February/March 2017
datacenterdynamics.com

Will data centers continue their move to renewable energy?

Hyperscale vs Microscale

Are they really so different? The clash of the titans may have been overstated

Here comes the flood

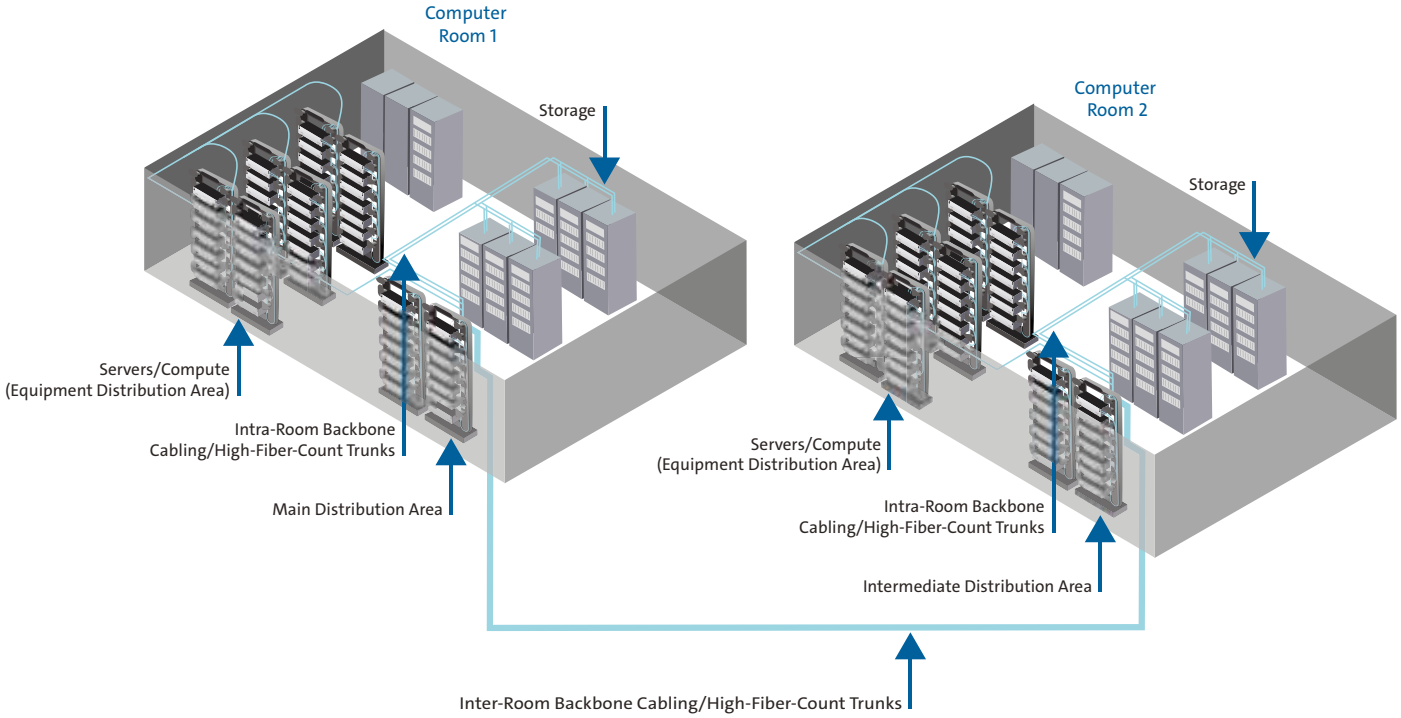
As DDoS attacks ramp up, how do you respond - and is there a silver lining?

Ten mega deals

Our pick of the mergers and spin-offs that will shape the data center industry in 2017 and beyond

We've got your back!

CORNING



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DCD >Enterprise

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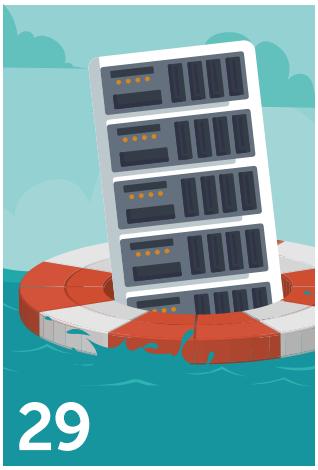

