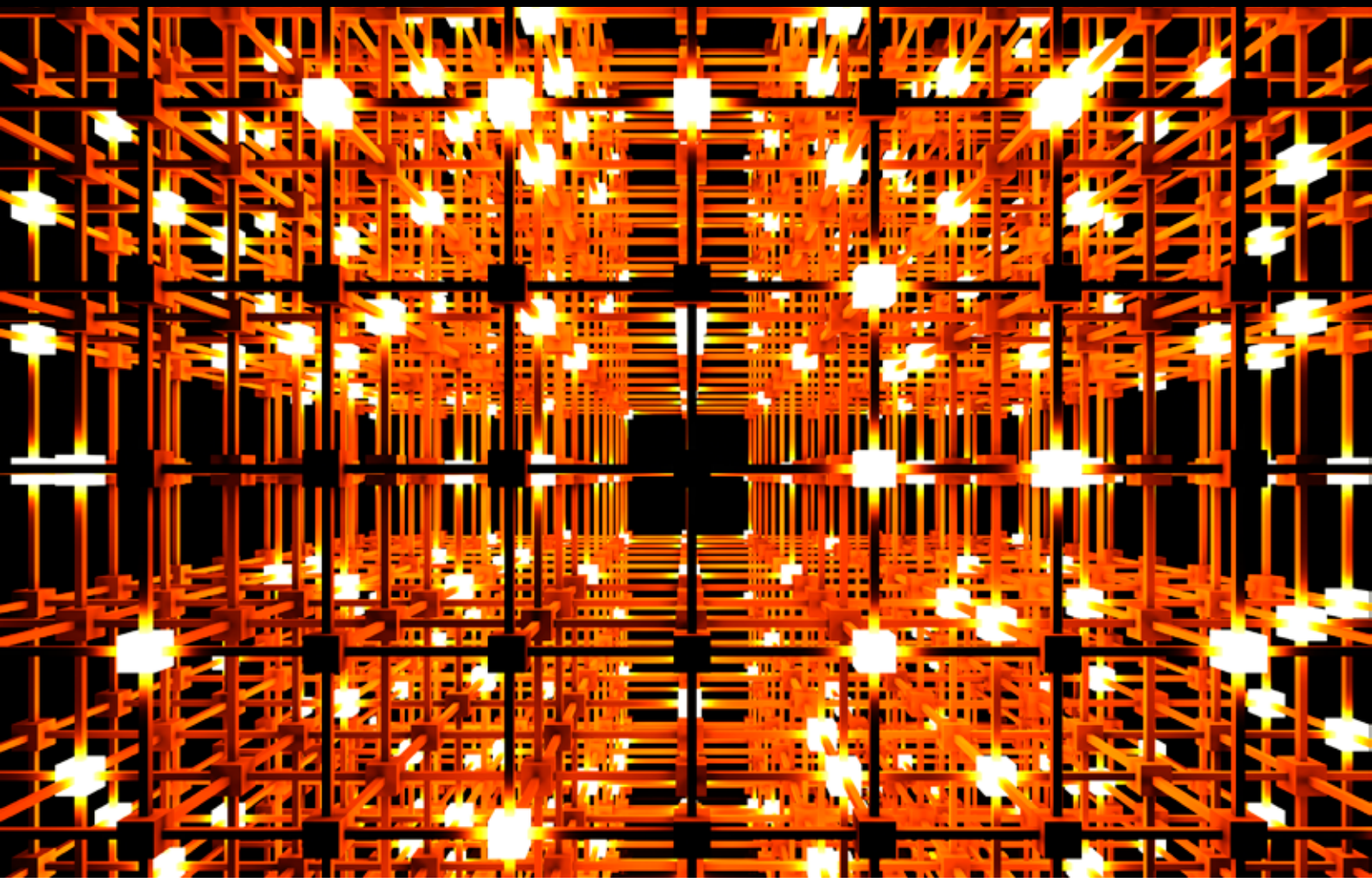
How the evolution of technology is changing the way we manage energy



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From the editor ...

