Inside_Networks

5

Personality crisis

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Trial and error

CHALK HILL MEDIA

6

None of us is infallible, yet there is this idea that the human beings that operate and manage data centres should be. It's probably why so many people are surprised when they find out that nearly 70 per cent of data centre outages can be attributed to human error. This attitude seems strange given that a data centre's infrastructure is generally under processes and procedures that are devised, developed and implemented by humans!

That said, even the smallest amount of downtime must be avoided and, therefore, reducing human error is imperative. So, as well as suggesting what can be done to reduce human error, we've also asked a panel of esteemed industry experts whether it could ever be eliminated and if artificial intelligence is the answer to minimising downtime. **CLICK HERE** to read their comments.

There has been a positive response to the recently launched Network Cable Installer (NCI) Apprenticeship, which is good news for an sector that needs to attract new entrants and improve is professional profile. To give the the full lowdown on the NCI Apprenticeship and its aims and objectives, we've asked CNet Training's Andrew Stevens to provide a comprehensive overview and you can read it by **CLICKING HERE.**

Getting back to technology, the importance of converged network infrastructures has never been higher and in this issue we have two articles on this subject. First up, Andy Hirst of Sudlows explains why it can encompass numerous, not always obvious, disciplines and fields within a data centre, while Matthew Payne of Nexans looks at whether 5G cellular technology will replace Wi-Fi in in-building networks. **CLICK HERE** to read Andy's article and **CLICK HERE** for Matthew's.

Also in this issue we have a special feature dedicated to enclosures, racks and cabinets. Alberto Zucchinali of Siemon discusses how innovative cabinet design supports managed service providers to create an agile data centre environment and meet the rising need for better space utilisation, repeatability and security. **CLICK HERE** to read his comments.

With lots more besides the above, I hope you enjoy this issue of Inside_Networks and, don't forget, if you'd like to comment on any of these subjects, or anything else, I'd be delighted to hear from you.

Rob Shepherd
Editor

Inside_Networks
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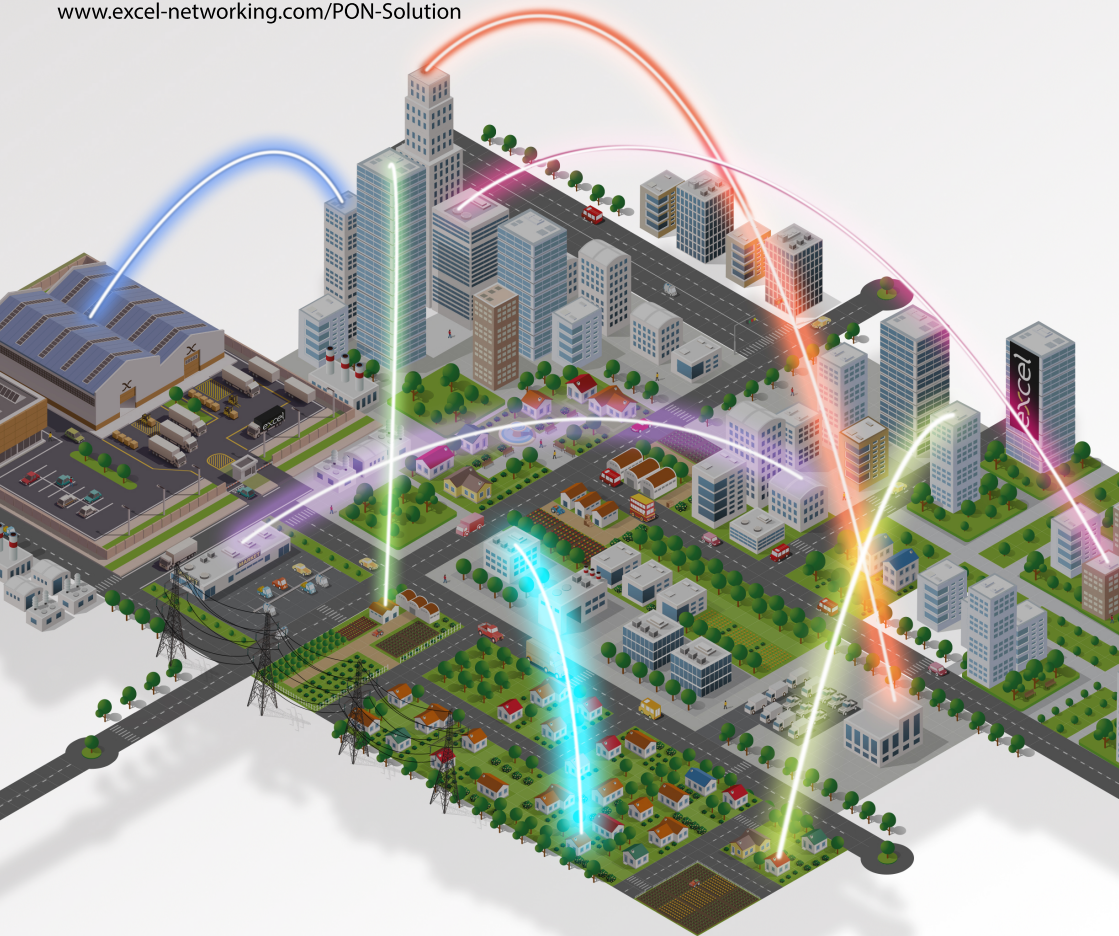
TIA launches ANSI/TIA-942 accreditation scheme for certification of data centres

The Telecommunications Industry Association (TIA) has launched a new industry scheme to provide official auditing and certification to data centres conforming with the ANSI/TIA 942 standard.

'ANSI/TIA-942 is perhaps the most popular true standard in the world for data centres,' said TIA CEO, Wes Johnston. 'It is one of TIA's most popular standards and it is constantly evolving to match today's data centre design requirements, including new technologies and design principles. We are delighted to now have an official scheme to verify conformance to this standard.'

The new certification scheme will establish conformity assessment bodies deemed competent to verify data centre conformity with the standard. Recognising the benefits of implementing a sound quality management system for audits and certification in addition to the technical requirements, TIA has selected Certac to provide verification of conformance to standards by independent third party conformity assessment bodies.

Harry Smeenk, senior vice president for technology programs at TIA, concluded, 'With this official recognition by the TIA, data centre operators can now demonstrate, to both internal and external end users, that their data centre has been independently audited to meet the target resilience rating required.'

Wes Johnson

9

Datacentrepricing's latest research uncovers the latest trends in the UK

According to Datacentrepricing's latest research, the UK data centre market remains the largest market in Europe with 880,000m² of potential data centre raised floor and 1,213MW of potential power at the end of June 2019. It continues to grow, with new space being added by a handful of providers including Ark Data Centres, CyrusOne, e-shelter, Equinix and Virtus, with the focus on areas within the inner London and M25 areas, followed by the Slough city cluster.

Margrit Sessions, owner of Datacentrepricing.com, commented, 'The UK data centre market is growing by up to 50,000m² per annum, with the third party UK data centre market forecast to grow by 45,000m² during 2019 including new development activity and developments already announced.'

She added, 'Also, as of the end of June 2019, the UK third party data centre market party has over 1,230MW of data centre customer power in total – up from 1,180MW in December 2018.'

Two thirds of adults worried AI will take jobs

Fountech.ai commissioned an independent survey among more than 2,000 UK adults to uncover the nation's sentiments towards artificial intelligence (AI) technologies.

It found that 67 per cent are worried AI will result in machines taking people's jobs, 58 per cent find the use of AI tools such as those used by Amazon and Netflix to recommend products to us 'creepy', while 59 per cent are more nervous about the way their personal data is collected and used since the rise of AI. In addition, 24 per cent even think AI could be responsible for the end of humankind and 37 per cent of people admitted they do not fully understand what AI means. However, the majority (62 per cent) do believe AI will do more good than harm to the world.

Nikolas Kairinos, CEO and founder of Fountech, commented, 'For decades, AI has been misrepresented in sci-fi movies and literary fiction, but we should not let this blinker our view of how this amazing technology can enhance the world around us. Importantly, the technology must be harnessed and used in the right way – the ethical questions surrounding the development of AI will rightly remain until both governments and businesses show they are applying it in responsible, safe ways.'

Nikolas Kairinos

Atlancis Technologies becomes the first to adopt OCP in Africa

Atlancis Technologies, headquartered in Nairobi, Kenya, has become the first ICT services provider in Africa to embrace the Open Compute Project (OCP). The company, which specialises in delivering ecosystem transforming ICT solutions, has adopted open technology for its industry cloud platforms.

The founders of Atlancis – Toney Webala and Dan Njuguna – had been closely following the deployment of OCP and its benefits to global hyperscale companies like Facebook, Google and Microsoft to deliver value, optimised performance, total and rapid scalability and competitive advantage. In developing scalable delivery of industry solutions they were excited about the opportunity to leverage these proven, efficient technologies in Kenya and across Africa.

'The OCP is the basis of our go to market strategies for transforming target industry ecosystems globally,' said Dan Njuguna of Atlancis. 'Our hardware design, inspired by OCP, gives incredible flexibility and scalability to allow us to respond to demand in the enormous markets we operate in, and to move quickly into new markets, be they industries or geographical.'

Dan Njuguna

10

Surge in cyberattacks on smart buildings propels global IT/OT security market

Widespread digitisation of building operations and rising incidences of cyberattacks on operational environments are driving the adoption of information technology (IT) and operational technology (OT) security services in smart buildings. The market is estimated to reach $897m by 2022, increasing at a record compound annual growth rate of 37 per cent.

'Today, smart devices control building management activities including temperature control, access and lighting control, communication, and safety systems in many enterprises,' said Swetha R Krishnamoorthi, industry analyst at Frost & Sullivan. 'Such converged IT/OT environment has made enterprises more vulnerable to cyberattacks. With diverse protocols, hardware, and software systems, the OT devices controlling building operations provide a heterogeneous environment. Coupled with IT devices and a common network connection, the attack surface expands, providing a thriving ground for cyber adversaries to play on.'

Frost & Sullivan's recent analysis – IT/OT Security Convergence for Building Technologies – delves into the key trends in the IT/OT security market, identifies the drivers and restraints, and sheds light on the competitive landscape and evolving market share of major participants. In 2018, the Americas accounted for 43.6 per cent of the total revenue share, followed closely by the Europe, Middle East and Africa (EMEA) region at 40.7 per cent; while Asia-Pacific (APAC) was a distant third at 15.7 per cent. However, with a majority of opportunities for IT/OT security solution vendors predicted to arise from the EMEA and APAC regions, this is set to turn around.

11

NEWS IN BRIEF

The Telecommunications Industry Association (TIA) TR-42.9 Committee on industrial telecommunications infrastructure has issued a call for interest for document TIA-1005-A titled Telecommunications Infrastructure Standard For Industrial Premises. This standard specifies telecommunications cabling to support industrial premises applications such as voice, data, text, video, industrial and building controls, security, fire alarm and imaging, while allowing for exposure to the wide range of environmental conditions expected in industrial premises such as temperature, humidity, electrical noise, shock, vibration, corrosive gases, dust and liquids.

The Next Generation Mobile Networks (NGMN) Alliance has announced that it recommends a common RF cluster connector for early 5G deployment.

Equinix has announced an expanded partnership with VMware. The companies will develop solutions to help enterprises accelerate hybrid cloud transformations based on VMware Cloud on Dell EMC within Equinix International Business Exchange (IBX) data centres.

M247 has today announced the double appointment of Mark Allen, cloud overlay specialist and Steve Briant, sales director for the south.

