| DOCKETED | |
|---|---|
| **Docket Number:** | 24-FDAS-02 |
| **Project Title:** | Load Flexibility Policy & Planning |
| **TN #:** | 260059 |
| **Document Title:** | Power Networks response to CEC FDAS-24-02 |
| **Description:** | Power Networks response to CEC Docket # 24-FDAS-02, Request for Information (RFI) and Feedback: Expanding Flexible Demand in California through Statewide MIDAS Data Delivery: A Comparison of Signaling Options. |
| **Filer:** | Robert Cruickshank |
| **Organization:** | Power Networks |
| **Submitter Role:** | Public |
| **Submission Date:** | 11/15/2024 9:41:22 AM |
| **Docketed Date:** | 11/15/2024 |

Power Networks, LLC
132 Cruickshank Rd
Big Indian, NY 12410
703-568-8379
rfciii@ cruickshank.org

15 Nov 2024

CALIFORNIA ENERGY COMMISSION
715 P Street
Sacramento, California 95814

Subject: Power Networks response to CEC Docket # 24-FDAS-02, *Request for Information (RFI) and Feedback: Expanding Flexible Demand in California through Statewide MIDAS Data Delivery: A Comparison of Signaling Options.*

Honorable Commissioners and Staff –

Power Networks appreciates the opportunity to respond to the subject RFI. Our 30 years of expertise are at the intersection of consumer electronics, telecommunications, and the electric power grid. We help design, globally deploy, and operationally support standards-based consumer electronics connected to hybrid broadcast and broadband networks. From Ted Turner's first all-digital, satellite-based superstation (Cable News Network - CNN) to modern fiber and coaxial cable broadband networks, the telecommunications standards we help develop and curate enable the interconnection of billions of networked set-top boxes, cable modems, and power supplies, each of which observes grid power quality. In our experience, the far-reaching, low-latency connectivity of hybrid broadcast and broadband networks can rapidly accelerate the deployment of flexible demand and provide quantum leaps in viewing and efficiently managing the grid.

Combining multiple communications technologies provides the missing link to scaling up flexible demand. To that end, we suggest clarifications to the report referenced in the RFI:

1. The state can add existing FM Radio Data System (FM RDS) and 5G/LTE cellular data networks to complement today's broadband/Wi-Fi networks, connect billions of energy management devices, and better manage the load on the grid.
2. Energy management devices can better thwart nefarious grid cyber-attacks by using multi-network authentication across FM RDS, 5G/LTE, and/or Wi-Fi.
3. FM RDS adds a much-needed capability to manage demand on the grid time-synchronously in transportation, residential, commercial, and industrial sectors.

In short, FM RDS, 5G/LTE, and broadband/Wi-Fi each have unique and necessary capabilities. FM RDS and 5G/LTE networks should be added to (not replace) broadband/Wi-Fi. Doing so enables multi-network authentication to build upon increasingly popular multi-factor authentication. In addition, time-synchronous broadcast of energy management messages is essential for immediately reducing stress on the grid, for example, during emergency load curtailment when demand exceeds supply or during “black start” grid restoration after an outage.

Perhaps motivated by capitalistic incentives, some RFI respondents' submissions a) downplay the merits of FM RDS and 5G/LTE and b) Favor the ongoing deployment of non-interoperable proprietary technologies. For example, utilities are inclined to increase their investment return by deploying capital-intensive equipment such as smart meters. Likewise, manufacturers are inclined to sell proprietary products and dictate what new functionality will be included, when it will be available, and what it will cost. In contrast, buyers are inclined to purchase products based on interoperability standards that enable multiple manufacturers to compete on price, performance/functionality, and availability.

Case in point, cellular phones are interoperable in that they work on all carrier networks. Yet, most smart energy management devices are not interoperable, which thwarts scaling up.

