Past and future technologies

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When asked to do an article on 'Technology of the Future', the hardest part was deciding on the topic. With technology increasing at an astonishing rate over the past few years, deciding on one single direction was difficult. For this reason, we decided to write about how technologies have evolved over the past few years, and the direction that they seem to be taking for the future.

Within the 'electricity+control' industries, the focus in recent times has been on automation and the communications networks that allow devices to intercommunicate. Gone are the days of a technician or an engineer needing to travel to a site for each and every breakdown. These days (and as we move into the future) monitoring, troubleshooting and even regular maintenance such as firmware upgrading can all be handled from a central control room. However, the call for automation on these sites requires reliable, stable networks, known as 'mission critical' networks.

RSTP and bumpless redundancy

Key to discussing critical communications networks is redundancy at the substation network level. Redundancy adds reliability and robustness to a network, allowing communications to continue - even in the event of cable or hardware failure. In recent years, the most common form of redundancy has been Rapid Spanning Tree Protocol (RSTP), which allows for fully meshed networks, providing a much higher form of redundancy than traditional ring redundancy protocols. Although RSTP has a quick recovery time (30 seconds in a worst case scenario), this can often be too long a delay, especially in cases such as smart grid control. For this reason, redundancy technology evolved and now offers bumpless redundancy. Bumpless redundancy means that there is zero recovery time, and that no data will be delayed.

Parallel Redundancy Protocol

One form of bumpless redundancy that has emerged is Parallel Redundancy Protocol (PRP). PRP works by sending data traffic across two completely independent networks simultaneously. This means that, even in the event of one network failing completely, the second network will already be transmitting the relevant data and will continue to do so, even when the first network is restored. Each of the independent networks can also run RSTP internally, meaning that two levels of redundancy are present.

End devices

The end devices that attach to these critical networks have also become smarter and more self managed. Utility programmable logic controllers (PLCs) and networking hardware (switches and routers) are now coming with IEC 61850 [1] support, meaning that there is a common methodology and language for them to use when intercommunicating. Compliance with the IEC61850 standard allows for increased vendor interoperability and reduces vendor locking (being required to purchase PLCs only from a single vendor so as to maintain interoperability with proprietary communications protocols). PLCs are even beginning to have built-in ports to handle technologies such as PRP and HSR, showing that they are evolving to keep up with the relevant communications technologies.

Human Machine Interface

Another technology that has been improving in recent years, are the HMIs used to interface to the network and its attached devices. Originally a PC would need to be installed in most remote sites to act as an HMI between the engineer or technician and the network devices. When laptops started becoming more and more popular and affordable, users could take one of these to connect to individual networks when required. However even laptops can be bulky and cumbersome to carry around a remote site. In recent years tablets made a large splash in the commercial market, with improvements in processors (more power in a smaller physical size) and solid state hard drives (increased storage in more reliable, smaller volumes) allowing tablets to contain the power of a laptop or desktop in much smaller form. Now tablets are beginning to emerge for harsh environments, such as industrial or utility sites.

Tablets with resistance to weather (ingress protection ratings) and physical damage (scratch resistant screens, drop resistance etc) are proving robust enough to be used instead of laptops in these environments, and often can be even better suited. With a wide range of interfaces available on these tablets (such as COM ports for serial communications, RFID and barcode scanners, Ethernet ports etc), they can be used for most applications.

Customised solutions

Another application that has been greatly assisted and improved as technology evolves is the manufacture and testing of customised solutions. Often an installer or engineer will need a single small part made for a particular solution, or a customised mounting bracket for one or two devices. Previously, if the part could not be machined on site, one would need to contact a design company to create the design for the part, and then would need to get moulds made up until finally they could get hold of a physical prototype. This process could cost large amounts of time and money, and in the event that the original prototype does not work could lead to even higher expenditures. Producing a mould could also cost thousands of rands, and in cases where small quantities of the finished part are required, the cost is completely unfeasible.

3D printing

These days a much easier, cheaper solution is available in the form of 3D printing (manufacturing), and even though it is a young technology, it is increasing at a rapid pace. Commercial and personal 3D printers are already available and are starting to become increasingly affordable. These printers work by extruding layers of melted plastic to 'build' the finished part. Parts are designed using a 3D CAD program and are then sent to the printer for immediate manufacture. From design to finished part will depend on the intricacy of the design, but will mostly take only a few hours to complete (for some simple parts this may even be a couple of hours). 3D printing will save time and money, and will also remove the headache of having to deal with 3rd party companies and delays while waiting for the new part. Changes to a prototype is also a simple matter of changing the design and reprinting, rather than having to deal with 3rd party companies and delays caused by a required change to the prototype part.

3D printing is evolving at a rapid pace for different industries, allowing for various materials to be used and higher accuracy of printed parts. In fact 3D printing technology has already been used, along with stem cells, to print out fully functioning human organs that have been accepted by host bodies. The implications of a technology like this are mind blowing, and in the future it is not too far-fetched to believe that one day replacing a device such as a television will be a simple matter of purchasing a one-use design from the internet and printing the finished part out in the comfort of your own house! By this stage security protocols will also have evolved to prevent viruses from infecting these advanced printers.

Conclusion

So as we can see, technology is increasing in leaps and bounds, and there is no reason to believe this will slow down any time soon. Technology is there to make our lives easier, and implications for the utility and industrial worlds are constantly increasing. Technology is also moving forward into new and unforeseen directions. Exciting times lie ahead of us, and it is important to keep ahead of the game in order to constantly increase productivity, safety and reliability of the industrial and utility sectors.

CAD - Computer Aided Design
COM - Common Object Model
HMI - Human Machine Interface
HSR - High-Availability Seamless Redundancy
PC - Personal Computer
PLC - Programmable Logic Controller
PRP - Parallel Redundancy Protocol
RFID - Radio Frequency Interface Device
RSTP - Rapid Spanning Tree Protocol

Abbreviations

Reference

[1] IEC 61850. 2013. Communication networks and systems for power utility automation.

Doron has been working with Industrial Ethernet and IP-based systems for over 10 years and has intimate knowledge with the design, implementation and maintenance of such mission critical applications. He started H3ISquared in 2006 to better serve the industry with products that are leaders in their class. He has provided infrastructure, IP telephony and video solutions to the mining, smelting, and power delivery industries and is deeply concerned about supporting his customers quickly and effectively. Doron also provides extensive training and is a supporter of institutions such as CPUoT (Cape Peninsula University of Technology) for the professional development of students.

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