The heart of the

Hi Rob

I enjoyed the Aug 19 issue's Question Time concerning the advantages of premium versus budget cabling solutions. However, I'm really surprised that no one actually addressed the core differences, as there are even some legal implications.

Here are some critical aspects:

• In my domain of structured cabling, the budget brands do not have any means of regular quality control. They rely strictly on their original equipment manufacturer (OEM), which means that defects are often found after installation rather than during continuous quality control. Sometimes the defect cannot be detected during field testing but will only be discovered years later with the network upgrade, simply because field testers do not have the objective of confirming component compliance to all parameters but only system compliance to specific parameters.

• European regulations state that if a product is defective, the responsibility lies on the company making the product, if present locally. This is the case for most mid-range to premium products. But if the product is imported then the responsibility lies on the importer/distributor. Again, if it's a premium well-known brand the risk is limited, but if it's a low end or an OEM simply rebranded, then there's a risk of the supplier

disappearing or refusing to respond, and the importing company not having the capability of repairing the fault or damage.

Then there are some other points to look at:

• Research and development is generally absent with low cost solutions, so if you want the latest products with the best technology, it's no surprise that the premium option has a key advantage.

• Premium brands will check their products for compliance to everything visible and invisible to the customer. They must ensure that they do not risk any damage to their brand, even if it means going beyond basic requirements. The budget solutions will only comply to what the customer can verify. Anything else is irrelevant because it increases the cost without adding visible value. Cybersecurity can fall into this category.

• Local support and training, which is self-explanatory.

So actually, higher quality and performance is really only the visible part of the iceberg that separates premium from budget solutions. But in my opinion, it's not the most important one.

Gautier Humbert
Legrand

12

e matter

Editor's comment

Gautier makes a number of excellent points and highlights some key considerations. As with most things in life, it really is a case of 'buyer beware'. It is therefore important to carry out some research and ask the right questions in advance.

Cost benefit analysis

When it comes to selecting a copper cabling system for an intelligent building there's a diverse array of solutions to consider, a variety of price points. Inside_Networks has assembled a panel of industry experts to discuss the differences between products at the premium and economy ends of the spectrum and whether it really is a case of getting what you pay for

Even though network cabling is an important element of an intelligent building, it can often be tempting to assume that, as all copper cabling has to meet a required minimum standard, choosing the least expensive option makes good financial and business sense. However, it is worth questioning why prices

differences in price can be difficult and not always immediately apparent. While there has always been a determination by certain vendors to push the technology as far as it will go and produce systems which provide enhanced bandwidth and headroom, these have always had a corresponding price position.

WHEN IT COMES TO SPECIFYING COPPER CABLING FOR USE IN AN INTELLIGENT BUILDING, ARE THERE ANY GENUINE ADVANTAGES IN USING A PREMIUM SOLUTION OVER A LOW COST OR BUDGET ALTERNATIVE? IF SO, WHAT ARE THEY AND HOW CAN THIS DECISION AFFECT THE OPERATIONAL QUALITY OF THE INSTALLED NETWORK INFRASTRUCTURE AND ITS LONGEVITY?

differ so considerably and whether using a premium solution is more cost effective in the long-term than a low cost or budget alternative.

It is widely acknowledged that the majority of failures in the network infrastructure are due to the physical layer, so selecting the right cabling system for the job is vital. This process begins with an analysis of business needs and goals and, once established, makes it easier to determine the business processes likely to be employed, the applications needed to run these processes and the IT architecture required to support them.

When faced with the wide range of products and systems on offer, being able to establish what justifies the vast

Also, will the 'extra' that are used to justify the higher price of a premium product be worth the additional money, or is it simply clever marketing spin?

In order to establish truth from fiction, Inside_Networks has assembled a panel of experts to explain the difference between premium copper cabling solutions and low cost alternatives, what should be the key criteria to assess when making a purchase, and how any decision affect the operational quality of the installed network infrastructure and any return on investment.

Don't forget, if you have a question that you would like answered in Inside_Networks, CLICK HERE and we'll do our best to feature it.

ALAN BULLEN
MANAGING DIRECTOR AT LYNX NETWORKS

My guess is that most of the other participants in this Question Time will make the case for a premium solution. However, I'm going to argue that it's horses for courses because, in my experience, a lower priced but good quality solution can provide the same benefits and virtually never fail. It just has to be correctly designed, installed and tested.

Saying that, in favour of a premium solution, most of the cost of an installation is for labour, and this is roughly the same whatever the materials, although the better manufacturers usually select and train their installation companies more thoroughly.

Also, bear in mind that paying 30 per cent more for higher grade cable and connectors may only increase the total cost by about 15 per cent. Also, if you're paying £60 per square foot to rent office space in central London, the additional cost may be a drop in the ocean, and if your building intelligence is mission critical, you shouldn't skimp on it. Any cabling installation service should include test results showing performance to the required standard and a warranty that is still going to be worth something in 20 years.

Operational quality must not be sacrificed at the altar of cost savings, and it's not just about reliability. It's being

able to commission new equipment, make patching changes easily and quickly trace any problems. So a well labelled, fully documented system in the right enclosures and racking is vital. This can be achieved with a premium or low cost solution.

So, it is possible to get a cabling system suitable for an intelligent building without over spending. Buyers just need to beware that lower price doesn't mean better value and, conversely, paying a premium could mean diverting scarce budget from somewhere where it is badly needed. I would suggest paying for an excellent installation company rather than a premium solution and maybe the savings could be spent on some additional outlets to allow for the inevitable growth of the wireless network.

'Operational quality must not be sacrificed at the altar of cost savings, and it's not just about reliability. It's being able to commission new equipment, make patching changes easily and quickly trace any problems.'

13

2

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Make no mistake

The figures quoted for data centre outages caused by human error are very high. As the potentially catastrophic consequences of downtime in a data centre are well documented, Inside_Networks has assembled a panel of industry experts to discuss what can be done and whether human error can ever be completely eliminated

▶ It was the English poet, Alexander Pope, who first published the phrase 'to err is human' way back in 1711. He was trying to convey that it is natural for people to make mistakes, and while this is undoubtedly true, there's also a good case to be made for minimising the likelihood of error in the first place.

99.999 per cent service uptime is

actual figure for human originated issues is much higher, simply because people are instrumental in the design, construction, operation and maintenance of these facilities.

While it's tempting to think that the corporate behemoths of this world are immune to such events, think again. Microsoft, Amazon and Google have all

ACCORDING TO THE UPTIME INSTITUTE NEARLY 70 PER CENT OF DATA CENTRE OUTAGES CAN BE ATTRIBUTED TO HUMAN ERROR, WITH PROBLEMS RESULTING FROM PROCESSES AND PRACTICES, RATHER THAN ARCHITECTURE OR EQUIPMENT. SO, WHAT CAN BE DONE TO REDUCE HUMAN ERROR, COULD IT EVER BE ELIMINATED, AND IS ARTIFICIAL INTELLIGENCE (AI) THE ANSWER TO MINIMISING DOWNTIME?

generally considered the benchmark for data centre reliability. This equates to 5.26 minutes downtime per year or 6.05 seconds per week and when it's put like this makes the challenge facing data centre owners and operators all the more remarkable. Not surprisingly, downtime is enough to make the most experienced data centre owner, manager and/or end user break into a cold sweat.

Yet according to the Uptime Institute nearly 70 per cent of data centre outages can be attributed to human error and a much lower percentage attributable to technology and a failure of automated failover mechanisms, either on the power infrastructure or the network side. It's also possible to make the case that the

experienced data centre downtime issues and the problems that caused their services to be interrupted can happen to anyone.

The issue is how to prevent it or, at the very least, reduce the risk and it's why it makes sense to concentrate on the people that interact with these facilities on a day-to-day basis. In order to explain how to minimise the possibility of human error, Inside_Networks has assembled a panel of experts to give us their advice on what to look out for and the measures that can be put in place.

Don't forget, if you have a question that you would like answered in Inside_Networks, **CLICK HERE** and we'll do our best to feature it.

MARK ACTON
INDEPENDENT DATA CENTRE CONSULTANT AT ACTON CONSULTING

Human error is either a contributing factor or the root cause of many data centre failures or service outages. Jerry Williams in his HEART Methodology, developed originally for the British nuclear industry, noted that if individuals are stressed, under time pressure, poorly motivated, inadequately trained and/ or inexperienced there is up to a 50 per cent chance of performing an action incorrectly.

If, however, the individual is properly trained, under no time pressure or other stress, able to properly focus on the job in hand, has the correct training and experience, this failure rate drops to 0.04 per cent. And yes, the decimal point is in the right place!

From this it is evident that to minimise data centre failures or service outages it is vital to have properly trained and experienced staff who are not under any form of pressure during the operations they perform, and are properly motivated to follow and focus upon detailed instructions and processes, without complacency or a willingness to follow their own path because they feel they know better. Overconfidence can be just as destructive as inexperience or lack of focus.

But let's not just focus on individuals. Human error can be both individual and institutional and the institutional elements are often forgotten or neglected. Examples of institutional failures leading to human error are lack of suitable training or recruitment of inexperienced personnel to save costs, understaffing resulting in time pressure on individuals or the lack of ability to work in pairs, which is accepted best practice during critical operations. Other factors include a lack of technical oversight or governance, weak or missing corporate process/ procedure and lack of appropriate or up to date documentation.

It is easy to blame individuals for getting it wrong and in some cases this is entirely fair. However, many human errors have root causes at a corporate management level as a result of short-term cost saving or 'value engineering'.

Of course, we should be taking the measures suggested to improve individual performance as suggested above, but also senior operational managers should be looking more closely at the decisions they make and the culture they instil at the ground level. This will minimise the risk of human error to their data centre operations and, ultimately, their businesses.

> 'It is easy to blame individuals for getting it wrong and in some cases this is entirely fair. However, many human errors have root causes at a corporate management level as a result of short-term cost saving or "value engineering".'

16
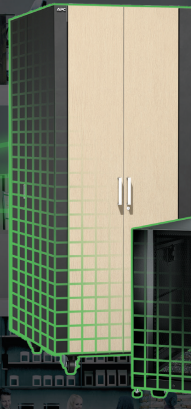
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ANDREW STEVENS
PRESIDENT AND CEO AT CNET TRAINING

I find it quite alarming that despite human error being a hot topic for some considerable time, this figure remains at the same high level today as it was several years ago. This means that this potentially huge and costly problem just isn't being given the attention it deserves. Personally, I'm mystified as to why more mission critical organisations are not focusing on reducing people risk, particularly considering the potential disruption and brand damage it could cause.

Yet, the answer is not a complex one. There is a need to analyse data centre teams' processes, their skills gaps and other areas that require improving. There are some clever tools available that are backed by psychologists, which can identify people risk and therefore highlight areas that need to be addressed to take steps towards mitigating it.

Individual assessments can identify gaps in knowledge, confidence and competence levels. This allows the appropriate support, knowledge development and mentoring activities to be implemented to fill these gaps. We tend to find that highly confident people often disguise their technical incompetency with their confidence, meaning they confidently do things wrong. This obviously increases the likelihood of mistakes, outages and downtime in a data centre.

Yet this can all be addressed with commitment and time dedicated to it.

Recognising and evidencing individuals' knowledge and skills with official certifications and qualifications is always a good idea, as well as monitoring and managing their processes and procedures on an ongoing basis.

I believe organisations with highly knowledgeable, confident and competent technical teams have the opportunity to absolutely thrive in the marketplace, especially when they can prove that their teams are the best and can reflect this when comparing their own outage figures against the overall published figure.