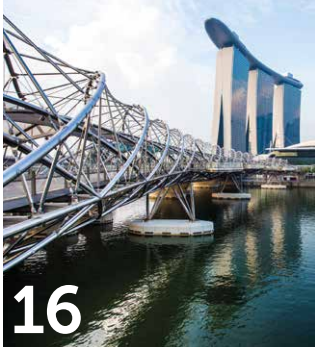

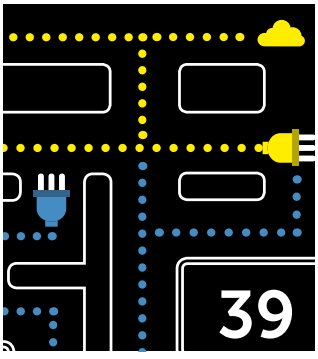

ON THE COVER

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REGIONAL FEATURES

DCD COMMUNITY

EDITOR'S TOP PICK

From the Editor

Infrastructure wins in power politics

We prefer technology to politics, but sometimes the two are inseparable. Energy seems to be one of those areas. Any power policy will be treated as a political statement.

So this year we find ourselves heading to New York for our DCD>Enterprise show, with a keynote discussion that might be out of step with US politics. But the issue of renewable energy is more complex than any campaign slogan: see our feature (p18).

Cloud providers are moving as fast as they can to renewable energy sources, and they were keen to talk about this. Wind and solar reduce the carbon emissions which lead to global warming, and are great for long term power stability. They also help to move the whole of society onto the post-fossil world.

Data centers are set for huge growth driven by demand, and hopefully fuelled by a future-proof energy source

A sensible industrial strategy would not rely entirely on old-school coal, oil and manufacturing, but would drive towards renewables which, many say, could be the new automobile industry delivering low-carbon sustainable jobs.

Data centers themselves are set for huge growth, partly due to the stripping back of regulations in the US, but mostly because of a simple surge in demand.

So we'll arrive in New York just as a data center industry prepares for a surge of growth - hopefully powered by a future-proof energy source. See our event preview (p42) and come along to the show!

Micro or macro has become a question lately. Webscale data centers appear to be the direction of the cloud, with ever larger and more efficient facilities serving the world.

But at the same time micro data centers pop up as the best way to provide the edge facilities we need to serve individuals and all the tiny Internet of Things (IoT) devices in the world.

Which of these is most important? They both are, and they are closer in technology than you might think, says our US expert David Chernicoff (p33).

What's running inside the buildings? The latest buzz is around serverless computing (p39). The hardware is there, but the software swallowed it.

And speaking of swallowing, the last year has seen a steady stream of mega-mergers, acquisitions and spin-offs in data centers and related industries. Read all about our favorite ones (p36).

25%

Share of renewables in electricity production in China (Enerdata)

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You could say we were power hungry...

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US colocation has a record year

Multi-tenant data center leasing in the US increased by a quarter between 2015 and 2016, marking a historic high for the industry, according to a report from consultancy firm North American Data Centers (NADC). Meanwhile, commercial property consultancy CBRE predicts that demand for data centers in the US will continue growing in nearly double-digits in 2017.

Rapid growth was encouraged by demand from large customers like Microsoft and Oracle, as well as heightened activity in the Northern Virginia and Chicago markets, according to the NADC report.

As a result of large increases in data traffic, more submarine cable was laid around the US during 2016 than the last five years combined.

NADC anticipates that construction in key US cities will be met by strong leasing activity in the first half of 2017.

According to NADC, just four metro markets - Santa Clara, Ashburn, Dallas and Chicago - were responsible for 80 percent of the overall 2016 multi-tenant data center (MTDC) leasing in the US. However, these key markets have only seen a 20 percent increase in turnkey space and space under construction, leading to concerns about future supply.

The report noted that large cloud providers have been shifting from speculative leasing to pre-leasing during the past 15 months, something that benefitted the MTDC market.

Chicago was among the most active data center hubs in the US in 2016, with colocation providers including CyrusOne, T5, EdgeConneX and Digital Realty all announcing new facilities for the region.

There were also new data center projects announced in Quebec and Toronto – and considering the declining price of the Canadian Dollar, these could represent a viable alternative to some markets in the US.

CBRE admits that there has been more speculative data center supply slated for delivery in 2017 than in previous years. But the report is quick to dispel fears of oversupply, suggesting that commercial data center operators will continue to benefit as more enterprise users adopt cloud services and move their equipment into colocation facilities in order to cut costs.

"Typical enterprise demand will likely evolve to require smaller, hybrid solutions that incorporate elements of wholesale and retail data center leasing as well as public and private cloud solutions," said Jeff West, director of data center research at CBRE.

http://bit.ly/2jUXB8Y

Apple builds 200MW solar farm

Apple is building an additional 200MW of solar energy in Nevada by early 2019 to help power its Reno data center campus. The project is being carried out with NV Energy.

