Demand Response Research Center

Demand Response (DR) and Automated DR (Auto-DR) Strategies for Data Centers

Introduction and Background

The California Energy Commission and the Department of Energy classify data centers as industrial facilities because they are dominated by machine-based energy systems and have industrial energy consumption levels and operation patterns. Specific demand response (DR) strategies are needed for data centers due to their sophisticated controls of environmental conditions, high level of technology implementation, and users' technical knowledge. These make data centers' potential participation in DR participation unique, especially in implementing strategies for automated DR (Auto-DR).

Objectives and Purpose

One purpose of the DRRC's DR initiative for data centers is to identify potential research and control strategies for their participation in Auto-DR. This potential is dependent on the type of controls present in a data center, especially the automation capabilities of its energy management control systems. The type of controls in a facility influences the automation system design to deliver DR event signals from utilities.

Following are participation benefits and some potential strategies for data centers emphasizing on Auto-DR offerings such as Critical Peak Pricing (CPP) and Demand Bid Programs (DBP. Participation benefits vary by the DR and Auto-DR programs offered by California utilities[1], Pacific Gas and Electric[2] (PG&E), Southern California Edison[3] (SCE), and San Diego Gas and Electric[4] (SDG&E). DR programs are available for both their firm service customers and direct-access customers in their territories. DR participation involves responding to events during peak summer days (10 to 12 utility-issued events every year, typically lasting 2 to 8 hours).

Benefits from Participation

- Financial
  - Lower electricity bills from reduced energy consumption from server processing loads during high-price periods on peak event days. Savings can be higher than those in other industries because reducing server loads simultaneously reduces cooling and other equipment loads.
  - Financial and technology incentives to reduce load during periods of peak demand.
  - Economic security resulting from reduced risk of blackouts or brownouts.
  - Reduction of data centers' largest operating expense (energy costs) during high-price period(s).
- Reliability and Security
  - Maintained reliability of electric grids and electricity supply, which can prevent loss of data and revenue and avoid service delays.
  - Lowered likelihood of rotating outages and risk of energy crises.
- Environmental
  - Reduction of peak day consumption decreasing the need for electricity generation and its resulting emissions, including those that contribute to global warming.
  - Achievement of the sustainability requirements of the data center industry regarding climate change.
- Societal
  - Protection of neighborhoods from energy emergencies and safeguarding of people who rely on electrical equipment (often schools and the elderly) from power disruptions.
  - Incorporation of DR into corporate social responsibility (CSR) policies and values.
- Industry Collaborative Research
  - Industrial partners' collaboration to analyze DR and determine optimal response for peak load management, price-responsive systems, and end-use monitoring to provide downstream benefits.

PT[1]TP Auto-DR Programs: http://www.auto-dr.com/

PT[2]TP PG&E: http://www.pge.com/demandresponse/adrp/

PT[3]TP SCE: http://www.sce.com/RebatesandSavings/LargeBusiness/autoDemandResponse.htm

PT[4]TP SDG&E: http://www.sdge.com/business/esc/

Potential Data Center Specific DR and Auto-DR Strategies
The following table outlines potential strategies for data center DR. These strategies are categorized into two groups: (1) those within the control of the IT department/infrastructure (IT) and (2) those controllable at the facility-level (FL):

- **Tasks prioritization [IT]**

Usage policies for software algorithms can shift low priority and testing-related tasks on event days to non-critical peak times. For example, backups may be run before 12 p.m. or after 6 p.m. Other tasks to shift may include software and related updates, data replication, system upgrades, etc.

- **Load Consolidation and/or Demand shift [IT]**

Most data centers have locations in different grid or climate zones, sometimes in different states and/or geographic locations, as backup during crises. Using existing or custom technologies, faster and efficient temporary migration of loads is possible without much effort. Some strategies are:

  - Server consolidation or utilization: capacity analysis and creation of consolidated server-pool to run fewer server(s); enabling technology is presently available.
  - Server virtualization: process-load management using virtualization to eliminate redundant server(s); enabling technology is presently available.
  - Migration of load to another location; enabling technology is under development.

- **Environmental Conditions and Synergies [IT/FL]**
  - Data centers with cooling set-points at or near the minimum requirements for IT equipment may temporarily reduce demand by allowing zone set-point temperatures to rise by a few degrees for a few hours without any adverse effects.
  - Data centers with backup reserves such as ice storage or chilled-water storage for cooling may make effective use of these reserves during peak event days.
  - Significant reduction of loads is possible through automation and existing technologies. This reduced IT equipment load, when synergized with reduction of accompanying loads such as cooling, lighting, and others, results in efficient management of building zones.

- **Technology Integration [IT]**

Data centers' high-level technology advancement and expert knowledge benefit integration. For example, synchronization of data center software and EMCS using utility DR event notification may be accomplished via the Demand Response Automation Server (DRAS).

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Website and Related Activities
http://drrc.lbl.gov/industrial/