AI and, more specifically, machine learning, will become part of the data centre process in the future for predictive and repetitive tasks, however, they still require human intervention and knowledge to validate them. It's interesting to see how the data centre sector is embracing this change – if there is ever an industry that is geared up for constant change, it's this one.

'We tend to find that highly confident people often disguise their technical incompetency with their confidence, meaning they confidently do things wrong. This obviously increases the likelihood of mistakes, outages and downtime in a data centre.'

EMMA FRYER
ASSOCIATE DIRECTOR AT TECHUK

Although I don't perform an operational role or handle failures first-hand, I'm very conscious of the impact of outages. That's because I sit between the industry and external stakeholders like government and media, providing a collective voice for operators and protecting the sector's reputation. Data centre outages are particularly problematic because a single facility may support critical business functions for hundreds of customers. Consequences can be far-reaching, and very public.

Although we expect the percentage of incidents caused by human error to shrink as industries automate, I'm unsurprised by the Uptime Institute's figures. Other sectors are instructive – 94 per cent of car accidents are caused by human error – although manufacturing and mechanics are automated, driving is not. However, in aviation, a highly automated, extremely risk adverse industry, the figure is 80 per cent.

Why so high? Perhaps we're prioritising the wrong numbers. It's the overall incident rate that matters. If automation has whittled accidents down from 1,000 a year to 100 a year then the proportion caused by things that automation can't solve necessarily increases. 80 per cent of 100 is better than 30 per cent of 1,000. Tackling those causes becomes the new priority.

We also lack data. Operators are reluctant to disclose service interruptions or near misses, so we don't know how many have happened and can't learn from mistakes. The Data Centre Incident Reporting Network (DCIRN) is a helpful initiative, providing a confidential reporting framework for operators.

Analysing incidents identifies common causes, and knowledge can be shared. Where we target automation matters too. On the roads, it's focused on vehicle to vehicle communication and movement, so human error incidents should, in theory, reduce as automation increases. However, in data centres, automation is often focused on equipment and infrastructure rather than human activity.

So where does that leave us? Operators aren't ready to relinquish control of qualitative decisions and standards will therefore play an increasing role in defining processes and good practices. We will continue to rely on education, professionalism and competence but rapid growth and technical staff shortages will continue to challenge us. I don't expect human error to drop off the list of causes, but I do expect the incident rate to diminish.

> 'We will continue to rely on education, professionalism and competence but rapid growth and technical staff shortages will continue to challenge us. I don't expect human error to drop off the list of causes, but I do expect the incident rate to diminish.'

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Why tomorrow's zero net emissions targets demand action today

By Dr. Stu Redshaw, Founder and Chief Technology Officer, EkkoSense

When the previous Prime Minister committed the UK to becoming the first G7 nation to make zero net emissions a legislated goal, there was only a vague discussion about the ultimate cost of this initiative. In fact, Government figures suggest that total UK decarbonisation will require an investment equivalent to 1-2% of GDP through 2050, and some estimate the total cost for the UK to exceed a trillion pounds overall.

Clearly this is a huge cost, and it's hard to see it being delivered unless there's a significant uplift in green taxes. And these will inevitably be focused on the highest energy consumers – so it's unlikely that the data centre industry will escape an increased focus on its power usage and management.

Unfortunately this comes at a time when many data centre operators aren't doing enough to optimise their energy performance – indeed according to the Uptime Institute average Power Usage Effectiveness (PUE) numbers have actually gone up over the last 12 months.

The good news is that some of the smarter DC teams are already using the latest software-driven thermal optimisation techniques to secure an average 25% saving on their data centre cooling energy usage. At the same time, they're also successfully removing 100% of thermal risk from their facilities. At EkkoSense we're also helping those operators who aren't yet ready to go down the full optimisation route by providing an embedded software Cooling Advisor capability that can actually unlock data centre cooling carbon reductions of at least 10%. By offering clear recommendations of actions that teams can take immediately to fine tune their data centre's operational performance, organisations can take a significant step towards minimising their environmental impact.

It's this kind of accessible and practical 'expertise as a service' offering that can make a real difference for data centre operators – giving them a head start on serious energy reduction programmes before the carbon reduction team inevitably starts knocking on their door.
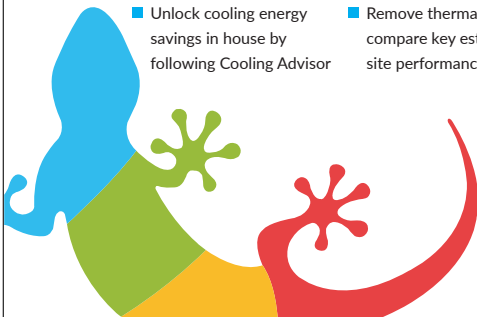
JOHN LABAN
RESET CATALYST AT THE OPEN COMPUTE PROJECT (OCP) FOUNDATION

So what can be done to remove human error? It's difficult for me to be reductionist in this discussion and only consider processes and practices in isolation from architecture (design) and equipment (design).

A data centre is a complex system and one must therefore use 'systems thinking' and look holistically at it. I would therefore like to comment on the design foundation in my short response here.

If the objective is to reduce human error occurring from when people touch stuff then designs that are simpler and remove humans from the data centre facility is a good starting point. This should include but not be limited to the following:

- Tool-less servicing that allows 80 per cent of server components to be replaced in less than 60 seconds, as demonstrated in a Yahoo Japan OCP case study
- A standard rack layout for all ICT racks
- Intuitive hardware operation/servicing that removes anxiety and makes you happy
- Eliminating the requirement for rear servicing in the hot aisle
- Removal of all unnecessary hardware duplication by using software virtualisation, and consign Tier III hardware redundancy designs to the dustbin of the last millennium
- Good lighting by not using black racks
- Simplification and minimisation of hardware using open source software
- Removal of proprietary product differentiation
- Defining where fingers can touch equipment using 'green touch points'
- Automating everything in software that can be automated
- Removal of plenum access floors which, when lifted, divert cooling airflows away from equipment

Could humans be eliminated from the data centre by using robots? Yes, of course, but it's important to design the data centre facility with the robots in mind. For example, by using blind mate connectors for liquid/network/power on the rear of racks so that the robot only works at the front of the rack and does not need to deal with a spaghetti of cables. This is already happening, as Huawei OCP racks are optimised for robots. Likewise, machine learning software is a useful tool to eliminate routine preventative maintenance activities.

In the future there shall only be two animals in a data centre – a human and a dog. The human shall be there to feed the dog and the dog will be there to prevent the human from touching the equipment!

'In the future there shall only be two animals in a data centre – a human and a dog. The human shall be there to feed the dog and the dog will be there to prevent the human from touching the equipment!'

GERARD THIBAULT
CHIEF TECHNOLOGY OFFICER AT KAO DATA

70 per cent of data centre outages can be attributed to human error. Although it is a striking headline, we need to peel back the layers of this onion to reveal the heart of the matter. The data centre market is maturing at a steady rate and technical innovations are appearing at an ever faster pace. While there is human involvement within the data centre there will be the opportunity for human error.

Behind the Uptime Institute data we find that it is not just active error (where a deliberate action causes a problem), but also latent error, (where a non-deliberate action causes a problem). Most of us associate human error with operational personnel making a mistake and causing an outage. However, what about a design error, which occurred months if not years earlier and didn't identify a possible cascade scenario?

High quality knowledge and depth of experience in the data centre design team, across the build and installation of infrastructure, compute and support systems, is essential to minimise error possibilities. A wholehearted top down and bottom up acceptance of, compliance to, and continued review of appropriate standards, processes and protocols offers real benefits. Furthermore, accepting the importance of these principles will greatly reduce possible human error from the whole environment.

Will we ever remove human error from the process, delivery and operation of the data centre? Automated systems and AI will increasingly improve the monitoring of live systems and massive data inputs from around the data centre will allow these systems to better predict possible error scenarios, and trigger actions to pre-empt problems. However, while the code which drives these systems is written by humans, and the operators sent around the data centres on maintenance routines and systems alerts are human, then there will be an inherent level of risk.
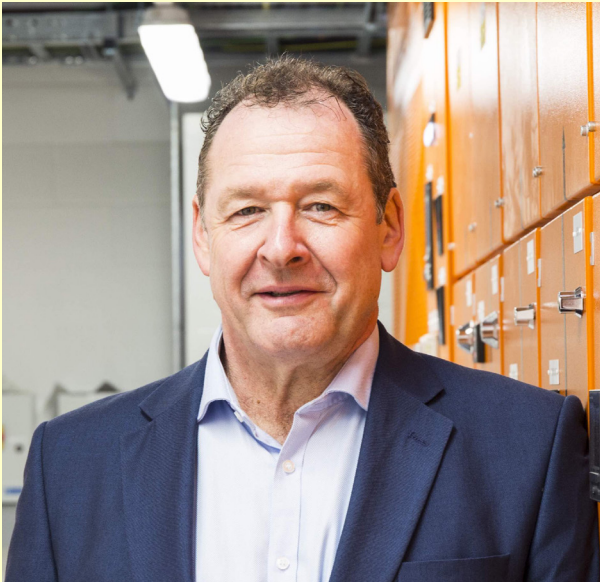
'A wholehearted top down and bottom up acceptance of, compliance to, and continued review of appropriate standards, processes and protocols offers real benefits.'

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Thinking inside the box

Alberto Zucchinali of Siemon discusses how innovative cabinet design supports managed service providers (MSPs) to create an agile data centre environment and meet the rising need for better space utilisation, repeatability and security

▶ Today's data centres are experiencing rapid growth in processing requirements and a seemingly unstoppable demand for storage. At the same time, power needs are on the rise and space is becoming an increasingly precious resource. MSPs working within the data centre environment, especially those providing network infrastructure as part of their service portfolio, are encouraged to develop a thorough understanding of the role that data centre cabinets can play in addressing these challenges and in adding value to customers.

SELECTION PROCEDURE

Choice of design will define the long-term outcome for the data centre in terms of flexibility, cooling and power consumption. Along with the infrastructure architecture selected, cabinet choices will also determine active equipment and port density and it is therefore important to better understand the contribution cabinets can make to an efficient data centre operation.

One of the most important responsibilities of an MSP operating in a data centre is providing overall security to the cabinet. There are many ways to prevent access to and theft of critical and sensitive data stored in data centres, but physical access control and management remain a critical measure. At cabinet level, universal keys that can open any cabinet only provide limited means to ensuring physical security. As an alternative, cabinet door security systems that control cabinet access by restricting access to mission critical equipment based on specific cabinets, roles and time periods play an increasingly important role.

They comprise hardware and software, and with secure door handles that support various levels of authentication including personal identification number (PIN) and radio frequency identification system (RFID) card access, biometrics and dual factor authentication. As well as separate front and rear security, these systems provide cabinet level or end of row authentication and can also be deployed for free-standing cabinets. Innovative door security systems also offer compliance with privacy regulations such as the General Data Protection Regulation (GDPR) and Sarbanes-Oxley.

FASTER DEPLOYMENT

Customers expect an MSP to provide an agile IT environment that quickly scales to meet new demands and growth plans.

With the rise in processing requirements, computing capacities have to be expanded swiftly and this will also become a question of cabinet choice.

The traditional process of adding new cabinets to enable more space for active equipment can be quite lengthy and typically involves a number of steps including delivery of the different components, unpacking, component location and installation into specific cabinets. With pre-configured cabinet solutions these steps can be entirely eliminated and deployment time – as well as labour – can be reduced by up to 30 per cent.

