Online Demand Response

A practical solution for reducing peak demand

A White Paper by Power Meter Technics

Direct load control using the Demand Response Online (DOL) system allows utilities to turn specific loads on and off during peak demand periods and critical events.

- **Utilities can directly manage appliances such as geysers, pool pumps, and air conditioners.**
- **The smart load control switches can be programmed to respond to time-of-use periods or critical peak events.**
- **Consumer engagement is achieved by providing home owners with the ability to customise their own schedules for these loads by using the online application.**

Background

South Africa's electricity shortfall is expected to endure for at least the next five years and the need for effective demand side management solutions (DSM) is now more important than ever. Unfortunately, achieving savings through DSM is becoming increasingly difficult to achieve as most of the "low-hanging fruit" technology options have already been exploited and more innovative technologies and solutions have to be found.

Ripple relays – an outdated technology

Ripple relays to control geysers have been used in South Africa for more than half a century, but the technology is intrinsically flawed because ripple control is a telegram based system in which communication only travels in one direction – from the transmitter to the receiver relays connected to household geysers as shown in Figure 1.

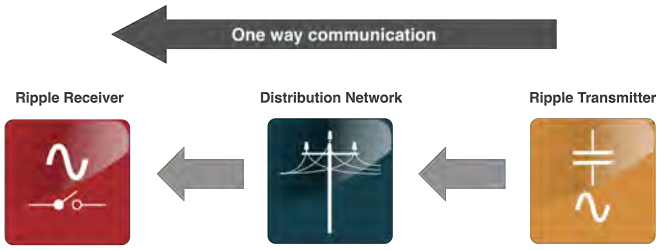

Figure 1: *Ripple relay communication*

The limitation of one-way communication means that there is no way for the Distribution System Operators to know if a particular relay has received the message and fulfilled the switching order or even if switches are operational. In addition to the problem of unidirectional communication, ripple relay technology has the following problems:

- Ripple relays are "imposed" on home owners who have no say in how or when they are operated and receive no direct benefit from them.
- This leads to resentment and inevitably many

installations are either damaged or bypassed and there is no practical way to detect or manage this.
- The equipment required to inject the ripple signal onto the distribution network is bulky and expensive.
- This also means that smaller stand-alone projects are not feasible and only large scale implementations are economically viable.
- Ripple control signals are attenuated over long distances and control of relays at the fringes of the network is problematic.

Smart load control

The DOL system provides a comprehensive demand response platform, which solves the problems associated with ripple relays. The system consists of smart load control relays that have reliable two-way communication capability managed by cloud based server.

The server communicates with the switches using advanced cellular technology and this direct control means that the system adds immediate value the moment the first relay is installed.

End users such as home owners or commercial tenants access the system over an Internet portal at www.demandcontrolonline.com. High-level control is implemented using a secure SOAP web service.

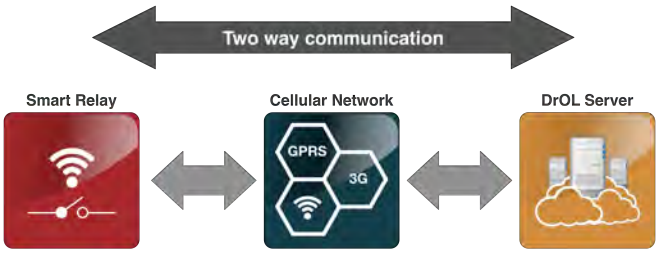

Figure 2: *Smart switches with two way communication*

The advantages of the system include:

- Bidirectional communication means that the switches are always visible and their state is precisely known at all times.
- Home owners and other end users have access to the switches using a simple Internet interface, ensuring positive buy-in.
- The system is cheap, easy to install and requires no large initial capital investment to get off the ground. This means that even small installations in, for example, housing estates are immediately economically viable.
- The system can be used anywhere in the country and is not limited to large urban centres. Implementation can be focused on customer service levels rather than geography.

How does it work?

Control hierarchy

The system consists of smart switches that are connected to customer loads like geysers, swimming pool pumps, air conditioners and under floor heating. Each smart switch supports trigger or cycle-based scheduling with three levels of control as shown below.

Figure 3: *Multi tiered control*

Level 1: Utility is the top level reserved for Eskom or a Municipality. This level is used to restrict the operation of smart switches to ensure that loads are not enabled during peak load periods. An emergency disconnect command can be issued to all switches or to individual groups of switches by the utility during times when the network is stressed.

Level 2: Building is intended for use by the owners of the building or complex. This level has the same functionality as level 1, but is subordinate in that exclusion periods specified at the Utility level will override anything set at this level.

Level 3: User this level is intended for the end user (home owner, tenant) and has the lowest priority. The user is able to create custom schedules to manage his or her load as it suites them. For example, the smart switch can replace a timer on a swimming pool pump. In addition to the scheduler, the

end user also has the ability to switch their loads on or off at any time using a mobile device such as a smart phone or tablet.

Communication

Demand Response Online (DOL) is a cloud based service. The DOL cloud connection is a service that provides a persistent, asynchronous and bidirectional connection to smart switches anywhere in the country. Communication is bidirectional – not only can the load control server send messages to the smart switches, but the switches can send messages back to the server using the same secure connection. The asynchronous nature of the communication system enables more messages with fewer resources, ensuring that the system is extendible to almost any number of smart switches.

Scheduling

The smart switches store separate schedules for each hierarchy level in non-volatile memory. Once a schedule has been uploaded to a switch, the system will continue to operate autonomously without the need to communicate with the server. This ensures that the switches will operate reliably – even in the absence of a communication signal. Bandwidth utilisation is also kept to a minimum because communication is completely event driven.

The following periods can be configured in the scheduler:

- Time of day
- Sunrise and sunset
- Day of week
- Month
- Public holidays may be treated as either a Sunday or a Saturday

Grouping

The Demand Response Online system has been designed so that switches can be grouped together in any number of ways. Typically, smart switches are grouped according to the load type, location or a combination of the two. All devices within a group would share the same schedule and commands to connect or disconnect loads are broadcast the group as a whole.

Cold load pick up

To prevent abnormally high peaks in demand from occurring when devices are switched back on, the Demand Response Online smart switches can be configured to delay switching on for a random period. The maximum duration of this delay period is configured on the system.

Conclusion

The Demand Response Online smart load control system makes direct response to demand control economically viable for residential homes and small businesses. The system not only solves problems inherent with traditional ripple control systems, but is highly scalable and shows a total cost of ownership significantly below any other technology available today.

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