

Technologies for Fast Load Control

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Abstract:

Direct Communication, broadcast to a variety of customer-premise load reduction technologies, is an effective way to pre-empt price spikes due to congestion or supply shortfall. With a multi-tier group addressing structure and an open-access nationwide communication network, direct control can be called by any of the power delivery participants for system security, based on electrical location, geographic location, load type, or program name. Direct control is extremely fast-acting, and well distributed; most programs do not require notification or customer intervention, and in a “pool/proxy” environment, could be used by all grid participants.

Discussion:

Direct load control is defined as load that can be curtailed directly by a utility or dispatcher, without intervention of an operator at the end-use customer premises. This type of control has been widely used in mass markets (residential and light commercial) by many utilities for demand reduction, but for cost effective use as a tool for system security or congestion relief, several new enabling factors must be present:

1. Use of existing commercial communications network that offers coverage of the entire grid area;
2. Open access dispatch of the directly controlled loads;
3. Multi-tiered group addressing structure that allows units to be controlled only where needed for clearance of load congestion;
4. Low-cost, flexible end-point devices;
5. Optionally, a fifth enabler would improve the economics, specifically a financial structure within an Independent System Operator (ISO) or Regional Transmission Operator (RTO) grid area, that allows the investment of a single device to be utilized by all grid participants (pool/proxy environment).

Use of Existing Commercial Communications Network

Using a widely deployed, open access commercial wireless network enables devices to be built in a standard format, rather than a format that is “frequency-specific”. These devices could be sold through many channels and will remain compatible with the system. Commercially available one-way paging using the Motorola FLEX protocol is the de-facto standard paging system in North America, with local, regional, and nationwide paging being offered by many retail providers. FLEX paging uses 900 MHz band for maximum penetration with a high data speed.

The ideal direct control system would use this existing network, yet allow both group/broadcast communication and unique individual communication to all units, through a single local, regional, or nationwide subscription. The FLEX paging network is used by millions of subscribers, with service being offered by dozens of providers, so

competition exists at the provider level, yet the large subscriber base provides long term viability.

Open Access Dispatch

An open access point for dispatch of direct control enables dispatchers from different levels of the power delivery structure to call for control of a tightly defined group. A single Internet Website could allow direct dispatch of individual units or groups of units, with the proper login. Each login would allow access only to specific address groups. Encoded messages are broadcast as a common alpha-numeric page.

Multi-tiered Group Addressing Structure

Controlling load for system security has some inherent complications that are not present when controlling load for general demand reduction. A robust group addressing structure is required that allows the various grid participants to control based on whatever value that drives them. In order to allow control only in a congested area, the group addressing should include the geographic & electrical location. An aggregator or retail energy service provider needs access based on load type and an identifier for that retailer. A distribution utility needs an identifier for electrical location. The ideal system offers many tiers of addressing that can be combined into a “query” that allows a very strict set of the devices to be controlled, and restricts access to other tiers used by other grid participants.

For example, a distribution utility may call for all the connected load management available on “substation 28, feeder 4”. A retailer may call for all the available controllable load for “Rate M” customers. An ISO may call for all the curtailment in a zip code OR substation. The system needs to be able to broadcast to all these specific groups within seconds.

Low-cost, flexible end-point devices

Direct control generally requires thousands of end-points to provide a substantial impact, therefore end-point devices need to be low-cost and flexible, meaning that they can work in a variety of situations. The devices should be able to mechanically open or cycle a load directly (up to 480 volts), open or cycle a load via control circuits, or potentially to communicate digitally using standard protocols – all from one standard indoor/outdoor NEMA box.

Interfaces to thermostats, building energy management systems, gensets, and lighting controls should be available. The raw equipment cost should be less than \$100 in quantities.

Pool/Proxy Environment for Load Management within ISO or RTO

Regardless of whether a direct control system exists or is a new implementation, there is a significant investment in

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equipment, installation, marketing, and management. An ISO or RTO should make provisions for load curtailment to be traded within the grid area. This would allow the investment to benefit all grid participants, while providing a pay-per-event financial incentive to the program participants.

At least one RTO has announced acceptance of load curtailed by one aggregator on behalf of another grid participant. This is called the "pool/proxy environment".

Why Direct Control ?

Load control among most utilities today means arranging for large commercial "key account" customers to curtail load based on an interruptible rate, a pre-defined capacity rebate, or a negotiated payment per event. This type of curtailment requires advance notice of at least one hour, and a minimum control time of 4 hours, with optimum being an entire shift (8 hours). Direct control is an immediate resource, allowing large and widely distributed aggregations of controlled load to be dispatched within seconds, based on a tightly defined group address subset of all the connected capacity, and generally usable for up to four hours. Usually there is no need for notification, and with new "gateway" technologies, an automated response to price fluctuations or curtailment events is possible. This resource can be used to deflate a rapidly increasing price spike caused by a line congestion or supply shortfall.

Price elasticity can be manipulated with direct control, whereas with voluntary curtailment, the prices have already risen, and act as an incentive for curtailment volunteers to wait for higher prices.

Finally, direct control is typically very evenly distributed in every segment of line, providing a gentle relief to excessive demand.

Summary:

To use direct control for system security and congestion relief, several enabling factors should be present for maximum cost effectiveness. These include an open access, Web-based dispatch system; a widely distributed existing communication network that allows use of standard equipment rather than area-specific equipment; a robust, multiple-tiered addressing structure that provides flexible yet restricted access to all grid participants, low-cost, flexible customer premise equipment; and where available, a pool/proxy environment that allows utilities to share the investment in the direct control system with other utilities or grid participants that may need to reduce demand for a variety of reasons.

Biography:

Douglas Backer received a degree in Education from the University of Nebraska in 1976. After leaving education, was energy advisor for a rural distribution utility in Nebraska from 1985-1991, operating a direct control system that directly controlled irrigation wells. He joined

Cannon Technologies in 1991 as Mid-States Support, covering a variety of tasks including training, sales support, and technical support. Over the past five years he has been serving as the Director of Marketing.

Doug has presented papers for the American Association of Energy Service Professionals, Rocky Mountain Electric League, NW PPA, National Rural Electric Association, and many regional and statewide conferences.

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