Pre-configured cabinets are pre-assembled and preloaded with components, meaning that optical fibre and copper connectivity, power distribution units (PDUs), cable management or other accessories are already pre-mounted into the cabinet when it arrives, and the cabinet only requires final connections and installation of active equipment. In addition, they are often identified by one unique customer specific part number and price which simplifies and speeds up the ordering process of future identical cabinets.

The ability to repeat the same design configuration of cabinets is also important. Pre-configured cabinets offer a repeatable deployment option, which minimises errors and increases the speed of deployment for any project.

DELIVERING DENSITY

In other circumstances, a client might need to increase capacities but is limited to the amount of available floor space – either in their own data centre or within the cage leased from a colocation MSP.

The type of cabinet an MSP selects for the facility can thereby have a distinct impact on the ability to maximise existing space. Cabinets that feature dedicated vertical space for cable management and

'MSPs are advised to work closely with manufacturers that have a wealth of experience in network infrastructure design, which offer a broad range of cabinet solutions and which can provide expert advice on the type of cabinet required based on specific needs.'

power distribution to the left and the right of the cabinet allow for increased active equipment density inside the cabinet – up to the maximum power delivered to the cabinet. Getting cable out of the cabinet's heavily congested equipment mounting space creates the space required to deploy ultra-high density data centre infrastructures. In addition, the overall neatness and aesthetics of the facility are also maintained.

In addition, cabinets that offer dedicated cabling spaces will enable faster and easier moves, adds and changes, without disturbing active equipment. Good cabinet designs also take accessibility into account and provide split door options to provide unimpeded access for maintenance and management.

with large amounts of power required to operate and cool advanced IT equipment. Cabinets can lower cooling demand thereby making an impact on the customer's power bill.

With this in mind, it's best to select cabinets that are designed to control airflow to maximise thermal management and efficiency without sacrificing equipment and cabling density. Proper vertical cable management moves data centre cables out of the horizontal

COOLING DOWN

Power consumption continues to play a huge role in the data centre environment

equipment mounting areas and away from equipment cooling fans, improving overall airflow and cooling efficiency. In addition, high flow front and rear doors will facilitate good airflow to ensure proper hot aisle/cold aisle circulation.

The best cabinets include accessories such as brush guards, blanking panels and grommets to better control airflow and temperature. Vertical exhaust ducts (chimneys) can passively direct exhaust heat from active equipment into the return air space to increase heating, ventilation and air conditioning efficiency, and can be field extended to a range of ceiling heights. This keeps hot air from entering the data centre space and controls the flow of air to the computer room air conditioning (CRAC) units.

DEMAND DRIVEN

Data centres are under pressure to keep up with the rising demands of the evolving business, making network infrastructure design considerations and component selection more critical than ever. Innovative cabinet solutions will be key to the density, agility and efficiency requirements and play an active role in cooling and associated power demand for lower operating costs and a better return on investment. When planning and designing cabinets into the data centre space, MSPs are advised to work closely with manufacturers that

have a wealth of experience in network infrastructure design, which offer a broad range of cabinet solutions and which can provide expert advice on the type of cabinet required based on specific needs. ∎

ALBERTO ZUCCHINALI
Alberto Zucchinali is Siemon's data centre solutions and services manager EMEA. With 20 years' experience in structured cabling, Zucchinali has authored and presented a number of papers at industry conferences worldwide on various specialist subjects concerning premises cabling, data centre design, intelligent patching, copper and fibre technologies. Today he applies this learning to data centre infrastructure and designs network architecture for sites around the world.

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intelligent rack power distribution units (PDUs) are designed, built and manufactured to provide extremely high levels of resilience. Digital local touchscreen displays, DC power modules and latching relays are standard features within InfraPower Metered and Outlet

Switched (WS) PDU, and Outlet Switched with Outlet Metering (WSi) PDU models.

InfraPower PDUs can be integrated with InfraSolution networked smart card access control for added cabinet security or InfraGuard for full cabinet environmental monitoring and management. Installing a remote rack IP door access solution allows monitoring, control, alarm and reporting capabilities for all server racks. Sensors are available for complete environmental monitoring and peripherals such as fans and lights can be added to further expand functionality.

To find out more **CLICK HERE.**
www.austin-hughes.eu

Excel Networking Solutions

Excel's comprehensive range of Environ racks, cabinets and open frames offers exceptional quality. They are suitable for a wide range of applications in the enterprise, data centre and security markets, as well as for everyday cabling systems.

To complement the Environ range, Excel offers the Environ Locking Solution to provide an ergonomic and stylish solution for environments where security is paramount. Bringing intelligence and monitoring right down to the lock level of a rack, the Environ Locking Solution

provides ultimate access control.

The full range, which is available for free next day UK delivery, can be viewed in the dedicated Environ digital catalogue.

Excel's Specialist Support Services include pre-configured cabinets and on-site rack assembly to offer customers a flexible service, which is proven to reduce installation cost and time, whilst providing a fully tested, fully traceable, 100 per cent inspected product.

CLICK HERE for further details.
www.excel-networking.com

HellermannTyton

HellermannTyton provides a complete end to end range of fibre to the X (FTTX) solutions, delivering fibre from the point of presence (PoP) to the building and through to the customer termination point.

HellermannTyton's new range of MDU fibre distribution enclosures strengthens the company's FTTX product portfolio. Adding the new MDU enclosures allows HellermannTyton to offer a full end to end last mile fibre solution, which provides installers, engineers and network designers with a one stop shop of products for every step of the fibre network.

There are three new MDU enclosures in the series. The MDU-S5 is the larger enclosure, presenting up to 96 connectorised fibres or 432 fibre splices. It provides a number of options, giving the installer total flexibility. The smaller MDU-S3 offers up to 96 fibre splices and is built with a loop storage basket option. Finally, the MDU-S1 can be pole, facade or wall mounted with eight connectorised fibre drops, making it perfect for the smaller building. All of these MDU enclosures are stylish, compact and come with an IP54 rating.

To find out more **CLICK HERE.**
www.htdata.co.uk

EDP Europe

EDP Europe recognises that sometimes 'off the shelf' solutions don't always exist for IT projects in data centres and enterprise IT rooms. Server racks may require a non-standard configuration, networking frames might not have the cable management you desire, your data hall may have too many obstacles for standard aisle containment, or you might just require a custom made rack kit to support heavy IT equipment installed in racks.

Whatever the issues you're having, no matter how big or small the requirement, EDP Europe's Bespoke Design Service can help. EDP Europe works with UK manufacturers to develop and deliver, on short lead times, bespoke solutions with no minimum order quantities.
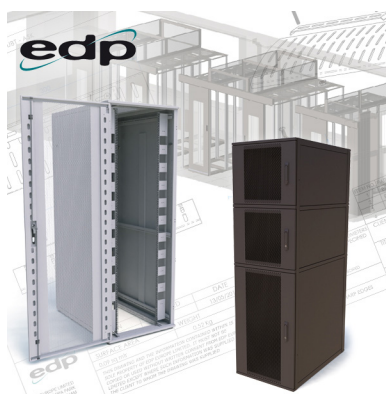
Our racks include data centre server cabinets, 42U computer racks, colocation racks, high density patching frames and flat pack server racks. We also offer tailor-made aisle containment systems and other bespoke solutions to aid your IT projects.

CLICK HERE to find out more, call 01376 501337 or **CLICK HERE** to send us an email.
www.edpeurope.com

Panduit

Data centre energy performance is now equally as important as the data speeds and connectivity to the data centre operator.

Just as importantly, cooling energy efficiency is critical to low Power Usage Effectiveness (PUE).

The trend towards high heat and load density cabinets in technology halls makes hot air containment systems that offer segregated cool air cooling and exhaust ducts for hot air removal essential to cooling efficiency, as within the Kao Data Technology Suites. Operating at server manufacturers' temperature specifications allows maximum product performance and longer lifecycles, which benefits operators and customers.

Panduit supplies its Universal Containment, hot aisle containment enclosure and rack systems to the Kao Data Campus. This highly energy efficient and leak free solution offers hot aisle containment from cabinets, racks and enclosures, as well as exhaust and inlet ducts. This guarantees that the airflow is directed to where the cooling air is required, and exhaust air is extracted so no mixing of the airflows occurs.

To find out more **CLICK HERE.**
www.panduit.com

Chatsworth Products (CPI)

IT managers are being tasked with delivering increasing levels of high performance, while still retaining optimal efficiency levels – working hard to cut costs and meeting demanding deadlines.

To overcome these challenges, Chatsworth Products (CPI) has re-introduced an efficient cabinet solution – the EF-Series EuroFrame Gen 2 Cabinet – now with UK stock availability for guaranteed fast delivery.

The EuroFrame Gen 2 cabinet is designed to minimise deployment time and resources by offering a quick and easy to install storage solution, whilst still providing the high performance associated with the CPI brand. The evolving requirements being placed on European data centre owners and operators are leading them to seek increased levels of performance and efficiency, while keeping expenditure increases to an absolute minimum. EuroFrame Gen 2 cabinets address these requirements perfectly.

Along with its matching airflow, cable and power management accessories, this cabinet provides a reliable and cost effective solution for modern data centres.

To order your EF-Series EuroFrame Gen 2 Cabinet or to find out more **CLICK HERE.**
www.chatsworth.com

34

Siemon

Unplanned data centre downtime can cost a business thousands of dollars and whilst power outages and network failures range amongst the most common causes, industry reports show that downtime is often attributed to human error. In a colocation facility human error can be as simple as accidentally accessing the wrong cabinet for patching and maintenance work.

Siemon's new V-Lock cabinet door security system provides superior cabinet level access control for improved security, administration and control in mission critical colocation and enterprise data centres. V-Lock comprises a comprehensive and easy to set-up hardware and software system, and a wide range of secure door handles to meet specific cabinet security needs including electronic, low frequency card, high frequency card, biometric fingerprint and PIN access.

The solution uses a server based software platform to administer users, their cards and biometrics and to manage user and group permissions. It also provides real time monitoring and maintains extensive logs of events for auditing and compliance regulations.

To find out more **CLICK HERE.**
www.siemon.com

Made to Connect

MDU-S5

MDU-S3

MDU-S1
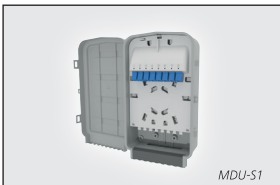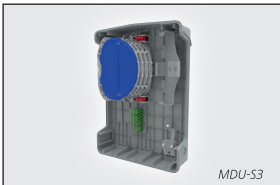
MDU Fibre Enclosures

The range of MDU enclosures from HellermannTyton provide high fibre capacity and flexibility within the multi dwelling unit (MDU).

The range has been designed in a variety of sizes to service the varying sizes of apartment blocks or office buildings.

The S5, the largest enclosure in the range, offers up to 432 fibres or 96 connectorised fibre ports. The S3, the middle sized enclosure offers up to 96 fibres or 24 connectorised ports. The S1, the smallest in the range provides 8 connectorised fibre drops, designed for the smaller residential or building unit.

IN-AD-MDUS-R10

Stay in touch with us!

Optimum Fiberoptics becomes fully integrated into R&M USA

R&M announced the acquisition of Optimum Fiberoptics in March this year and the integration of the company into R&M USA, based in Milpitas, California, is well on course.

In order to better meet the growing needs of its customers and to enhance its product line, R&M will move into new premises towards the end of the year.