The number of connected devices will reach 25 billion by 2020 — around six times the world population. Around 9.7 billion of connected things will be used by smart cities, according to Gartner. Smart cities and smart grids facilitate two-way energy and information flow allowing building owners, operators and users to reduce their electricity bills and greenhouse gas emissions, and improve energy management. This is made possible with the help of components such as sensors, controllers and actuators that can be connected using Ethernet in smart panels. This eBook provides insights into how smart panels, ubiquitous connectivity and the Internet of Things are creating opportunities for the electrical industry.

Mansi Gandhi,

Editor – *ECD Solutions (Electrical+Comms+Data)*

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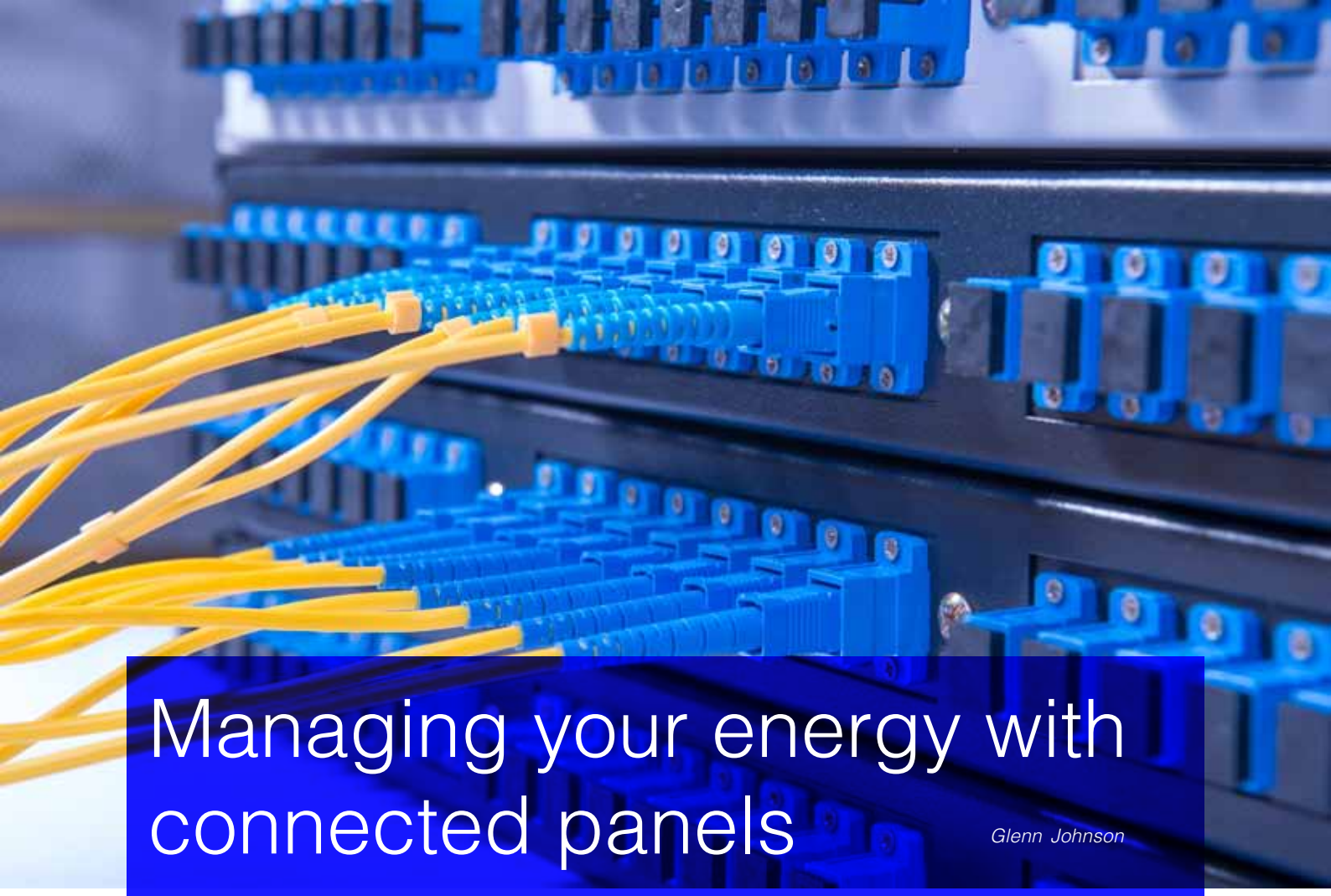

Managing your energy with connected panels

Glenn Johnson

Modern life is increasingly characterised by a high level of connectivity on many levels. We are all familiar with the fast access to information that we enjoy through our computers, smartphones and tablets due to the ubiquity of access to the internet.