By way of example, Power Networks demonstrations of broadcast-based, plug-and-play, configure-less, managed charging of electric vehicles are covered in this1-min video https://bit.ly/47kbjJ5 and 7-min video https://bit.ly/41HoOBc.

Starting on the next page are each of the RFI questions, followed by our responses.

Please let us know your questions.

Respectfully submitted,

Robert F Cruickshank III
Managing Member

*1. In regard to communication standards, what reliable alternative communication technologies exist to communicate directly to or with appliances?*

Communication technologies should be considered additive as opposed to alternatives. Experience dictates that multiple network technologies are required to meet all needs. The more networks securely observing the grid and communicating with appliances, the better.

Broadcast and unicast communications are complementary, proven, and reliable network technologies that can communicate directly to or with appliances. *Broadcast* technologies include terrestrial data transmission using existing FM radio transmitters to simultaneously communicate with millions of appliances. *Unicast* technologies include broadband/Wi-Fi and cellular data networks, which use Internet Protocol (IP) to communicate with appliances one at a time (not simultaneously). With unicast IP, the time it takes to communicate with appliances scales up with the total number of appliances; more appliances means longer and more variable communication times, which means less effective energy management. In the October 4, 2023, test of the U.S. Nationwide Alert System, it took more than 10 minutes to reach the last of several hundred devices using Wi-Fi and Cellular telephone data networks.

To date, most energy management messages are delivered via unicast using IP, not via broadcast. While IP networks provide many advantages, they cannot match the precise timing capabilities of broadcast networks. Timing precision in broadcast networks is measured in microseconds, one thousandth or less of the timing precision in IP networks.

Combined with broadband/Wi-Fi and cellular telephone data networks, broadcast data networks are useful technologies to communicate directly to or with appliances. Broadcast data networks, such as the FM Radio Data System (FM RDS) and FM HD Radio, are widely used worldwide and provide critical advantages: they are secure, reach more devices, and provide simultaneous delivery. For example, over 100 million cars with HD radios are on the road. Today, millions of electric vehicles can flex their managed charging demand with no new hardware, just an over-the-air software update.

Imagine if Amazon could deliver all customer packages at once. That is what broadcast does with energy management messages. Broadcast delivers all messages simultaneously to benefit the grid. Even as IP networks become faster, their inherent design is such that they will never match broadcast networks' low-latency simultaneous transmission capabilities. Never, ever.

*2. Do you see any opportunities for CEC to mitigate the challenges associated with a 24/7/365 signal that have historically limited broadband/Wi-Fi as a preferred communication pathway?*

We see immediate opportunities to add broadcast FM RDS and 5G/LTE networks (where needed) to mitigate the challenges associated with a 24/7/365 signal that have historically limited broadband/Wi-Fi as a preferred communication pathway.

Today, the impacts of Wi-Fi availability and configuration issues limit the effectiveness of DR programs. Despite 50 years of DR deployments, only 10-15% of Wi-Fi-enabled energy management devices are enrolled in energy management programs. Even worse, the attrition of enrolled devices that stop participating in energy management programs is ~10% annually. In contrast, FM RDS and 5G/LTE networks can reach ~90% of energy management devices with only ~1% annual attrition. See our videos on using an FM broadcast to manage EV charging: 1-minute https://bit.ly/47kbjJ5 and 7-minute https://bit.ly/41HoOBc.

The first challenge FM RDS and 5G/LTE networks can mitigate is consumers having to provide broadband for energy management devices, such as appliances. In California, while 80% of homes subscribe to a broadband service, nearly 25 million homes cannot participate in energy management programs requiring broadband/Wi-Fi. Furthermore, homes that don't have broadband/Wi-Fi and cannot participate in energy management programs are disproportionally located in distressed and rural communities. As such, FM RDS and 5G/LTE enable energy management and value creation for low-to-median income and rural communities.