The entire production will be relocated to a new building in Elkridge, near Baltimore, which has the necessary space reserves for today's and tomorrow's business.

'The acquisition of Optimum already shows first results and is a perfect addition to our current activities. It enables us to serve our existing customer base on the East Coast as well as to reach new customer groups,' stated Christopher Stratas, managing director of R&M USA. 'It gives us excellent access to the important data centre providers market area in the American east coast market region.'

Christopher Stratas

CNet Training's Infrastructure Forum 2019 examines the latest trends and evolving needs of the industry

CNet Training recently held its Infrastructure Forum 2019 in London, which was attended by a selection of industry professionals with the aim of discussing the latest trends and evolving needs of the industry. This annual event gives specially invited delegates from across the network infrastructure sector the opportunity to offer advice and feedback to CNet Training, so it can help network cable installers to extend their skillsets and take on the installation of equipment supporting the rollout of smart technologies.

Andrew Stevens, CEO at CNet Training, commented, 'We have been running the Infrastructure Forums since 2016 and we value all the feedback and advice we get from attendees. It's great being able to work together with the industry to help shape the future of the network infrastructure sector and really make a difference through joined up thinking to scope the future knowledge, development and professional certification needs.'

He added, 'A measure of the success of this partnership is the addition of the new Certified Integrated Infrastructure Technician (CIIT) program, which has been added to The Global Digital Infrastructure Education Framework. The CIIT program develops knowledge and practical skills required to deliver network infrastructure projects that include the installation and commissioning of intelligent network devices.'

Andrew Stevens

The Cabling Company acquires Brotel Technology Services

The Cabling Company has acquired Brotel Technology Services. Brotel has ceased trading and the two companies will merge into and trade as The Cabling Company, headquartered in Witney.

David Jackson, managing director of The Cabling Company, said, 'Since establishing The Cabling Company in 2009 I have worked in both sales and operations. Through running the business it became apparent that additional support and assistance was needed in these areas in order to continue our trajectory of expansion. We see this acquisition as a means of meeting this requirement and a natural progression for The Cabling Company to grow its client base and turnover in the coming years.'

David Smart, managing director at Brotel, added, 'This mutually beneficial merger gives Brotel the perfect opportunity to enhance our services to existing clients, grow our sales team and together fulfil our potential in both sales and operational areas. This will ultimately develop the business as a whole and support future growth. Our 20 years' experience working in the industry now provides great potential for further success working with The Cabling Company.'
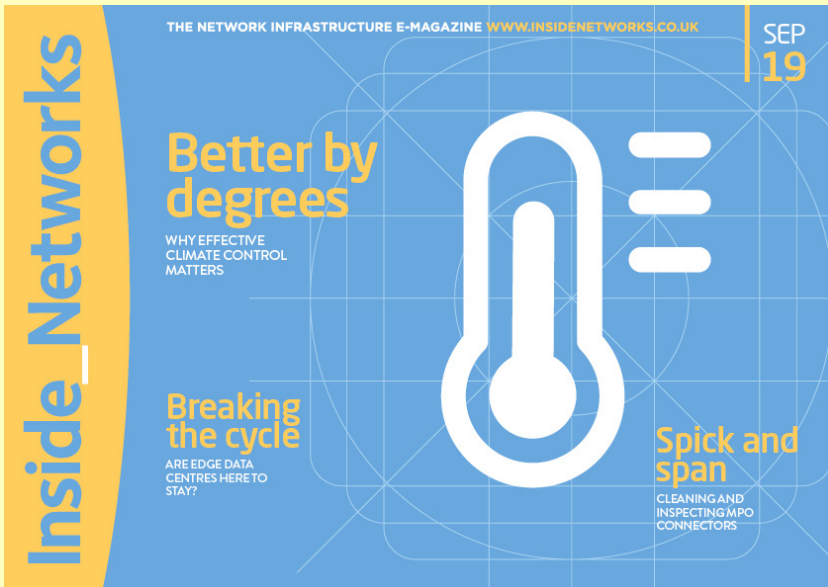
Panduit appoints new EMEA marketing manager

Panduit EMEA has appointed Martin Kandziora as senior marketing manager. He will lead the international and country marketing teams with responsibility for developing and implementing marketing strategy and campaigns across Europe, Middle East and Africa to support the developing activity of Panduit in the region.

With 20 years of experience gained in technology marketing for global and family owned businesses, Kandziora is well acquainted with working successfully within an international infrastructure provider. He was previously vice president marketing and communications for Rittal, where he spent 15 years.

Martin Kandziora

Ralph Lolies, managing director at Panduit EMEA, commented, 'Martin is an excellent fit for Panduit. This is a period of transformation across our target markets and marketing is an essential building block for Panduit. Martin's experience in marketing across EMEA will be highly valuable as we continue to develop our customer base and revenues over the coming years.'

CHANNEL UPDATE IN BRIEF

EkkoSense has appointed Pete Le Noury as its chief operations and chief financial officer. He brings in-depth experience and will be instrumental in driving the company's next key growth phase.

Ideal Networks is appointing leading manufacturer rep agencies to extend the company's local coverage for customers in the US. This follows recent news that it has established a dedicated facility in New Jersey to meet the needs of installers, technicians and distribution partners.

Nimans has appointed Camilla Kirkham as director of sales for its new CCTV and AV division. She joins Nimans from Norbain, where she was divisional director of sales.

In July, the Haiger-based Rittal Innovation Center welcomed its 10,000th visitor, three years after its opening.

Harting Technology Group has officially opened its state-of-the-art European Distribution Centre (EDC) in Espelkamp.

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FLUKE *networks.*

Greater than the sum of the parts

Andy Hirst of Sudlows explains why the term 'converged network infrastructure' can encompass numerous, not always obvious, disciplines and fields within a data centre

▶ Converged network infrastructure within a data centre is usually associated to the operation of the server, storage or network elements, however, I believe that it also encompasses numerous other disciplines. In my opinion, whatever context it relates to, a converged solution is key in overcoming operational inefficiency, significantly improving energy efficiencies, reducing points of failure and thus de-risking elements of a facility.

HARD AND SOFT
In general, converged systems are largely homogeneous – meaning that a system is integrated from a single vendor and encompasses both hardware and software. These integrated systems tend to be distinct to the majority of data centre building management systems (BMS), which are typically very much heterogeneous and highly bespoke.

Although technologies are being continually developed within this sector, driving efficiencies and resilience mainly around the electrical and mechanical disciplines, a part of the infrastructure that would benefit from a more converged network infrastructure, and which to a certain degree has been overlooked, is the integration of BMS property management system (PMS), energy management system (EMS) and data centre infrastructure management (DCIM) on to one platform by a single manufacture or supplier. I realise that there are solutions

out there that do integrate, to a certain degree, but are they really able to offer the client the advanced intelligence and controls needed?

BIG ISSUES
Usually, a BMS that is incorporated into a facility may simply be for monitoring purposes only, with no control capability, and is probably isolated from a DCIM solution that runs alongside it. They are all based on platforms currently available, which accept multivendor solutions but, in my experience, this comes with technical issues at the commissioning stage and although the issues can be ironed out, the system might not report exactly how the client envisaged it would.

More importantly, a vital trick has been missed here. If they could be combined, then the BMS, PMS, EMS and DCIM working together can be used to not only monitor, alarm notify and report on systems but, with the right type of integrated controls, be used to:

- Manage and sequence chillers
- Optimise free cooling
- Control and modulate pumps
- Maximise temperature setpoints
- Optimise valves
- Dynamically adjust chilled water setpoints

These, along with other benefits, such as power balancing, are taking it one step further. They can even be used to monitor
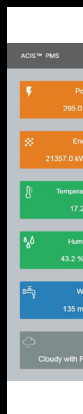
Figure 1
stamping
not affec
happenin

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undetected power anomalies, enabling these potential unnoticed issues to be time-stamped, enabling investigatory work to be carried out as to why incidents are arising when they potentially would go unnoticed. This turns an integrated system into a potentially preventative maintenance tool and cognitive monitoring function, as Figure 1 shows.

- A CBEMA curve, due to the meter actually date and time
g every milliseconds. This enables us to see issues that do
t the system but might still be a concern as to why they are
g. Image courtesy of Airedale Air Conditioning

MONITOR AND MANAGE

Sudlows uses multiple vendors to build up the monitoring of the BMS – which all goes back to a head end. As an example, when one of our clients' requirements was a system that would encompass more than just a traditional system, we worked with one of our partners, took a step back and looked at what we could achieve if we took the monitoring and incorporated controls to the system from one platform. Figure 2 shows the on-site control panel for a completed facility.

Figure 2 - Although the system can be remotely accessed, on-site access is still provided for maintenance engineers.

Looking at the tools being developed, we implemented the latest technologies into this solution and found that we could not only improve efficiencies, by way of the controls, but that we could even look at issues that were happening to the electrical system that were going unnoticed.

This solution was driven by a client's requirements and, once it was completed, it demonstrated clearly how much more you can achieve by integrating monitoring, alarming, trending and remotely controlling the full mechanical

'When you look at the BMS, which is a small area of a data centre infrastructure, it is interesting how much you can improve efficiencies and potential points of failure. This then leads you to consider what other areas are being overlooked that could have the same impact.'

and electrical (M&E) infrastructure – thus improving efficiencies and reducing points of failure.

This integration enabled the full

Figure 3 - One of Sudlows' sites being commissioned, demonstrating the integration of all the systems and the efficiencies achieved

commissioning process to be seamless, as multiple vendors were not required on-site, all attempting to upload compatible software in order to enable communication between multi-solutions. This new approach was refreshing as it enabled all

equipment and controls to communicate through one vendor's platform.

BENEFIT CHECK
The benefits actually become very apparent, even at the commissioning stage, where it is possible to demonstrate how the efficiencies are attained during the system integration testing, as shown in Figure 3.

For many facilities, it may not be crucial to have a converged network solution around the BMS. Therefore, the multivendor approach is still a suitable solution but when you do incorporate a converged infrastructure you realise how much more you can get out of the system.

One consideration is that although it can be beneficial to achieve the most out of this, additional time on upfront design work may be required. The time to carry this out may require factoring into the programme, ensuring if new technologies have been developed within equipment, such as UPS or chillers, that these will still be compatible with the BMS/control solutions software that is being integrated into, and that the equipment's protocol will allow this.

As the drive for data centre efficiency and resilience continues, M&E infrastructures are the key elements that are targeted, due to the high power consumption. So, with continual development and innovation to improve these being carried out – and rightly so – sometimes other areas of improvement are overlooked.

CASE IN POINT

When you look at the BMS, which is a small area of a data centre infrastructure, it is interesting how much you can improve efficiencies and potential points of failure. This then leads you to consider what other areas are being overlooked that could have the same impact. Will it be driven by the clients' demands or by designers lifting their heads above the parapet of M&E infrastructure to look at other elements of the data centre that can be improved? ◼

ANDY HIRST

Andy Hirst is managing director of Sudlows' Critical Infrastructures division. He has previously been chairman of the ICCT on behalf of the Electrical Contractors' Association (ECA) and a member of the BICSI steering committee in the UK. He is an incorporated engineer, a fellow of the Institution of Engineering and Technology (IET) and has achieved the prestigious Accredited Tier Designer (ATD) designation by the Uptime Institute and is currently studying for his MSc in Data Centre Leadership and Management.

Nexans

To meet explosive growth in demand for bandwidth and functionalities, and ensure cabling, connectivity and networks hold up in an increasingly demanding environment, a digital transformation is needed.