Ethernet as the foundation

The technology that supports all this connectivity has been through a process of evolution for about 40 years, starting with the development of Ethernet technology in the 1970s and following with the development of the TCP/IP suite of protocols that make the internet possible. Today, Ethernet is the standard method of connecting computers together into networks — both wired and wireless — and the TCP/IP protocol suite is the standard method used for communication over Ethernet and many other technologies such as cellular phone networks. The widespread use of Ethernet has made networking hardware affordable enough to be embedded in a range of devices other than just computers — including industrial sensors and actuators, in our cars and appliances and even in our television sets.

The enormous growth in Ethernet-connected devices is leading to what is being called the Internet of Things (IoT), which is expected to grow to 50 billion connected devices by 2020 (Cisco 2011[1]). Within the IoT, devices across a variety of industries will be interconnected through the internet and peer-to-peer connections, as well as closed networks.

Ethernet-enabled devices are making our interaction with the electrical system in our homes and business premises smarter, therefore allowing better control and monitoring to make it more efficient. We are then able to keep a constant eye on our energy consumption, leading to savings in its daily costs.

Information that was not previously available can now be accessed — about the life cycle of the equipment, usage trend and alarms and signalling — should something go wrong in the electrical distribution system. A restaurant owner can now be notified immediately if a chiller unit has tripped to prevent any spoilage of food. This visibility allows significant cost efficiencies as the owner can quickly identify issues and respond accordingly.

Energy management and sustainability challenges

In parallel to the rapid evolution in smart technology and connectivity, the usage and cost of energy are also increasing exponentially as a result of industrialisation and urbanisation. This has led to growing concerns about the damage of increased electricity generation (such as non-renewables) to the environment. Ethernet-enabled smart devices are being seen as technology that we can leverage to monitor and control our buildings and facilities to optimise our energy consumption.

In response to these challenges, recent years have seen large growth in alternative electricity generation at end-user premises, particularly the use of solar panels. Electricity distributors are also working towards a technology known as the 'smart grid', part of which involves the use of 'smart meters' at end-user premises. Rather than just metering energy use for bulk billing purposes, these new meters will allow distributors and end users to have better information on how energy is consumed, and to better control that use, including the use of end-user generation systems. And of course, the enabling technology that makes all this possible is the technology of the internet.

According to the Energy Networks Association:

As technology and energy markets develop rapidly, smart meters and other devices will benefit individual customers. Customers should receive practical information and more rewarding tariff structures that match their needs; be able to control their energy use to get better deals and participate in new markets, such as exporting energy to the Grid through solar panels or supporting energy storage options, as these develop commercially.[2]

Making the most of it

In residential premises, the electricity distribution is relatively simple: the switchboard divides the home up into various circuits for lighting, cooking, water heating and general-purpose use, with circuit breakers protecting those circuits in case of overloads. Better monitoring of these circuits will enable the consumer to minimise their electricity consumption and costs.

In commercial premises, the layout of electricity distribution can be a lot more complex. Take for instance a hotel: each suite has its own electricity supply that must be protected without affecting other suites; there is a highly variable air-conditioning load from day to day and hour to hour; large common areas with lighting and air conditioning; commercial kitchens; fire protection and security systems; water heating; complex water distribution and wastewater systems — the list goes on. The ability to enhance the monitoring and control of electrical distribution in commercial premises has the potential to help businesses realise significant savings.

Industrial plants, as significant consumers of electrical energy, also stand to benefit greatly from smarter monitoring and control of electrical distribution systems.

Connected panels to the rescue

Modern switchboard panels can now be equipped with smart, Ethernet-enabled devices that greatly increase the control and monitoring of the electrical systems in a plant or building. Circuit breakers with embedded sensors can provide current monitoring down to the individual circuit level, passing this data to smart monitoring and data logging devices that are Ethernet and internet enabled.