200k servers have Heartbleed

An OpenSSL security bug found in 2014, Heartbleed, still affects 200,000 machines. Attackers can steal website encryption keys and impersonate those services at will.

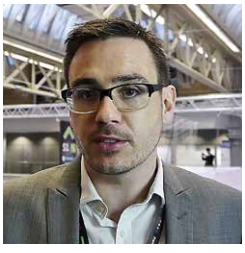
Breaches delay Yahoo sale

Verizon's $4.83bn purchase of Yahoo's core Internet assets is to be delayed because of security breaches which revealed the credentials of up to a billion Yahoo accounts.

United and Delta ground flights over IT

United Airlines and Delta each grounded all domestic US flights for a period of hours, in two separate events due to IT failures during January.

VOX BOX / DCD VIDEO



David King
Product manager
Future Facilities

How can computational fluid dynamics help with fire suppression?
We've taken our data center models and simulated inert gas discharge in the data center to understand whether the nozzles can be placed away from the IT equipment. The noise created during the discharge of inert gas can have an impact on hard drives, causing a loss of service or a loss of data. We found that fire suppression can be effective with nozzles in the floor void and the hot aisles.

http://bit.ly/2j4mFNV

Massimiliano Falcinelli
Head of security infrastructure
International Atomic Energy Agency

How real is the threat of cyberwar?
Different governments are preparing themselves for cyberwar. It looks like fantasy, but it is not fantasy any more. People know how much impact they can have, and they are ready to do it. But they need to do it in an anonymous way, so they will be protected by governments, and will not be caught easily. They are preparing it, but they don't want to use it.

http://bit.ly/2jpab2f

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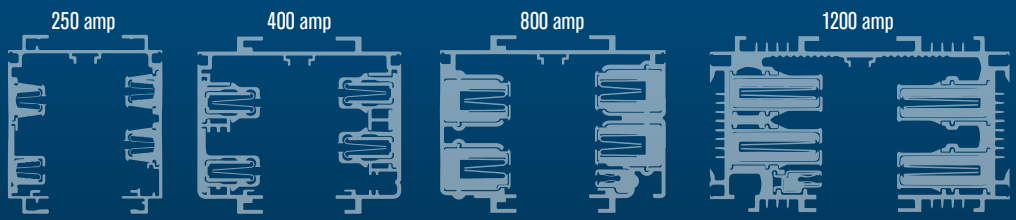

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Tanzania's biggest data center struggles to find customers

The Tanzanian Minister for Works, Transport and Communications has instructed local public sector agencies to stop their data center development plans, and move into a government facility instead.

Professor Makame Mbarawa was surprised that the largest data center in the country, located in Dar es Salaam and run by the Tanzania Telecommunication Company Limited (TTCL), was barely occupied, while several public institutions had already started developing their own server space, reports local publication *The Daily News*.

"I am going to communicate this to the government so that the institutions stop such plans," Mbarawa said.

The $93.6 million data center in the Kijitonyama suburb of Dar es Salaam's Kinondoni District was built to Tier III specifications and is operated by TCCL – the largest fixed line telecommunications company in Tanzania, still part-owned by the state.

http://bit.ly/2j8hn3Y

Stockholm opens data center park with heat re-use

The city of Stockholm has designated a large parcel of land for data center development, offering power, connectivity and cooling-as-a-service.

The Stockholm Data Parks initiative was launched in cooperation with infrastructure companies Fortum Värme, Ellevio, and Stokab. The first site, located in the suburb of Kista, will enable data center operators to sell their waste heat to the grid and buy cooling as a service. In the next three years, the scheme will be expanded to another three locations.

"I am determined to make Stockholm a major hub for sustainable data centers," said Stockholm Mayor Karin Wanngård.

The announcement follows the news that Sweden has cut tax on electricity used in data centers by 97 percent.

Stockholm aims to supply 10 percent of the city's residential heating needs through recovered excess heat from data centers.

Kista has 10MW of power capacity, and its tenants will be able to take advantage of tax cuts which have reduced the total cost of electricity used by data centers in Sweden by approximately 40 percent, resulting in the cheapest power in Europe - less than €0.04 per kilowatt-hour.

Two percent of Swedish electricity is derived from fossil fuels – the rest is provided by hydroelectricity, wind and nuclear.

http://bit.ly/2k2KQfr

Melita pushes Malta data centers for online gambling

Malta-based Melita Data Centre saw 100 percent growth in the number of customer racks in 2016 compared to 2015, the company said, highlighting the growth of online gambling as a reason.

The Melita facility is built to Tier III specifications on 10,000 sq m (107,639 sq ft) of land.

