DR17.01 SCE OpenADR Test Lab Development: Phase 1

SCE OPENADR TEST LAB DEVELOPMENT: PHASE 1

Southern California Edison (SCE) conducted a study focused on the development of a multi-use technology test lab for emerging Auto-DR (ADR) products at its Technology Test Centers in Irwindale, California. The ADR test lab would be designed for maximum flexibility, allowing continuous rotation of products that enable varying configurations of different ADR strategies and devices. It would have multiple Virtual End Nodes (VENs) with capability to accommodate multiple test scenarios.

Three technology protocols used for controlling load management devices where compared for the initial phase of the ADR test lab development to determine which would be the best fit.

Phase I Objective *To conduct research on Z-Wave, Wi-Fi, and BACnet communication protocols and load management capabilities to explore the viability of creating a universal lab to test demand response (DR) load reduction strategies.*

RESEARCH FINDINGS

Z-Wave Controlled Load Management Devices

The Z-Wave protocol has historically been a proven cost-effective solution for implementing OpenADR2.0a/b DR signals. Due to the proven record of Z-Wave load control devices, it was chosen to establish the test lab baseline, and as the first proof-of-concept build.

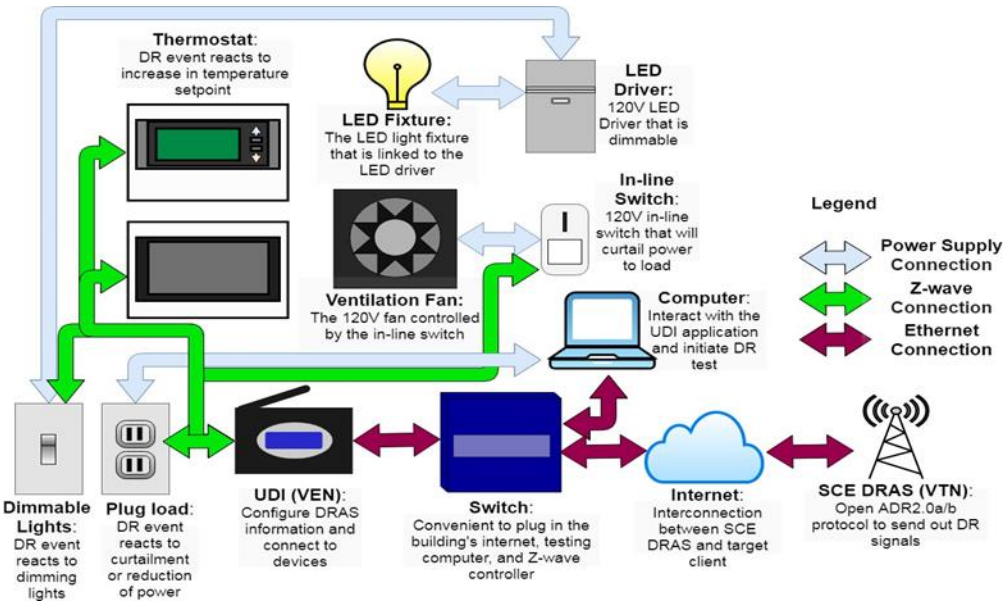

Figure 1. Z Wave Controlled Management Devices Protocol

TABLE 1. OPPORTUNITIES AND BARRIERS OF Z-WAVE	
Opportunities	**Barriers**
Simplicity - setting up the network is very simple and easy.	Requires knowledge of the system.
Centrality - there is one primary controller, but multiple secondary controllers.	Replacement costs are higher for Z-Wave appliances.
Scalability - easy to scale and add/remove network devices.	Z-Wave operates on radio frequency and could potentially be attacked by unauthorized users.
Z-Wave protocol inherently consumes less power than other wireless protocols.	Range is limited, so to cover more area, repeaters are needed, eventually driving up the cost.
Z-Wave has interoperability with other wireless devices.	Limited to 232 connected nodes.
Uses the Advanced Encryption Standard, AES-128 for protection.	Slower data communication speed than Zigbee.

Wi-Fi Controlled Load Management Devices

The Wi-Fi protocol replaces only the physical Ethernet cable, which still leaves device-to-device communications unique and specific to their programming. Due to the end-use application being dependent on proprietary programming, a Wi-Fi test lab was determined not to be a current viable universal solution for testing load reduction controls.