Another challenge FM RDS and 5G/LTE can mitigate or eliminate is limited Wi-Fi network reach within a home or business. Too often, Wi-Fi signals do not reach and reliably connect to spas, swimming pool pumps, and other equipment located outdoors or in hard-to-reach areas, like water heaters in basements and utility closets. Wi-Fi connectivity issues can be mitigated by adding FM RDS and 5G/LTE communication pathways to connect hard-to-reach appliances.

Another challenge FM RDS and 5G/LTE can mitigate is consumers having to configure their energy management devices to connect to Wi-Fi. Many consumers need help with configuring Wi-Fi. For example, over a decade, the most significant driver of customer support calls to broadband providers is consumers needing help reliably connecting to Wi-Fi. In contrast, the FM RDS and 5G/LTE communications can be plug-and-play, not require any consumer setup, and be configure-less at installation.

Perhaps worst of all, a never-ending challenge that broadcast can mitigate is consumers having to be vigilant in observing and fixing Wi-Fi configuration issues that arise when customer routers are upgraded, new software is downloaded, and passwords are changed. Maintaining consumer vigilance in identifying energy management device connectivity issues can be difficult as they are not as obvious as identifying connectivity issues with cell phones, tablets, or game consoles. Across the vast geographies where FM RDS and 5G/LTE signals are sufficiently strong, each can be a permanent workaround to mitigate Wi-Fi requirements and configuration issues.

*3. Given the report's conclusion that broadcast delivery of MIDAS data is more cost-effective than point-to-point delivery for the volume of appliances under FDAS, what are the main concerns with a statewide FDAS signaling system that relies on a broadcast, and what cost-effective solutions might mitigate these concerns?*

The main concerns with a statewide FDAS signaling system that relies on one-way broadcast of energy-related messages are: 1) FM RDS signals will be unable to reach and reliably connect to a small number of appliances, and 2) While broadcast is sufficient for communicating with many/most devices, some devices require or will additionally benefit from two-way IP communications.

In cases where FM RDS doesn't reach appliances, Broadband/Wi-Fi and/or 5G/LTE connections should be used to mitigate connectivity concerns. The statewide FDAS signaling system should rely on a hierarchy of connectivity options from lowest-cost to highest-cost technologies to be most cost-effective.

In addition, A hybrid of broadcast and unicast networks can mitigate concerns related to accelerating scalability of deployments. For example, enabling configure-less plug and play, addressing individual devices (where and when needed), and providing a continuous spatiotemporal DR signal that benefits all stakeholders and the grid, including generation, transmission, distribution, storage, and end-uses.

*4. How should the CEC prioritize broadcast options presented in Chapter 3 (FM, AM, Cellular) and why? Are there more appropriate and cost-effective broadcast options not listed here?*

Broadcast options should include FM RDS and FM HD Radio. There is little buildout of AM radio data services and thus, AM does not need to be prioritized.  As a point of clarification, cellular networks provide unicast data, not broadcast data.

Broadcast is no more or less critical than unicast. All secure networks have roles to play, can be complementary, and can provide symbiotic benefits. In a self-healing way, when a broadband/Wi-Fi IP connection stops working, perhaps due to a configuration error, another network can automatically bring the device back online, such as FM RDS or 5G/LTE. In addition, satellite networks can connect energy management devices in remote environments without FM radio, cellular data, or broadband service.

*5. What message content options (e.g. GHG, price, or some combination) do you suggest being sent using the default FDAS Rate Identification Numbers discussed in Chapter 2, and why?*

Messages with GHG and price are deployed in California and elsewhere. In addition, new message content will be needed to mitigate the overloading of distribution grids (i.e., distribution congestion), including end-of-line transformers, where price differences would create inequities among neighbors who expect to pay the same price.

In all cases, message content should be standards-based and support devices, such as appliances, making immediate and throughout-the-day decisions on when to add or shed load. For example, message content should enable immediate DR and over-time DR, i.e., should support both event-based and continuous DR.