Malta, a small island nation south of Sicily, has jumped at the chance to corner the lucrative online gambling market. In 2004, it became the first EU Member State to push forward with comprehensive legislation on 'remote gaming,' offering incentives and tax breaks to individuals and businesses involved with the industry.

A 2011 European Commission Green Paper on online gambling noted that Malta's Gross Gaming Revenue (GGR) amounted to 7.82 percent of its GDP, 11 times more than the EU average.

http://bit.ly/2jedGFj

IBM to build private cloud data center for US Army

The US Army has chosen IBM to build and operate a data center in its Redstone Arsenal army post in Huntsville, Alabama.

Part of the Army Private Cloud Enterprise (APCE) program, the 'on-premises, commercially-owned, commercially-operated cloud' was announced last year as an initiative to replace 11 existing Army-run facilities, ahead of a possible larger roll-out.

The contract is for one year, with four additional one-year options, and is worth around $62 million over those five years. IBM will build the infrastructure, and provide Infrastructure-as-a-Service (IaaS), something that requires Defense Information Systems Agency (DISA) Impact Level 5 (IL-5) Provisional Authorization.

While other cloud providers like Microsoft have DISA Level 5 authorization, IBM says that it is the only company to be authorized by DISA at IL-5 to run Infrastructure-as-a-Service solutions on government premises.

"With this project, we're beginning to bring the IT infrastructure of the US Army into the 21st century," Lt. Gen. Robert Ferrell, US Army CIO, said.

The US Army is currently in the middle of a complex data center closure initiative that it has struggled to follow on schedule, but a new blog post by the military body has offered some insight into how far along its consolidation plans are.

"As of December 2016, the Army has successfully closed 433 data centers and is making measured progress toward reaching its goal," it writes.

The post adds: "The Army plans to further reduce its data center footprint to only 10 global Army Enterprise Data Centers (AEDCs)."

The army has set up a Pentagon consolidation team, and an Army Application Migration Business Office (AAMBO).

http://bit.ly/2knSnTC

Apple to manufacture cabinets in US factory

Apple is looking to build data center cabinets in Mesa, Arizona, according to a notification published in the Federal Register.

The Mesa facility was originally a GT Advanced plant meant to supply sapphire for Apple screens, but after a messy and contentious relationship that saw Apple pull out of the deal, the company went bankrupt in 2014. Apple took over the factory, and turned part of it into a $2 billion data center.

"Apple Inc has repurposed the site as a global data command center that will conduct high-tech manufacturing of finished data center cabinets for other data centers," a document filed by The City of Mesa Office of Economic Development, and spotted by *Business Insider*, said. "The nature of the product is not for end users but for other global data centers that will be supported from the site."

In 2016, an Apple official wrote to the Foreign-Trade Zones Board, which approves zones that exempt companies from customs duty payments, saying that it had "an aggressive production go-live timeline of September, 2016."

Apple has reportedly started building and testing cabinets at some of its data centers, including Oregon and North Carolina, an activity which it plans to consolidate and expand in Mesa.

The expansion into the Mesa site was supported by tax breaks from Arizona, but has not gone entirely smoothly, with the facility suffering a rooftop fire in 2015.

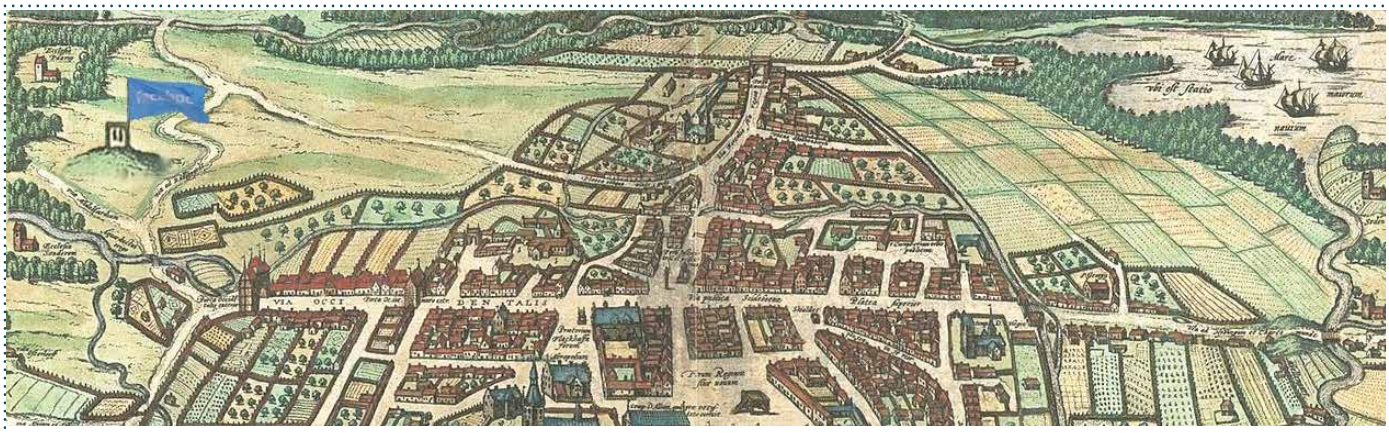
The company is thought to have begun to ramp up its own data center hardware plans in 2016, partially because of concerns over state actors adding new or modified components to enable unauthorized access, as the NSA did with Cisco systems.

