$50–150 cost of module (maybe less without OpenADR) + module maker cloud fee (less than **yearly** SSL certificate fee) (maybe less without OpenADR)

CTA-2045 enables broader adoption of OpenADR. The commands in OpenADR that define control functionality can be easily conveyed through the low-cost CTA-2045 physical interface at the appliance by putting it on the CTA-2045 module only when necessary or when the cost is justified. Meanwhile, less expensive CTA-2045 modules can communicate locally to an OpenADR gateway, or to an OpenADR cloud. This eliminates the obligation of every appliance to bear the extra cost of adding the OpenADR interface and annual SSL certificate fee. In these ways, CTA-2045 will broaden and support the number of appliances that can be accessed by OpenADR or other grid control information exchange models such as IEEE 2030.5.

As appliances with CTA-2045 ports further penetrate the market, a wide variety of communication paths and information exchange models will be enabled; this will encourage competition and innovation, which generally result in lower costs for consumers. Utilities and aggregators can fine-tune the level of security, the communication path(s), and the information exchange models that their business models can support. The existence of a CTA-2045 port on the appliance guarantees this optionality and flexibility in a way that OpenADR alone does not, and more importantly, in a way that proprietary communication modules “hard-wired” into the appliance do not, thus future-proofing the appliance.

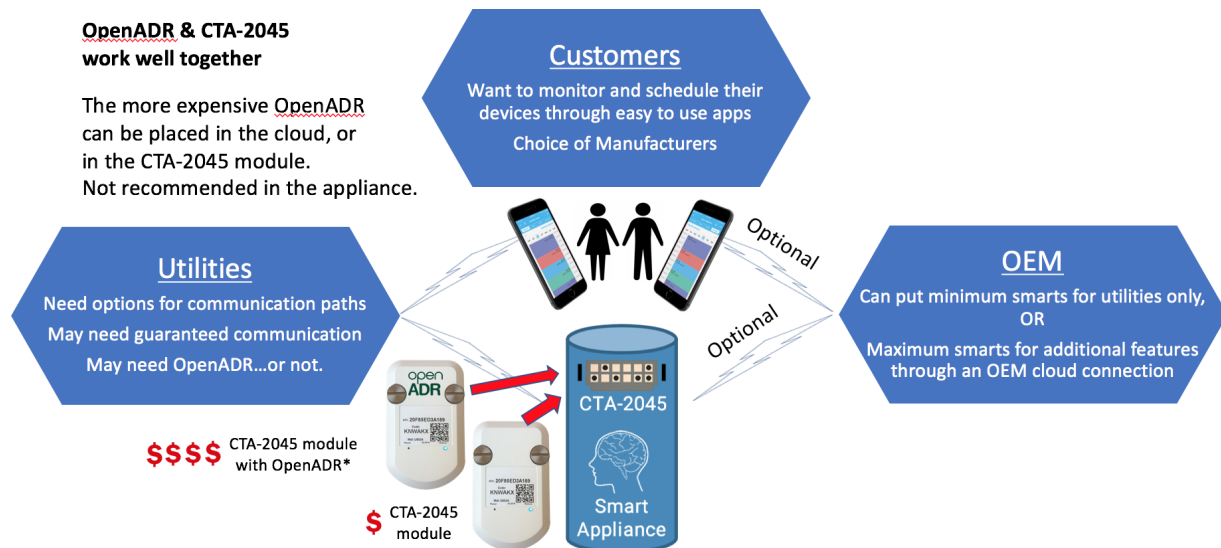
As illustrated in the graphic below, OEMs that have hard-wired solutions can maintain them while also adding the CTA-2045 port as an option. This flexibility and future-proofing inspired Washington State to pass HB1444, which mandates a CTA-2045 port in all new water heaters



sold in the state after Jan 1, 2021. The features of OpenADR and CTA-2045 work together to create a wide variety of options for low-cost, integrated solutions for customers and utilities that will accelerate adoption of orchestrated, intelligent, flexible loads for grid control.

All the benefits of the universal communication module make economic sense only if there is a universal port on the appliance. The incremental cost to add a port on an appliance could eventually be less than a dollar, but only if it becomes the universal standard placed on millions of appliances each year. If an appliance doesn't have the port, there is no possibility of using a standard module. CTA-2045 is a pragmatic solution to the integration of dynamic grid conditions, not just a question of cost/benefit.

CTA-2045 is a modular open standard for direct connection to smart grid appliances without the need for a communication hub in the home. In the future, a hub/gateway may benefit customers when they have several smart appliances whose control must be coordinated by an in-home energy management system. OpenADR is an open standard that can leverage a CTA-2045 port in every appliance through its location in the cloud, in the hub, or in the CTA-2045 module when desired. The telecommunications, automotive, and computer industries have all created standards that allow for lowest-cost solutions with maximum interoperability and great customer experiences. CTA-2045 is a fitting addition to that category.



\*OpenADR is expensive to code, certify, and has a yearly SSL certificate cost! Put it in the module if necessary, NOT IN THE APPLIANCE

### OEM communication path options for smart connected appliances

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