To accommodate GHG, price, and other signals, message content should convey a window of hourly (or less) values that provide the percent of total daily usage that a device should plan to use in each hour over a 24-hour horizon (with all values summing to 100%). For example, see the American National Standard for Optimum Load Shaping (OLS) at [https://account.scte.org/standards/library/catalog/scte-267-optimum-load-shaping-for-electric-vehicle-and-battery-charging/](https://account.scte.org/standards/library/catalog/scte-267-optimum-load-shaping-for-electric-vehicle-and-battery-charging/). The OLS signal can be based on any combination of price, GHG, or distribution congestion signals or other stimuli.

*6. Voluntary utility and third-party programs for load flexibility (shifting) have typically had very low participation from end users. What alternate Load Flexibility program(s) would you recommend that maximize participation while being ubiquitous, cost-effective, equitable, and technically feasible without requiring or precluding participation from third parties?*

Low participation in third-party load flexibility programs can be attributed to the difficulties consumers face during enrollment and ongoing operations that lead to attrition (see response to Question 2 above). Difficulties can be overcome through a simpler consent and sign-up flow for third parties, in which participation in a DR program occurs during the set-up process of a smart energy management device. Appliances and smart devices should opt-in automatically and provide interfaces for opt-out and automated demand flexibility.

In addition, there should be a review of related CPUC DR-related rulemakings, e.g., R.22-07-005, which have pilots underway from Jun 2024 - 2027. In addition to lessons learned from pilots, alternate Load Flexibility programs should incorporate configure-less, plug-and-play devices whose functionality can be built-in to appliances and do not require or preclude participation by third parties.

*7. Assuming a statewide broadcast signal were to be deployed, would a default appliance setting that automatically initiates response to MIDAS signals at installation allow for ease in initiating flexibility of the appliance? What issues or concerns would you anticipate with such plug-and-play functionality?*

A default appliance setting that automatically initiates responses to MIDAS signals at installation could simplify initial setup and encourage participation. However, several concerns need to be addressed: The appliance owner must be informed, able to opt-out, and optionally provide device location information. For example, electric vehicles can share their GPS coordinates when querying the grid to see if a local load shape exists that would help mitigate congestion in a distribution network, i.e., mitigate congestion on distribution feeders that may become overloaded from time to time due to the increased demand for electricity based on weather, consumer EV charging behavior, or other factors.

A default appliance setting that initiates an automatic response to MIDAS signals at installation will allow for ease in managing the flexibility of the appliance. Consumer acceptance of widespread default opt-in device signaling should be demonstrated. Default configurations could 1) minimize the difference between an OLS signal and a device's expected energy usage and 2) automatically gross up a device's energy usage to meet the OLS signal for the hours a device, such as an electric vehicle, is plugged in and charging.

Initiating & responding to real-time and over-time signals will be more complex than a device responding to a traditional event-based DR command from a utility. A pilot deployment would help identify concerns such as a robust user experience. In addition, potential opt-out rates, security, and validation issues should be considered and mitigated.

*8. The report proposes a hybrid communication architecture that incorporates both plug-and-play MIDAS response and third-party program-enabling technology, represented by the Plug-and-Play Port scenario, as the most cost-effective solution to enable demand flexibility for an appliance. What do you think are some pros/cons of this approach?*

In considering the pros/cons of cost-effective solutions to enable demand flexibility, both plug-and-play and third-party options should be included. In addition, current and future product availability should be considered.

Regarding the pros, today, across the US, Canada, and Mexico, all Home Depot and Lowes stores and many other retailers have Demand Response-Ready (DRR) water heaters available for sale. Oregon and Washington already require all new water heaters to have DRR capabilities. Other states positioned to have similar DRR requirements include CO, HI, MN, and NY. All DRR water heaters have a CTA-2045 EcoPort that is accessible to consumers or third parties. In addition to the EcoPort, DRR water heaters already support Wi-Fi and/or Bluetooth connectivity.