Apple's initiative to expand its own infrastructure was revealed last year to be operating under the codename Project McQueen. Since then, Apple has pushed forward with plans for a massive Irish data center and an Oregon facility, and could be set to expand in Reno, as well as come to Taiwan.

http://bit.ly/2jj5mnQ

Peter's random factoid

Renewable energy makes up 44 percent of the jobs in US power generation - more than coal, oil and gas combined (DoE)



Facebook reveals Denmark plans

Facebook has officially announced details of its planned data center in Odense, Denmark, after the site was leaked in October. The 55,000 sq m (592,015 sq ft) data center will be set in the industrial area of the city.

"As you can see, my body language is one big 'like'," Mayor Peter Rahbæk Juel said (translated) at a press conference, while presumably giving a thumbs up sign.

Niall McEntegart, director of Facebook's EMEA and APAC data centers told the Dutch media: "There's actually many factors that come into making a decision like this, it's obviously a long process, it can take many years.

"There's things like availability of fiber, which is excellent in this area, there's the electricity grid, again excellent in this area. There's also abundant Nordic clean renewable energy, which is very important for us from a sustainability point of view. But the people are also very important - there's a good labor pool here."

He continued: "We had a huge amount of support, both from Odense municipality, and from Invest in Denmark, which we actually met both in Silicon Valley and also here in Denmark multiple times, they made that happen."

The Odense facility, Facebook's third outside the US - after Luleå, Sweden, and Clonee, Ireland - will use 100 percent renewable energy, the company said.

http://bit.ly/2kwZ9FR

SSP blames Equinix for insurance app failure

Insurance services firm SSP Worldwide has pointed a finger at Equinix over a failure of its cloud-based insurance broking service. Equinix has said the outage only affected a few customers who don't have redundant connections.

The Pure Broking cloud service, which has been dogged by availability issues, was out of action for several hours on Thursday January 19. In this instance, SSP said the fault lay with "facility engineers" at a third-party data center where the service is located - the Powergate data center in North-West London, which is owned and operated by Equinix.

In August 2016, Pure Broking was brought down by a fault in SSP's data center in Solihull near Birmingham. The company decided to permanently close that facility and shift the application into third party sites including Powergate in North-West London. Powergate was originally built by Telecity, which was bought by Equinix in 2016, at which point Powergate became Equinix LD9.

A statement from SSP said: "At 12:42pm, the Powergate Data Centre used by SSP services was affected by a loss of power," going on to assert the failure was "not a Pure Broking problem," but was caused by the facility.

The cause was apparently a "direct result of the 'routine maintenance' carried out by the facility engineers," according to SSP, which says it "was assured in advance that the 'routine maintenance' would not affect any services."

Equinix told *DCD*: "Equinix experienced a brief loss of resilience at its LD9 IBX on Thursday. A small number of customers that do not utilize redundant connections may have experienced a short period of downtime as a result."

This didn't impress some angry users, who criticized SSP for shifting the blame and not apologizing. James Woollam, owner of broker Hayes Parsons, tweeted: "You can't blame other [companies]. You are responsible for your service providers and moved us to Powergate."

DCD has not heard reports of other Powergate customers suffering outages at the same time.

"There is very little information to go on here," said Tim Anker of Colo-X. "All we can say is SSP is pointing the finger at Equinix."

http://bit.ly/2knxoQy

Amazon gets site for fourth Dublin facility

Amazon has acquired a site in Dublin to build another Irish data center for its Amazon Web Services (AWS) cloud operation.

The new site, a former warehouse for the Barretts warehousing and distribution company, is projected to become Amazon's fourth data center in Tallaght, a Dublin suburb where Amazon is already building on the site of the former Jacobs Cream Crackers biscuit factory. Amazon has invested more than €1 billion in Ireland, according to the *Irish Independent*.