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- **Network flexibility.** How flexible does your network need to be to accommodate probable future requirements? How do you ensure this is the case?

Nexans has network infrastructure solutions available today that are designed to withstand the challenges of tomorrow. We understand the emerging technology and how it will affect your infrastructure.

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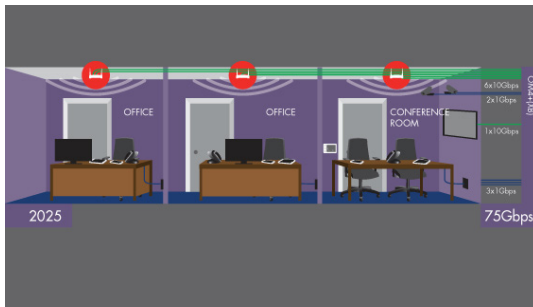
R&M

R&M's digital ceiling solutions are based on tried and tested cabling systems for office buildings. Sensors and controls for lighting, air conditioning and surveillance can now be networked simply and safely with building services engineering and the internet of things (IoT).

The digital ceiling provides IP infrastructures for intelligent building management. Sensors and controls for lighting, air conditioning and surveillance, even power for LED lights can be brought together in the data network. LEDs, and possibly larger devices, can be powered via data cables using power over Ethernet (PoE), whilst also obtaining unique IP addresses in the LAN. Surveillance cameras, smoke alarms, temperature and motion sensors or WLAN antennas on the ceiling may be integrated in the IoT in the same way.

R&M's U-Box – a multifunctional distributor housing that can provide up to 24 data network or PoE connections – is at the heart of these solutions.

To find out more **CLICK HERE.**
www.rdm.com

Mayflex

Mayflex has developed its business to become a leading distributor of converged IP solutions. Our product range includes IP security, cabling infrastructure and Ethernet switching products – everything necessary for a successful project installation.

Mayflex offers the expertise and a portfolio of products from leading vendors. At the heart of the network is structured cabling to allow PoE driven devices such as wireless access points, door access control, IP CCTV cameras to be installed across a single IP network. Intelligent power distribution units (PDUs) and monitoring devices help manage and control the network. Converged systems provide rich and deep data that IT and facilities managers can obtain, in both real time and historic formats.
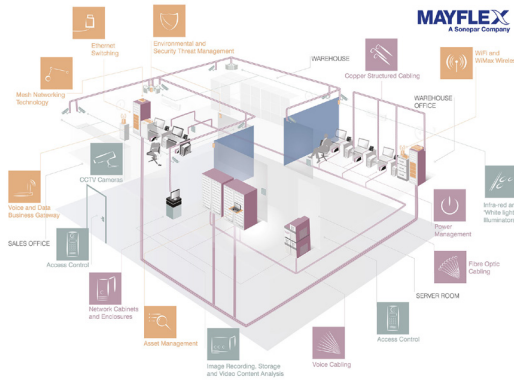
To find out about the full portfolio of products available from Mayflex **CLICK HERE.**
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45

Take five

5G cellular technology seems all set to compete with older Wi-Fi technologies, but will it replace Wi-Fi in in-building networks? Matthew Payne of Nexans takes a look

▶ Demand for wireless access points in office buildings and public facilities is exploding, driven by increasing usage of wireless and other IP devices and device to device communication. Network technology has to keep up with the growth that will come over the next years. Looking at the development of Wi-Fi standards from 1999 to today, we see a clear increase in wireless network speeds. Just a few years ago, access points were well matched to capacity requirements, however, as the number of access points grows and data speeds increase, access points may fully saturate gigabit lines back into the network.

UNDER PRESSURE
Some have suggested that 5G should be leveraged to offload this pressure, effectively making Wi-Fi obsolete. Operators are offering a combination of 5G and small cells, claiming to have an ideal solution for connecting voice and mobile data in indoor environments.

5G does, indeed, offer the higher capacity needed to support growing numbers of broadband users, machine-to-machine communication and high density environments. 5G isn't just faster than 4G, it also offers lower latency – down to 1ms, which is 20 times better than 4G. However, several factors severely limit the speed of 5G indoors and in built environments.

For one thing, construction materials absorb the high frequencies used. 5G uses millimetre wave frequencies – 28GHz and higher – to provide coverage, whereas current mobile networks generally rely on frequency bands below 3GHz. Weather and foliage can also reduce transmission distance. In short, it's tricky to provide even coverage without having 5G access points close to the users – just like a Wi-Fi network.

ON THE RADIO
Traditionally, building owners have relied on distributed antenna systems (DAS) to extend coverage of a mobile network indoors. This type of full spectrum DAS network supports current carrier aggregation features. Indoor small

cells have been a cost effective option for increasing coverage and capacity indoors for 3G and 4G systems, but for 5G to be successful indoors, a centralised radio access network (C-RAN) based solution with multi-operator capability and simpler cabling infrastructure would be required.

Providers are relying on small cell densification – adding small cell sites in high demand areas to keep up with the vast and growing amount of wireless data. Small cells can be remote radio units connecting to a

'Networks need to be ready for higher density. There will be more devices out there, as the number of users increases and many of them use multiple devices. This is particularly important in ultra-high density environments where you have a lot of machine to machine communications. Networks also need to be prepared for faster speeds and a significant change in level difference between average and peak loads.'

baseband pool, or radio units incorporating digital signal processing. C-RAN is important in realising this densification. C-RAN involves moving baseband processing units (BBUs) from cell sites to central locations serving a wide area. This approach reduces the amount of equipment at the cell site, but also lowers latency and helps avoid the risk of dropped connections.

PREPARING FOR THE FUTURE

There are several other arguments against replacing Wi-Fi with 5G. For large enterprises, using 5G as the only data network would require all critical business data to be moved into a telecom service provider's cloud, which may come with security and operational expenditure concerns. There might also be concerns about network security, questions about who is providing and controlling access and whether a company is willing to relinquish Wi-Fi network control.

Networks need to be ready for higher density. There will be more devices out there, as the number of users increases and many of them use multiple

devices. This is particularly important in ultra-high density environments where you have a lot of machine to machine communications. Networks also need to be prepared for faster speeds and a significant change in level difference between average and peak loads.

NEED FOR SPEED

As the access point speed increases, reach decreases. So in order to provide coverage for a faster speed across the same area you will need more access points. This, in turn, requires more cabling, which will result in increased alien crosstalk.

Therefore, any new Wi-Fi deployments should be equipped with additional drops in order to accommodate additional access

48

points and fully utilise possible increases in speed. Furthermore, Category 6A is recommended for all of these new drops and the upgraded access points to avoid crosstalk issues in future. Category 6A provides 10Gb/s pipelines for future consumption and decreases the possibility of having to re-cable or mitigate. If you use Category 5e or 6 cabling you will encounter deployment and length limitation issues when using new Wi-Fi infrastructure.

GOING NOWHERE

Although 5G will vastly improve cellular network capacity, Wi-Fi will remain the wireless transport of choice in the enterprise building. For one thing, it is too well established to disappear in the next 15 years. Furthermore, the cost to replace legacy Wi-Fi equipped devices such as laptops and projectors with 5G radio capabilities will ensure the traditional enterprise network remains a more attractive option for many organisations. In fact, Wi-Fi convergence is key to successful 5G deployment, allowing for multi-Gb/s speeds, seamless mobility and reduced latency. ∎

49

MATTHEW PAYNE
Matthew Payne is technical solutions manager at Nexans, leading its clients' pre-sales design, support and training service needs, as well as project management and capacity planning. He has been active in a variety of telecommunications sales, management and consultancy roles for 25 years.

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Your one click guide to the very best industry events, webinars, electronic literature, white papers, blogs and videos

10 Invaluable Lessons on Digital Transformation in 2019 is an article by **Charu Misra.** **CLICK HERE** to read it.

Masergy has published its 2019 SD-WAN Market Trends Report. **CLICK HERE** to read it.

When the Internet of Things Meets the Digital Supply Network is an article from **Deloitte.** **CLICK HERE** to read it.
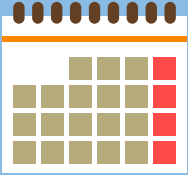
Not Exactly in the Limelight – Yet is a blog from Mark Mullins of **Fluke Networks,** which looks at OM5 multimode fibre.
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Climate Control Maintenance is no False Economy – It's the Key to Efficiency is a blog by Karl Lycett of **Rittal.**
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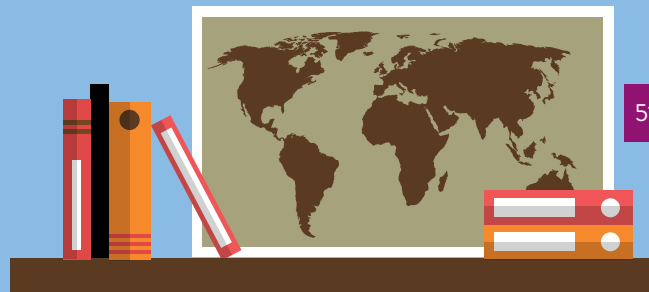
10 Steps to Smart Building Success – Part 2: Delivery Approach is a blog from Matt Salter of **ExcelRedstone.**
CLICK HERE to read it.

The shape of things to come

CNet Training recently launched the first government funded apprenticeship for network cable installation. The company's Andrew Stevens explains why the Network Cable Installer (NCI) Apprenticeship is vital for industry progression and how businesses in England and Wales can benefit from professional training and education to develop their teams

▶ The network infrastructure sector is now referred to as the fourth utility and is the backbone to our everyday lives. So now more than ever it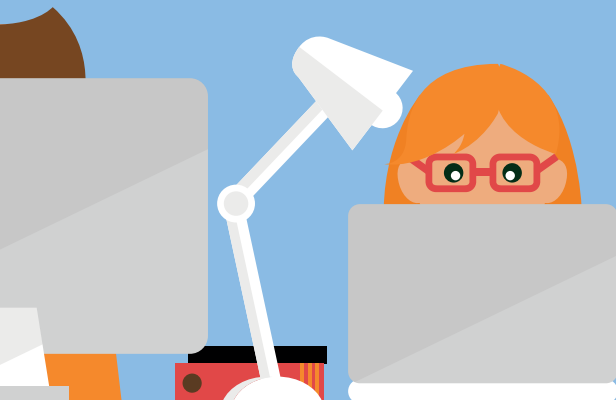's absolutely paramount for companies have confident and competent staff to monitor and manage the installation, maintenance and design of their network infrastructures.

CAREER PATH
The majority of people currently working in the network infrastructure sector didn't choose it as a career – most fell into their roles and have developed and learnt over time. However, there is now a realisation that businesses need to actively promote the sector as a career choice and implement the necessary education, training and professional development activities to encourage new entrants. The idea for the NCI Apprenticeship grew after years of speaking with businesses looking to do just that – they were looking for an entry level career pathway to encourage more people into the sector.

The NCI Apprenticeship is labelled as an 'apprenticeship in a box', purely because all the planning has already been completed in readiness providing an implementation plan for employers and employees to follow. CNet Training has taken the feedback from industry leaders to plan and scope the content of the apprenticeship to include on and off the job training, in addition to professional technical education programs leading to official certifications and qualifications.

It is hoped that the apprenticeship in a box concept will motivate and encourage companies to grow their technical teams. The NCI Apprenticeship provides a fully planned and detailed timetable of professional development activity for both the employer and apprentice to follow to enhance their knowledge and skills, and become professionally certified. It therefore alleviates the need for the employer to dedicate valuable time and effort in this essential planning stage, and allows the apprentice to commence straight away.