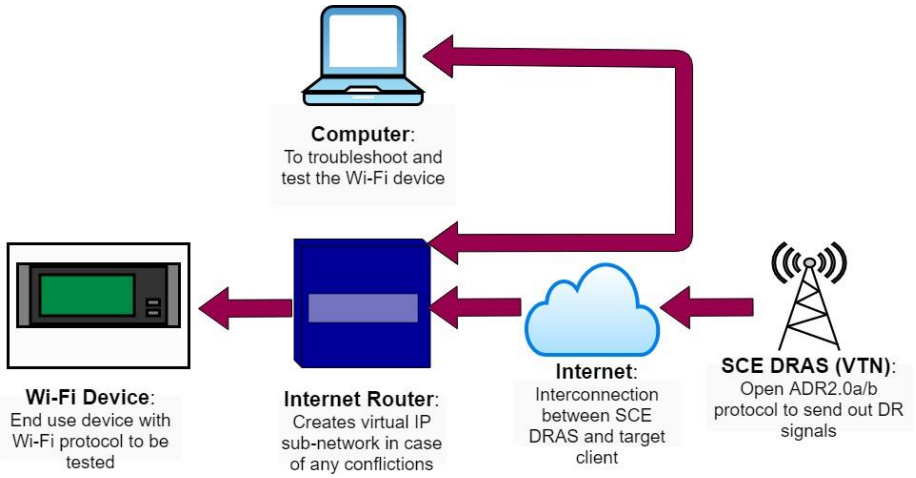

Figure 2. Potential Auto-Dr Wi-Fi Network Infrastructure

TABLE 2: OPPORTUNITIES AND BARRIERS OF WI-FI	
Opportunities	**Barriers**
Convenient – Useful for smartphones, tablet devices, and other portable devices to connect at any convenient location within the premises.	Performance/Speed – Although Gigabit Wi-Fi is available on the market, we cannot get the gigabit speed at all locations; cable networks now have 10 Gbps speed.
Simplicity – To connect a new device with a network, simply turn on the Wi-Fi and apply the basic configuration settings.	Connectivity/Reliability – Wi-Fi signals depend on interference (concrete walls reduce signal strength); also, there is a limited distance to connect Wi-Fi signals.
Mobility – Internet can be accessed from anywhere (bus, train, coffee shop, supermarket, etc.).	Security – Wi-Fi routers have various encryption methods to secure the network password; must be properly configured before using the Wi-Fi network.

Expandability – It is convenient to add more wireless devices with current hardware settings, without cost or time.	Limited Interoperability – Requires additional work to combine different devices to work together.
Efficiency – Wi-Fi-enabled devices are used at offices for convenient file access from any location, resulting in greater productivity.	Proprietary Application Source Code – Most Wi-Fi devices have proprietary application source code and restrict public distribution, making it harder for devices to interact because someone has to bridge the gap.

BACnet Controlled Load Management Devices

The BACnet protocol shares the application layer and network layer and is connected by a common Local Area Network (LAN). BACnet devices communicate with each other if they share the same open network protocols; however, if proprietary, they require manufacturer approval to communicate. It was determined to be viable to create a test lab for the BACnet devices using the open network protocol.

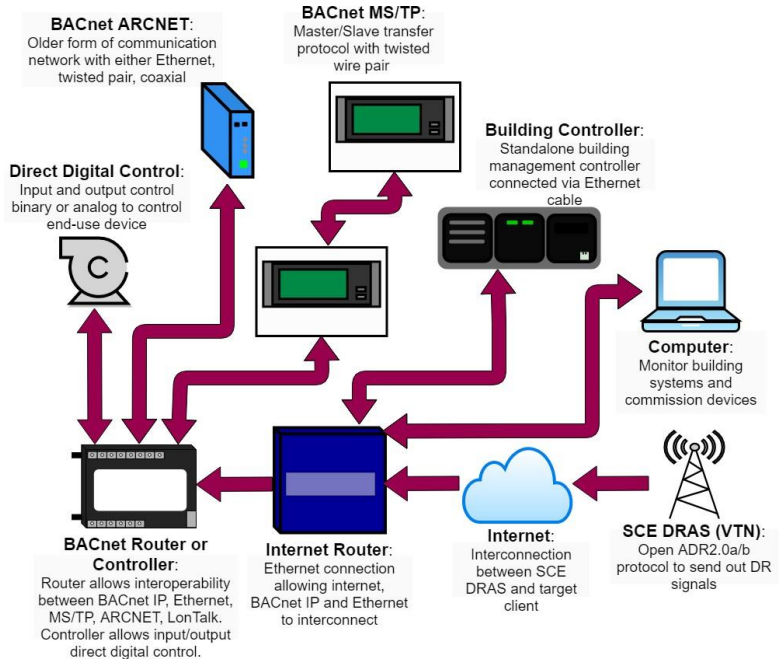

Figure 3. Automated Demand Response BACnet Network Infrastructure

TABLE 3: OPPORTUNITIES AND BARRIERS OF BACNET

Opportunities	Barriers
Convenient – Different building controls systems can be integrated into one main application for convenience and increased productivity.	Performance/Speed – BACnet's physical transfer rate is limited for certain data types.
Customized Solution – To properly implement BACnet, engineering is necessary, creating an opportunity to customize and tailor the application for customers.	Security – The BACnet network could potentially be hacked; for the industrial protocol ethernet, an individual with a connection could access the BACnet network.
Open Protocol – BACnet is an open protocol which shares the source code with the public, so BACnet devices should be able to communicate with each other.	Engineering for Interoperability – Requires engineering-level work to combine different devices to communicate with the BACnet network.

Expandability – As an open-source protocol, manufacturers have the ability to incorporate BACnet communications on all their devices, if desired.	Proprietary Source Code – Although BACnet is an open protocol, manufacturers have the ability to create their own proprietary BACnet code, which would typically require a license or fee.
Robust – The BACnet network is designed to be reliable for data transmission and building communication.	

CONCLUSION

Protocol openness and availability to associated DR devices like HVAC controllers, plug loads, and lights helped make the Z-Wave and BACnet platforms part the initial OpenADR Test Lab.

The full findings are based on the report "SCE OpenADR Test Lab Development: Phase I, DR17.01", which is available at **dret-ca.com**.