Amazon bought the site late in 2016, and has already begun the process of building a data center, starting with applying for permission to demolish the existing warehouse building.

Amazon started out in Tallaght with a 22,300 sq m (240,035 sq ft) data center built on the site of a former Tesco distribution center. In 2016, it applied to build on the former Jacobs biscuit site, which it had bought in 2014. That application has been approved, paving the way for a 22,000 sq m (236,806 sq ft) data center there employing up to 50 people. Also in Tallaght, it converted the Shinko Microelectronics factory into a data center.

Amazon has plenty of other data centers in Ireland, either in operation, or at various stages of construction. A large facility is being built in Blanchardstown, also near Dublin, where the company already has two data centers, and there is another project being constructed at the Clonshaugh business park near Dublin Airport.

http://bit.ly/2jCnUmN

Greenpeace names and shames fossil fuel burners

Environmental activist group Greenpeace has once again rated the world's largest digital businesses on their commitment to sustainable IT and renewable energy. In the latest Clicking Clean report, the organization has congratulated data center operators Apple, Google, Facebook and Switch on their progress towards using 100 percent renewable energy but reprimanded AWS, and was extremely critical of Chinese hyperscalers Baidu and Tencent.

Video streaming service Netflix was also called out on its use of fossil fuels, while Oracle got the worst marks among American cloud providers.

The 102-page document looked at the energy footprints of large data center operators worldwide and analyzed nearly 70 online services, marking them on categories like energy policies, energy efficiency and transparency in the power supply chain.

"Amazon continues to talk a good game on renewables but is keeping its customers in the dark on its energy decisions. This is concerning, particularly as Amazon expands into markets served by dirty energy," said Gary Cook, senior IT analyst at Greenpeace USA.

According to Greenpeace, nearly 20 data center operators and major Internet companies have announced commitments to 100 percent renewable energy since the first Clicking Clean report was published in 2009.

Direct purchases of renewable energy by corporations in the US have exceeded 3.2GW in 2015 alone, with over two-thirds of this volume attributed to deals made by technology businesses.

Greenpeace noted that Switch – a data center operator from Nevada known for its network of hyperscale facilities called SuperNAP – quickly became a leader in green IT, transitioning its data center fleet to renewables through both procurement and "aggressive advocacy."

http://bit.ly/2kx9dmg

Microsoft denies it will cancel data centers over Brexit

Microsoft has denied reports that it could shift data center building away from Britain, in response to UK Prime Minister Theresa May's policy for Brexit.

After May stated that Britain would very likely leave the EU single market and customs union, a Microsoft employee said the company could backtrack on current plans to expand in the UK.

"We're really keen to avoid import tariffs on any hardware. Going back to the data center example, we're looking to build out our data centers at a pretty strong lick in the UK, because the market is doing very well," Microsoft's UK government affairs manager Owen Larter said.

"If all of a sudden there are huge import [tariffs] on server racks from China or from Eastern Europe, where a lot of them are actually assembled, that might change our investment decisions and perhaps we [will] build out our data centers across other European countries."

However, as the press reported these statements, Microsoft backed away: "The comments reported today by a Microsoft employee were not reflective of the company's view. As we have said both before and after the EU referendum vote, Microsoft's commitment to the UK is unchanged."

Currently, trade between the UK and the rest of the EU is tariff-free, and trade between the UK and non-EU states is the same as with any other EU nation. This, however, is set to change once Britain has officially left the EU - something that will happen two years after Article 50 is triggered, which recently passed a parliamentary vote.

http://bit.ly/2jR2HDt

44%

of European data center capacity is in London - and it will grow in 2017 despite Brexit (CBRE)

Oracle adds cloud regions in the US, UK and Turkey

Oracle is planning to open nine data centers over the next six months, as it attempts to establish itself as a leading provider of public cloud services. The company will launch three new cloud regions in 2017 – based in London, Renston NC and an unspecified location in Turkey – each consisting of three low-latency sites.

Oracle says this expansion will achieve the goal of doubling the regional presence of its cloud platform in the space of just 24 months. There are further plans to open new regions in Asia Pacific, North America and the Middle East in 2018.

The expansion was announced by CEO Mark Hurd at the Oracle CloudWorld conference in New York, and follows last year's promise by executive chairman and CTO Larry Ellison that the company will compete with AWS, the world's largest cloud provider.

In order to accomplish this goal, Oracle is moving into new facilities located in the US, the UK and Turkey. Each location will involve at least three geographically separate data centers to ensure failure protection and high availability. This takes Oracle's cloud services to 29 different regions.