FORM AND STRUCTURE
A structured route that is
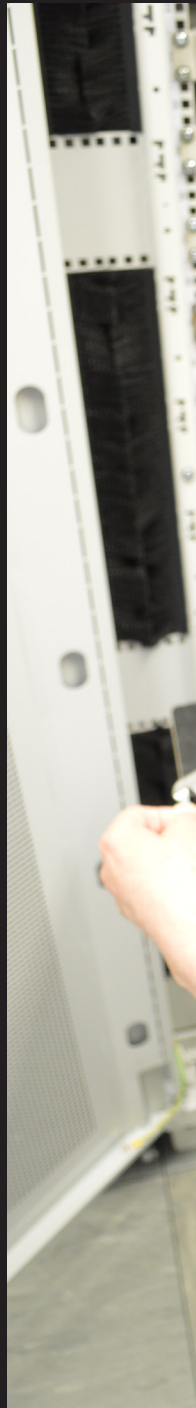
government funded will help companies encourage new recruits, as well as certifying the skills of existing team members. This announcement is a massive step forward in the sector and will help inspire a generation that might have never previously considered it as a career option following school education.

One of the key benefits of an apprenticeship is that it teaches best practice from day one – all off the job training and technical education is delivered by experts in the industry, so learners are educated and certified properly from the very start. Offering the apprenticeship also attracts future talent and helps competitive advantage. Clients will benefit from working with people that have had world class training and technical education, proven with official certifications and qualifications.

KNOWLEDGE BASE

The NCI Apprenticeship is levy funded to £9,000 or 95 per cent co-funded. It's now available across England and Wales and

'On successful completion of the NCI Apprenticeship, an individual will be able to confidently install, test and certify copper and fibre optic cable installation across a variety of environments, working to the correct standards and best practices.'

takes around 12-15 months to complete.

On successful completion of the NCI Apprenticeship, an individual will be able to confidently install, test and certify copper and fibre optic cable installation across a variety of environments, working to the correct standards and best practices. Apprentices will also be taught how to install a variety of smart building technology including wireless access devices, CCTV camera, door access controls and biometric security systems. These skills are in high demand as the requirement for more smart building technology grows.

Apprentices will also be taken out of their comfort zones by considering a wide variety of workspaces including potentially hazardous areas such as building sites, railways and highways. They will also be taught how to interpret detailed project plans to construct and fix network equipment cabinets, prepare cable pathways, and install cable support and containment systems. To complete and pass the NCI Apprenticeship, learners are required to pass a practical assessment and professional discussion, which ensures that the apprentice is fully competent and ready to work independently within the industry.
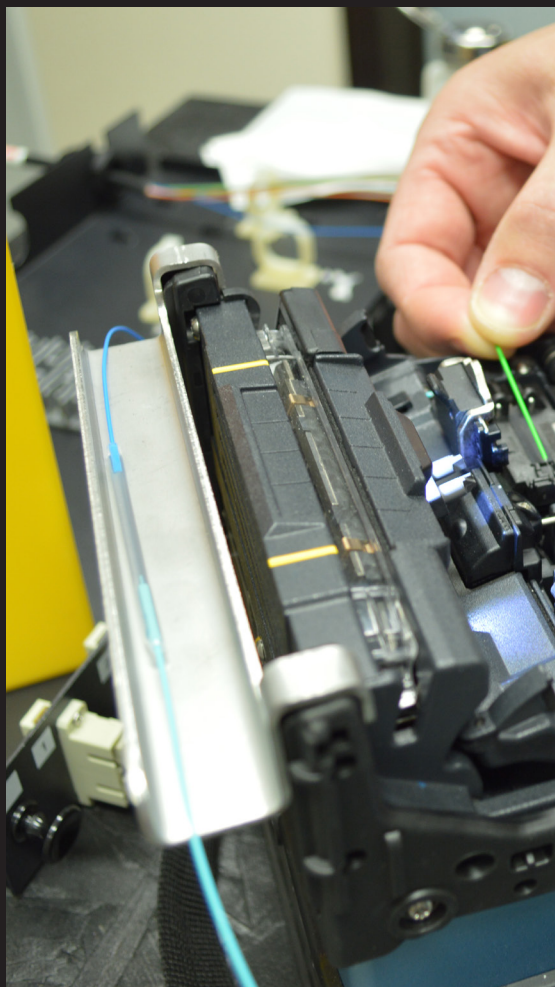
EARN AND LEARN

Undertaking the NCI Apprenticeship is hugely beneficial – not only does it teach highly technical industry skills, but the apprentice also gains a large variety of transferable skills that are valuable across any career going forward.

The career opportunities and future progression within this sector are huge – having the CNCI and CIIT certifications and qualifications opens a lot of doors and opportunities to venture into more specialist areas of technology. Individuals may look to expand their knowledge and

skills into wireless or more integrated technology or prefer to become a site manager, network infrastructure designer or enter the essential data centre sector as a technician.

OPPORTUNITY KNOCKS

The NCI Apprenticeship provides the perfect opportunity to plan professional education, knowledge development, certifications and qualifications in line with actual career development throughout the industry. ■

ANDREW STEVENS

Andrew Stevens is president and CEO at CNet Training. He has been involved in the international telecommunications and data centre industries for the past 26 years, starting his career within the manufacturing and distribution arenas.

He joined CNet Training in 1997 as sales director and has been CEO since 2004. Stevens has been an active member of numerous industry trade bodies and has also been awarded a number of industry accolades for his work including the legacy associated with working with the Olympic Delivery Authority Employment & Skills Team for the 2012 Olympic Delivery Authority. Here he worked on educating unemployed individuals with the Certified Network Cable Installer (CNCI) certification which, as a result, provided certified network cable installers to the London 2012 Olympics project.

Pinacl-GDA awarded Circle Square contract

Pinacl-GDA has successfully secured a contract on the prestigious Circle Square project in Manchester. Working alongside Imtech North, Pinacl-GDA will be supplying, installing and commissioning the structured cabling for the development, as well as installing the TV distribution system.

Situated in the heart of Manchester's Oxford Road Corridor, Circle Square is a joint venture between Bruntwood SciTech and Vita Group. The project aims to bring forward thinking people and progressive businesses closer together with plans including 1,700 new homes, workspace, over 100,00ft² of retail and leisure space, two hotels and a multi-storey car park.

The project will also include one of the biggest city centre parks in Manchester, Symphony Park. This space will hold a variety of events to celebrate the dynamic and creative community of Manchester.

Boston Networks wins place on Crown Commercial Service's Network Services 2 framework agreement

Boston Networks has been awarded a place on the new Crown Commercial Service (CCS) framework agreement Network Services 2 (RM3808).

As one of only a handful of companies to be awarded a place on the new Surveillance and Security (lot 12) section, Boston Networks can now offer its extensive range of security based solutions and services including CCTV and physical security monitoring technology, as well as associated maintenance and support services, to public sector organisations across the UK.

The framework is available to a number of government agencies and public bodies across the UK including the entire public sector, its associated bodies and agencies, the voluntary sector and charities, or those procuring on behalf of the public sector to deliver public services. The new Network Services 2 (RM3808) framework replaces the existing Network Services (RM1045) framework and will run for four years.

5G RuralFirst completes first residential deployment of Li-Fi using solar panels as data receivers in Graemsay

Homes on Graemsay, an island off the Orkney mainland, are now able to access the internet wirelessly for the first time, thanks to Li-Fi technology developed as part of the 5G RuralFirst rural connectivity testbed.

Prior to the trial, all residents on the island of Graemsay were connected through the same copper landline network, which was prone to congestion, with speeds often falling below 2Mb/s. By combining Li-Fi connectivity with the existing infrastructure, 5G RuralFirst's network can consistently deliver four times higher data speed.

Li-Fi on the island operates via two solutions – outdoor and indoor. Outdoor Li-Fi uses ordinary solar panels as broadband data receivers and eye-safe infrared lasers for data transmission. The solar panels decode the information transmitted by the laser. The lighthouse on Graemsay acts as a communications hub, connecting each property with a dedicated outdoor Li-Fi link as a last mile solution. This trial is the first to use ordinary solar panels for data transmission in a residential environment and delivers highly flexible last mile connectivity at a low cost.

By collecting light from lamps within the home, indoor Li-Fi receives light by a USB dongle to create networked wireless connectivity. This means offices and residential environments can take advantage of the security reliability and speed of transmissions offered by indoor Li-Fi by utilising an existing LED lighting infrastructure to enhance their connectivity levels.

PROJECTS & CONTRACTS IN BRIEF

UKCloud has been awarded a position on the Scottish Government's Cloud Services Framework, which has an estimated value of £30m and runs for at least two years. This procurement framework is designed to accelerate cloud adoption across public sector organisations in Scotland by making it easier for them select and consume cloud services.

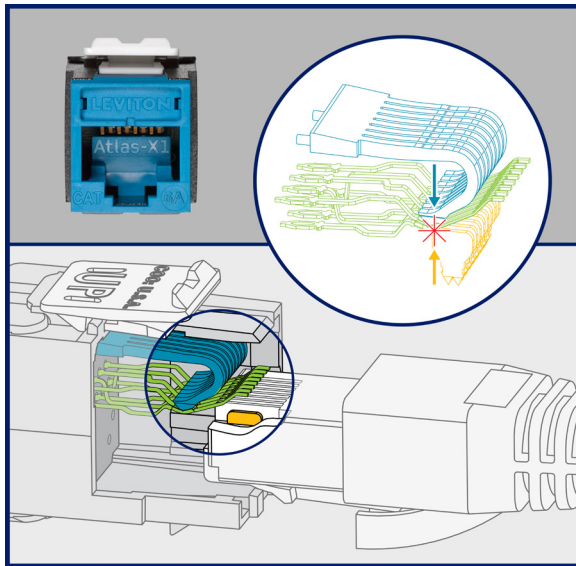CDN77 has selected maincubes to house its Frankfurt point of presence.

ThousandEyes has announced a significant expansion of its cloud monitoring coverage, including the addition of new global Alibaba Cloud monitoring capabilities.

ANSecurity has completed a secure access platform upgrade for the South Hams District Council and West Devon Borough Council to protect sensitive data.

Leviton

Leviton's patented Retention Force Technology (RFT) is a unique polymer spring that supports connector tines and increases their resistance to strain and damage. This extends the life of connectors, saves on costly repairs and increases overall system longevity.

Following the insertion of a 4- or 6-pin plug or other foreign object, RFT helps connector tines return to their pre-stress position and protects against long-term damage. For power over Ethernet (PoE) applications, RFT maintains contact force between the plug and connector, preventing electrical arcing from intermittent disconnects caused by vibration or operational movement.

RFT is available with Atlas-X1 and eXtreme connectors, and select Leviton patch panels.

CLICK HERE to learn more. **www.leviton.com**

Draka/Prysmian
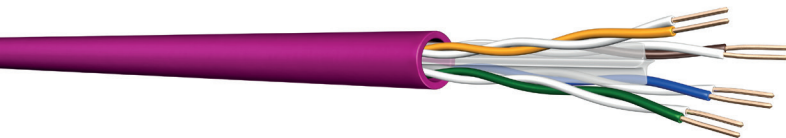
Prysmian Group's Draka UC400 23 Category 6 U/UTP LSHF D64 Cca data cable has been designed and engineered by the Prysmian Group Multi Media Solutions business to comply with the Construction Products Regulation (CPR) to Euroclass Cca s1a d1 a1 fire performance rating.