Traditionally, commercial businesses that wanted fine-grained control of their electrical systems have used a building management system (BMS), and the advent of smart panel technology provides data collection and control via a BMS more cost-effective through the use of standard Ethernet-based technology. For those businesses that have not invested in a BMS, data from connected panels can be collected and managed via a cloud service (see below).

Similarly, for industrial systems, connected panel technology permits simpler standards-based connectivity of electrical distribution technology with SCADA and DCS systems.

Modern switchboard panels can now be equipped with smart, Ethernet-enabled devices that greatly increase the control and monitoring of the electrical systems in a plant or building.

Since all modern buildings will have an Ethernet-based communication infrastructure in place, this data can be networked back to a central system or to the internet. The data can be collected to monitor and optimise energy consumption across the entire plant or building infrastructure, right down to individual circuits and devices.

Ethernet-equipped relays can also be used to provide control back to the individual smart panels — allowing individual circuits to be switched off or on as needed. For example, if you were a hotel operator, why would you want to air condition rooms that are empty for long periods of time? Connected panel technology could make this type of energy saving possible.

Managing the data

One of the challenges in making use of all this smart device technology is the sheer quantity of data that may need to be stored, analysed and presented in a meaningful way. Storing it and processing it would require computing and software infrastructure to be deployed, and the larger the number of smart devices, the larger the computing cost. For organisations with multiple sites, such as bank branches, restaurant or hotel chains, this would mean having to manage data at multiple sites.

The trend in dealing with such data issues is to make use of internet 'cloud' services. Rather than deploying software and computing infrastructure locally at a site — or perhaps in addition to local systems — the connected panel technology vendor can supply online services on the internet in the form of software-as-a-service (SaaS).

The SaaS service is configured to analyse and present the data back to the end user over the internet, without the end user needing to deploy any specialised services. Better still, for those users with multiple sites, the monitoring of energy consumption can be presented across all sites in one system, presenting considerable savings and providing access to the system from off-site and via mobile devices.

Multiple savings

While investing in electricity distribution switchboards with connected panels will obviously come at a cost, there will be a number of areas where savings will be realised.

First of all, for those businesses without a BMS or industrial control system, the use of cloud SaaS services removes the need for local site-based computing infrastructure and all the associated costs of owning and housing hardware and software. In addition, better management of building infrastructure, such as air conditioning, will in the long run reduce wear and tear by reducing the over-use of infrastructure, reducing future capital expense.

In terms of operating expenditure, the energy savings described above is a major saving, because the aim of the technology is to make better use of electrical energy, reducing waste.

Asset management and maintenance

One of the great benefits of connected panel technology is also the ability to know when the electrical distribution technology itself needs maintenance, or to make troubleshooting easier when electrical failures occur. When electricity supply fails it can take considerable time and effort to isolate and determine the cause of the failure. Whether a cloud service, a BMS or an industrial control system is used, connected panel technology can significantly speed up the correction of the problem by pinpointing exactly where the failure has occurred, minimising downtime and cost.

Similarly, as the electrical distribution system ages, smart panel technology can assist with preventive maintenance, by alerting when components are likely to need replacement before they fail.

Conclusion

It is now possible to make the 'smart buildings' and 'smart plants' of the future using components such as circuit breakers, sensors and actuators that can be networked together using Ethernet in 'smart panels' in order to form an intelligent system — or to integrate with a BMS or industrial control system — more cost-effectively and efficiently than ever before. Cloud infrastructures are also now available that allow businesses to locally or remotely manage and monitor their electrical systems via the internet.

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Choosing the right approach to leverage big data for energy savings

Cara Ryan, Offer Manager, Building Performance Centre at Schneider Electric

Energy efficiency has been in the spotlight for decades, particularly in regard to buildings, which account for 20% of Australia's energy use. Facility managers rely on building management systems (BMS) to gather data about building performance and energy usage to reduce operating and maintenance costs, improve building comfort and save energy.