Along with the geographical expansion, the company has expanded its cloud offering, making Oracle Database Cloud Service available on bare metal for the very first time. It has also added new virtual machine (VM) capabilities, with one, two, and four-core VMs running on the same Virtual Cloud Network as its bare metal servers.

http://bit.ly/2iDvhGp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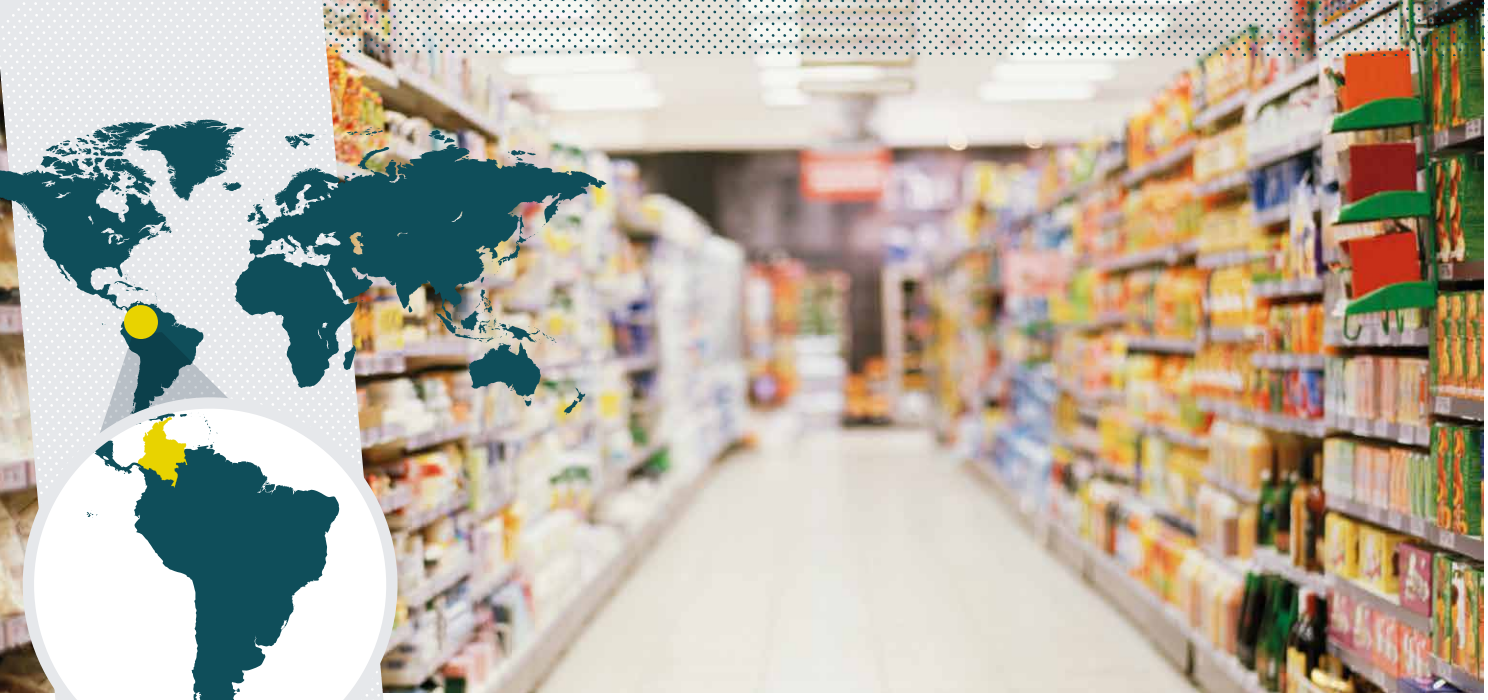


Grupo Éxito

- Founded 1949
- Also known as Almacenes Éxito S.A
- 2,606 locations
- Revenue (2015) 33.4t Colombian peso ($11.4bn)

Three steps to DCIM heaven for retail giant

Celia Villarrubia
Assistant Editor LATAM

Colombia's Grupo Éxito needed to implement DCIM to get its infrastructure under control. It took the process step by step, says *Celia Villarrubia*

Grupo Éxito is Latin America's largest retailer, with more than 2,000 stores across the continent. Founded in Colombia in 1949, it was originally a textile firm which has since branched out into groceries and other goods, as well as travel, insurance, gas stations and shopping malls.

To serve these various businesses within Colombia, the group has a corporate data center housed in a multipurpose building. This delivers all the organization's business activity - except certain strategic services that have been outsourced.

The installation covers 450 sq m, of which 220 sq m is white space, divided into two zones, with a total of 54 racks. The total load power is 185 kW, 110 kW of which feeds the IT load. The electrical system has 2N redundancy, while cooling has an N+1 topology. The current PUE (power usage effectiveness) stands at 1.68.