It provides a high degree of usability including deployment from a 305m Reelex box and delivers full Category 6/Class E compliant electrical performance. This has been achieved through a range of material engineering developments, optimisation of the cable construction design and fine-tuning of the manufacturing processes.

The new cable remains compact, with a diameter of just 5.9mm and a high degree of flexibility for easy installation.

To find out more **CLICK HERE.** **uk.prysmiangroup.com**

Kohler Uninterruptible Power (KUP)

Kohler Uninterruptible Power (KUP) and its PowerWAVE range of UPS offers reliable and flexible single phase and three phase UPS solutions – providing bespoke systems for smaller network and server rooms, through to the large data centres. KUP is also able to ensure a total no break solution with bespoke generator packages and a genuinely national support network to complete your power protection requirement.

Trusted by many of the largest organisations in the UK, the PowerWAVE range starts with the single phase PowerWAVE 1000, at just 1kVA capacity, and concludes with the class leading PowerWAVE 9500DPA, which has been designed specifically for data centre operations.

The flagship PowerWAVE 9500DPA UPS delivers the optimal balance between energy efficiency, availability and power performance, featuring up to five 100kW hot-swappable modules in a single frame, parallelable up to 3MW. For even larger power requirements, the standalone PowerWAVE 6000 offers both intelligent energy management and power protection up to 5MW.

To find out more **CLICK HERE.**
www.kohler-ups.co.uk

R&M

R&M is currently developing a number of smart city projects around the world, resulting in a unique, integrated and flexible offering of products and services.

For policymakers, municipal stakeholders and governments, it is essential that networks are in place that can support a vast web of sensors, a wide and changing variety of applications, and a layer of ubiquitous wireless connectivity. R&M is offering an integrated combination of services, advice and products to realise this.

The requirements of smart cities are very different to those in sectors such as telecom. R&M is leveraging its considerable experience in developing and customising products according to customer needs, ensuring these are ready to be installed without hassle or delays. Experience in areas from ceiling and façade deployments to data centre infrastructure and close cooperation with learning institutions and governments also contribute to this.

CLICK HERE to find out more.
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Single life

Richard Budd of Leviton addresses some preconceived notions about singlemode fibre – whether true or false – and provides guidance for testing, cleaning and inspection

61

In recent years, more enterprise and data centre networks have adopted singlemode fibre optics. Traditionally, singlemode had been limited to applications such as long haul, service provider networks, metropolitan area networks and backbone distribution for large campuses. However, singlemode is now finding its way into shorter reach applications.

GOING THE DISTANCE

It certainly true that more multimode generations have been introduced over the years, all supporting different distances. There have only been two singlemode fibre cable types in the past 20 years – OS1a and OS2. Having only two fibre types makes singlemode much more predictable for supporting distances and future upgrades.

For example, consider the cable types and distance limits for handling new 100Gb/s short reach standards in Figure 1 below. Older multimode standards like OM1 and OM2 can't support the 100GBASE-SR4 standard, while OM3 can support it up to 70m and OM4 or OM5 can support it up to 100m. On the flipside, the distance is the same for singlemode whether you installed OS1a 15 years ago or OS2 last year. Connectors may need replacing over the years, but there is no need to pull new cable with singlemode. The 500m example below for singlemode is for 100GBASE-DR, a duplex 2-fibre solution introduced in 2018.

Figure 1: Single-mode has fewer generations of fiber than multimode

Multimode Cable Type	100GBASE-SR4	Single-Mode Cable Type	100GBASE-DR
OM1	Not supported	OS1a	500 m
OM2	Not supported	OS2	500 m
OM3	70 m		
OM4	100 m		
OM5	100 m		

'There have only been two singlemode fibre cable types in the past 20 years – OS1a and OS2. Having only two fibre types makes singlemode much more predictable for supporting distances and future upgrades.'
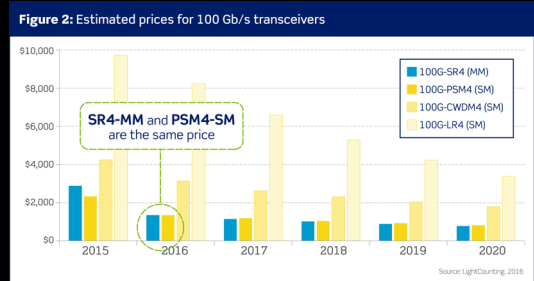
MONEY MATTERS

If singlemode cable offers a much longer life, why hasn't more of it been installed? The primary decision to use multimode instead of singlemode comes down to transceiver cost. In fact, there was a point in time when a singlemode transceiver was 7.5 times the cost of a multimode transceiver.

However, times have changed, and singlemode transceivers have come down in cost. This is largely the result of large hyperscale data centres installing more lower cost singlemode transceivers and, as a result, reshaping the enterprise and data centre markets. Adoption by these companies has reduced the cost of singlemode optics to the point where the cost for 100Gb/s singlemode dropped tenfold over the past two years, bringing it in line with multimode fibre.

For example, 100GBASE-PSM4 singlemode technology is currently the same price as 100GBASE-SR4 multimode transceivers. PSM4 transceivers were specifically designed as a low cost option for 500m or less, using an 8-fibre MPO/MTP connection. As the large hyperscale data centres buy new singlemode options like PSM4 in such large quantities and at shorter lengths, the prices for them drop. Similarly, the price for long reach

singlemode solutions such as 100G-LR4 and 100G-CWDM4 have dropped and will continue to drop, as shown in Figure 2 below.

Figure 2: Estimated prices for 100 Gb/s transceivers

SR4-MM and PSM4-SM are the same price

- 100G-SR4 (MM)
- 100G-PSM4 (SM)
- 100G-CWDM4 (SM)
- 100G-LR4 (SM)

Source: LightCounting, 2016

PARALLEL LINES

It is no longer true that singlemode only works with duplex connections, not MPOs/MTP connections. Transceiver vendors are now making singlemode versions that run on parallel optics – as shown in Figure 3 – in order to reduce costs for shorter data centre links.

Figure 3: Single-mode options to 400 Gb/s over parallel optics

Bandwidth	Standard / MSA	Distance
100 Gb/s	100GBASE-PSM4	500 m
200 Gb/s	200GBASE-DR4	500 m
400 Gb/s	400GBASE-DR4	500 m

These parallel options also allow for cabling breakouts, which has already become a very popular approach in multimode networks. With breakouts, you can split a 100Gb/s transceiver out to four 25Gb/s channels. This helps create more efficiency and greater port density in network designs.

LOSS AVERSION

It is also false that greater insertion loss is allowed for singlemode compared to

multimode. With cheaper transceivers comes a reduced allowance for insertion loss. Designers especially need to be aware of reduced loss budgets for newer transceivers targeted at data centres. And if your design has multiple connections, you can run into trouble. Be sure to ask specific questions, particularly if you are using MPO/MTP connections.

As an example of stricter insertion loss allowances for 100Gb/s, consider the channel loss limits listed below in Figure 4. When you move to new singlemode options like CWDM4, 100GBASE-PSM4, and 100GBASE-DR, you are no longer designing for 6dB or 7dB loss but down to 3.3dB and 3.0dB, respectively.

Figure 4: Channel Loss Limits

| 100 Gb/s Ethernet	Channel Loss
100GBASE-ER4	15.0 dB
100GBASE-LR4	6.3 dB
100GBASE-CWDM4	5.0 dB
100GBASE-PSM4	3.3 dB
100GBASE-DR	3.0 dB

CAUSE FOR CONCERN

Return loss is a real concern with singlemode. Multimode is very tolerant of light being reflected back into the transceiver, but singlemode is not. At higher data rates, errors are generated if too much light is received back. In fact, with higher powered lasers, too much reflectance can actually destroy a transceiver.

Reflectance is a result of small air gaps that can occur at the physical contact where two connections are joined

together, as shown by the yellow arrow in Figure 5. Due to reflectance concerns, the majority of singlemode connections use an angled physical contact (APC). In fact, all singlemode MPO/MTP connections use APC, as it is nearly impossible to achieve a good reflectance with an ultra physical contact (UPC) MPO over singlemode. With APC, an 8° angle results in any reflection being absorbed into the cladding rather than the transceiver, resulting in better return loss.

Figure 5: Reflectance in PC and APC connections

CORE
CLADDING
Angled Physical Contact (APC)

CORE
CLADDING
Ultra Physical Contact (UPC)

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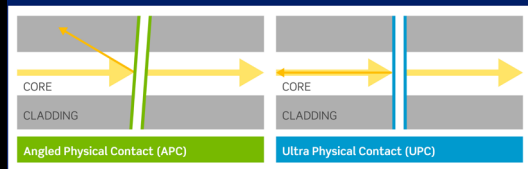
SAFETY FIRST

Singlemode transceivers use high power lasers, and as a result there are additional safety concerns. This notion is true for long haul singlemode versions, but not for the lasers used in the enterprise and data centres. These lasers — known as Class 1M lasers — are considered safe for viewing, except when passed through magnifying devices such as microscopes and telescopes.

If a singlemode link is too short, the transmitted light could saturate the receiver and require an attenuator to reduce the power of the signal.

LASER RADIATION
DO NOT VIEW DIRECTLY WITH OPTICAL
INSTRUMENTS CLASS 1M LASER PRODUCTS

This issue only arises with high powered lasers used in outside plant installations. Data centres typically use low power Fabry-Perot (FP) lasers, with a nominal output of -3dBm. CWDM4 transceivers use a slightly higher powered
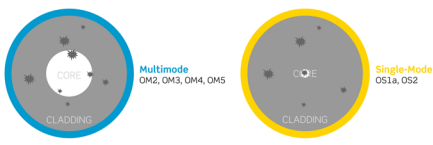
laser known as distributed feedback laser, with a nominal output of 2.5dBm, but this is still a relatively low power. For Class 1M lasers, saturation of the receiver is not an issue, as long as the link is 2m or longer.

CLEANING UP

While more dirt can collect on the multimode core, light can still pass through multimode's larger 50μm core size but with singlemode one speck of dust can block all light. A multimode fibre core is 50μm or 62.5μm, whereas a singlemode core is 8.2-8.6μm, as shown in Figure 6. To put these into perspective, a single human hair is 100μm. In singlemode fibre, data is transmitted through an area that is one-tenth the thickness of a human hair.

Figure 6: Dust in multimode and single-mode fiber

RICHARD BUDD
Richard Budd is product manager at Leviton Network Solutions Europe and oversees the development and deployment of a wide selection of fibre solutions.

LAST WORD

If you are working with APC connectors, you will need to use different camera tips than those used for UPC connectors. The angle at the end of the APC connector changes the focal depth and, in turn, requires an angled camera tip. Note that all singlemode MPO/MTP connectors are APC. The cleaning supplies will be the same between PC and APC, and only the camera tips need to change with APC inspection. ■

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> THE EVOLUTION OF CLOUD BASED DCIM

> EUGENE BERGEN HENEGOUWEN GOES UNDER THE SPOTLIGHT

> WHY SUCCESSFUL DIGITAL TRANSFORMATION MEANS GOING BACK TO BASICS

> HOW USING ENVIRONMENTALLY FRIENDLY STRATEGIES AND IMPLEMENTING A CIRCULAR ECONOMY CREATES A SMARTER, GREENER BUSINESS MODEL

> MOVES, ADDS AND CHANGES IN THE CHANNEL

> NETWORK INFRASTRUCTURE CASE STUDIES FROM AROUND THE WORLD

> THE LATEST PRODUCT, SYSTEM AND SERVICE DEVELOPMENTS