The volume of building data available has risen rapidly in the last decade as facility monitoring systems become more complex and thorough. But harnessing this 'big data' to leverage BMS potential requires significant training and in-depth knowledge of a facility and its history, along with an investment in IT and dashboards or automated analytics. Ageing infrastructure, reduced budgets, sustainability demands and lost expertise through personnel turnover are just some of the factors also contributing to this huge challenge for facility managers.

To help take advantage of big data, facility managers in Australia are considering the pros and cons of their approaches to BMS and what methods are the most compatible. Best-in-class software automatically trends energy and equipment use, identifies faults, provides root-cause analysis and prioritises opportunities for improvement based on cost, comfort and maintenance impact.

Custom-built systems, software-as-a-service (SaaS) and managed software-as-a-service (MSaaS) are some of the most popular analytics approaches when dealing with big data in buildings.

Some facility managers choose the custom-built approach and create their own on-site building data analytics system designed specifically for, and integrated into, their building's systems. This gives building managers the greatest flexibility with the system as they have exclusive access to all the servers, software and tools. To utilise big data, however, storage capacity and processing power can require significant, and therefore costly, IT infrastructure to provide the level of data confidence required.

Not only does a custom-built solution require a substantial investment in the IT infrastructure, it also requires highly skilled staff or vendors to build the diagnostics and maintain the systems to manage this big data. As well as this, customised systems rarely allow remote access or utilise web browser interfaces because of the high-cost browser updates and software to combat security threats.

An SaaS data analytics solution is cloud based and is a more cost-effective and efficient option than custom-built systems. Big data is automatically pulled from the BMS and analysed in a virtual cloud environment. This gives building managers both the powerful insights of data analytics and the flexibility of remote access and control.

Leveraging a 'mass customisation' approach, these subscription-based solutions cost less to deploy because an existing, fully built library of complex diagnostics can be customised to individual buildings very quickly. Additionally, the pace of technology change is so rapid today that on-site solutions may become antiquated very fast. Cloud-based SaaS solutions can react to customer feedback and constantly deploy new versions with added features and functionality continuously at no additional cost to the user. Software upgrades and diagnostic improvements are also cost-effective and predictable, budgetable expenses because they are included in the subscription.

One issue with SaaS systems is that they require staff to manage the software, interpret the big data and act on the opportunities identified. Considering the scope and complexity of the information being collected in its raw form, a high level of expertise and in-depth knowledge of big data is necessary to take full advantage of this deluge by understanding and applying feedback effectively.

Facility managers can circumvent this necessity by choosing an MSaaS as an analytics solution. MSaaS combines the SaaS analytics solution with the oversight of remote engineering experts who can specialise in big data. Remote engineering analysts use insights from the information to monitor, detect, diagnose and identify energy savings opportunities. They understand complex data and its relation to building issues so can deliver high-level recommendations for upgrades, repairs or maintenance based on business priorities.

Additionally, an MSaaS analytics solution can increase the efficiency of vendors and partners by consolidating and integrating data from various building systems. This data can then be made accessible to all vendors, saving them time and making building services more effective. The data can be leveraged to improve vendor management by ensuring issues are fully resolved by utilising analytic findings and monitoring capabilities. This ensures issues do not reappear.

Facilities owners have made significant investments in sophisticated BMS systems that generate a wealth of data about a building's performance. Data dashboards help facility staff visualise all this data, but dashboards tell only where inefficiencies exist - not why. Comprehensive data analytics software can interpret this big data and convert it into actionable information so facility managers can prioritise and proactively address issues for long-term solutions.

This can have a real impact on energy consumption, operational efficiency, occupant comfort and the financial wellbeing of buildings. The right analytics approach to big data management will proactively help facility managers achieve performance goals and contribute to a lower carbon footprint — all while driving a positive ROI, increasing portfolio value and maximising investments.

Cloud-connected panelboards:

opening an era of new services for electrical professionals

Jean-Francois Maubert, Schneider Electric

I've been working in electricity distribution management systems for 25 years now. And even when I started, the mantra was "service delivery".

Plainly, ambitions haven't changed. What has is the technology. Connected electrical switchboards can now meet the goal of enriched customer proposals, through intimacy between their components and the large scope of service delivery they enable by various electrical professionals.