Regarding the cons, given that water heaters already support DRR EcoPorts, Wi-Fi, and Bluetooth, the proposed plug-and-play MIDAS response and third-party program-enabling technology require software changes and a minor hardware change (adding a $1.50 FM RDS receiver module). In the interim, consumers can self-install an EcoPort, or a 3rd party can perform the installation. There is no need for a licensed electrician.

Third-party providers may deliver more value than the default MIDAS rate response. Enabling third parties is essential as they may be better positioned to tailor participation based on users' needs and preferences.

*9. The consultant report suggests that a gateway architecture cannot support plug-and-play flexibility. Is this accurate from your perspective? If not, describe how a gateway solution could enable both intrabuilding load optimization and plug-and-play flexibility for appliances without sacrificing cybersecurity.*

Gateway architectures can support plug-and-play flexibility. Based on the ANSI/SCTE 267 Optimum Load Shaping standard, an energy management device can receive a wide-area load shape, e.g., for a California RIN, via FM broadcast or other means. In addition, a device can choose to use a two-way IP connection (via Wi-Fi or 5G/LTE) to validate OLS signals securely. Furthermore, a device can share its GPS coordinates with a gateway to check for a local load shape. For example, an electric vehicle can share its GPS coordinates and find out whether there is a local load shape that it should follow instead of the broadcast load shape. The OLS standard was designed so devices could use a local plug-and-play gateway accordingly for neighborhood-level and intrabuilding applications.

*10. Are there equity issues related to a MIDAS plug-and-play architecture that remain unaddressed by the report?*

There are unaddressed equity issues related to a MIDAS plug-and-play architecture. In California, 80% of homes subscribe to a broadband service. As such, 25 million homes cannot participate in broadband-based energy management programs. Those unable to participate are disproportionally located in distressed and rural communities, which creates inequities. (see response to Question 2 above).

***11. Provide a summary of your support for and/or rejection of any of the recommendations and conclusions offered in the report, along with a brief description of why for each.***

Today, the impacts of Wi-Fi availability and configuration issues limit the effectiveness of DR programs. Despite 50 years of DR deployments, only 10-15% of Wi-Fi-enabled energy management devices are enrolled in energy management programs. Even worse, the attrition of enrolled devices that stop participating in energy management programs is ~10% a year. In contrast, FM RDS and 5G/LTE networks can reach ~90% of energy management devices with only ~1% annual attrition.

In 1969, the live transmission of Neil Armstrong walking on the moon was the largest time-synchronous transmission in the history of mankind. Some six hundred and fifty million people watched and heard, *at the same time*, “That’s one small step for a man, one giant leap for mankind.” Broadcast delivery of energy management messages is a small step that, when coupled with existing IP delivery methods, will vastly expand the penetration of energy management messages and devices to create a giant leap in the performance and resilience of the grid.

***12. How do you foresee electricity price, GHG, and grid signals being used in an appliance, e.g., an electric storage water heater’s logic command and controls, whether through broadcast or internet connections?***

While it is possible to build appliances that respond to price, GHG, and other grid signals, a simpler approach is having appliances respond to an Optimum Load Shape (OLS) signal. The OLS signal contains 24 hourly values that sum to 100%. The OLS values indicate the percentage of total daily energy usage an appliance should use each hour. The appliance is empowered to choose when to operate, more or less, now or later. By choosing when to operate, the appliance can minimize differences between its own load shape and the target/desired shape defined by the OLS signal.

Example 1: In attempting to follow the daily OLS, a hot water appliance can adjust the water temperature setpoints, causing an electric water heater to store and release thermal energy over time.

Example 2: In attempting to follow the daily OLS, a battery charger can adjust the state-of-charge (SOC) setpoints causing batteries to charge and discharge over time.

Example 3: In attempting to follow the daily OLS, a thermostat can adjust the cooling setpoints causing a building to store and release thermal energy over time.