"Energy efficiency" and "asset management" services can be provided over the internet — a cost-effective solution that building owners and tenants can account for in their operating expenses (Opex).

Central to the delivery of those web-based services is the device that interfaces field networks collecting data from electrical panels, with the main local area network and the internet.

It is in fact a data logger and a gateway. But it's more than that, too — a sort of network operating centre. As a data-logger-gateway-network-operating-centre, it logs readings from company LANs and exports them to a cloud-based repository. Then the data can be accessed and managed from anywhere.

Ultimately, the web-based services will include remotely maintaining, upgrading, repairing, monitoring and controlling electrical devices.

It relieves customers of the burden of contacting their electrical contractor in the event of, for example, a tripped circuit breaker. The system alerts the site manager and — importantly — explains why the device tripped. A skilled electrician then calls the customer. Depending on whether the issue is an overload or short circuit, the electrician tells the customer what to do, or takes action himself. What's most important is that the electricians initiate the contact. And they can do so because they have the remote control and management capacity.

Some circuit breakers also now incorporate early warning alerts. So electricians can even inform customers before any malfunction actually happens and advise them on to what to do.

What about demand-response management?

Coming soon. It is the next evolution of power and energy management services. Small or medium-sized energy consumers will be able to subscribe. The service provider will aggregate demand from all these enterprises and correlate it with delivery capacities for their utility. Then customers will be accurately advised on how and when to reduce their electricity usage. Twenty-five years ago that was impossible. Now, thanks to the abovementioned data management technology, we're on the verge of doing so.

Seriously, can an IP address alone meet complex demands?

Of course, an IP address is indispensable. But it's not enough. Complex parameters have to be factored into the cloud-based management of protective and measuring devices. The chief parameters are related to firewalls and multiple device management.

Clouding the issue:

centralised multifunctional device management

Marutharaj Ganesan, Schneider Electric

Panelboards in buildings' power distribution systems comprise a whole lot of devices — circuit breakers, fuses, sensors, meters, switches and motors, you name it. And those devices have to be managed — to ensure safety and the correct settings.

But the parameters that make up the 'right' settings vary: those that are consistent in one configuration may not be in another one. What is more, devices may be made by different manufacturers or have their own user interfaces, set-up procedures and specific ways of adjusting settings.

Standard practice today is still to save the settings of each device, which generates a history file for each device.

With the advent of multifunctional devices in response to increasingly customised applications, that approach won't be tenable much longer. Today it still works — just about — because there aren't many low-voltage multifunctional devices about. There soon will be, though, and multifunctional device management will be just too complex.

What if you could manage all your devices with a single tool?

The answer is: multifunction device management would be safe, reliable and efficient. And it soon will be because the trend today is towards smart panelboards that are connected to a cloud of networks.

All panelboard device commissioning and operating data will be stored in a single online repository. So device management practices will have to change as data will be accessible from any office computer, laptop or mobile device. The silo mentality, still widespread, will soon be a thing of the past.

What are a central repository's benefits for facility managers and other building operators?

You will able to track the histories of all your saved settings and monitor and control time and current coordination. You'll share data and updates with partners — in fact, you will be able to build sets of unified settings from your pooled experiences. In this way, you will be constantly enriching use and understanding of devices. Wherever you are, you'll be safe in the knowledge you can access panel device data. So the best settings for different applications are just a click or two away.

Will it improve safety?

Yes. Not only are your saved settings secured and maintained, you can monitor device status, too. Today, for example, you don't always know if the circuit breakers in your building are in good working order. If they're closed all the time, there's no way of knowing — until it's too late and a circuit failure causes serious damage and serious money loss; high-end CBs cost thousands of euros.

How will panelbuilders use cloud-connected panelboards?

The repository will act like a 'drop box', too. Panelbuilders will just drop into it all the panelboard documentation — user manuals, set-up procedures. And you can access them as and when you need.

How will vendors use the cloud connection?

Equipment manufacturers will be able to branch out into services. Most don't know much about their end users as 70% of panelboards and devices are sold through distributors. Cloud-connected panels and devices give them access to knowledge about customers — especially for the 'big' devices that require maintenance. In that way they can offer you the services that you need, and which you might not even know are available.

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