The system found a faulty valve, and avoided severe damage

With most of its corporate services delivered from this data center, which was built in 2001, the group was facing technical limitations that threatened to affect its daily operation.

Distributed monitoring infrastructure was inefficient and was not adequately controlled, and problems were emerging in the data center's power management and cooling capacity. "We were very reactive when dealing with this kind of difficulty," said Juan Carlos Ochoa, analyst and data center manager at Grupo Éxito.

In November 2015, the company began a three phase project to deploy a DCIM system which would allow it to "be more effective in monitoring all infrastructure and mature in managing the data center," said Ochoa. Seven months after the start, the company is seeing efficiency gains begin to show.

The Group's data center infrastructure was far from being adequately monitored, but some steps had been taken four years earlier, with the implementation of a management system. The new DCIM was kept separate, and a future integration of the two applications was planned.

The retail company wanted clear goals, and planned that early results from the first phase would generate support and ensure the implementation would continue, said Ochoa.

The first step was to evaluate DCIM solutions, a process which took five months. The choice was not about the provider with the most financial muscle, but the company which met actual needs, said Ochoa: "You have to understand what you need and what the market offers." Ochoa declined to name the chosen solution.

Once it had chosen a solution, the first phase included monitoring the electrical system - the power generators, UPS, the PDUs. The cooling system is 100 percent monitored, as are the environment and physical security.

In the next two years the remaining two stages will be addressed. The second phase will include monitoring fire detection and suppression systems, which uses the agent Inergen. This phase will improve reporting and drive deeper into the monitoring infrastructure, covering power quality, transformers, access control, and so on.

The third phase will address the integration with existing systems at the facility, such as CMDB and the management system. "At this point we will evaluate which path to choose: integrate IT management with the DCIM or build a hybrid option with the two solutions," said Ochoa.

In the project, IT departments and facilities are working together to achieve better integration and break with the typical data center silos. As Ochoa said: "both facilities and IT participated in the preliminary analysis of the project, and are an active part of the implementation and are indispensable."

Although the project is at an early stage of deployment, improvements have already been measured. The cost savings are difficult to estimate, but the system has already foreseen equipment damage, avoiding major investments or outages.

"In the refrigeration equipment an alert let the maintenance personnel identify damage to a valve, which was repaired promptly," said Ochoa. The benefit here is hard to measure in money, but it avoided severe damage.

Temperature and humidity are measured precisely and parameters can be adjusted dynamically, achieving savings from the efficient use of air conditioning.

In short, even before full deployment, the DCIM solution has boosted Grupo Éxito's efficiency projects and helped with management challenges. ●

Amazon Web Services has ideas and users in Asia

What's Amazon doing in Asia? *Paul Mah* talks to the cloud giant and its customers about new services and the move to hybrid cloud

Paul Mah
SEA Correspondent

With two brand new regions in India and South Korea in 2016, it is clear that Amazon Web Services (AWS) intends to grow in the region. Nick Walton, the head of AWS in the South East Asian region told us how cloud adoption is shaping up, and how AWS intends to serve the demand in this part of the world.

"The growth is coming from similar kinds of customers, different groups, different segments, very similar to what we're seeing globally," said Walton. There is also a lot of startup activity in Singapore, he noted, with growing maturity and momentum evidenced by the enterprise and small and mid-sized businesses segments.

Not all AWS services are offered in Asia Pacific cloud regions. New or beta services are often released in the US cloud regions first. For instance, Singapore does not yet have access to AWS's sneakernet services - the suitcase-sized Snowball and AWS Snowmobile, which ships data to the Amazon cloud in an actual truck.

"We don't support Snowball in Singapore yet," said Walton. "It depends on how much demand we see."

A bigger priority is pricing: "One of our jobs is to enable fixed parity, rolling out services consistently to all our regions globally." The latest round of AWS price cuts addresses this, by bringing greater consistency

AWS Asia locations

- Singapore (2)
- Sydney (3)
- Tokyo (3)
- Seoul (2)
- Mumbai (2)

across regions, he said: "The price drops in Singapore were pretty substantial, [around] 25 percent for EC2 prices. It's probably closer to other regions now after the price cuts."

Walton says he is unfazed by the pressure from rival cloud platforms and private cloud technologies such as hyper-convergence.

"We're surprised it's taken our competition so long to recognize there is substantial opportunity here. We feel the advantage we have is in terms of the experience that we've built [with the AWS platform]," he said.

AWS customers see the cloud as part of their strategy, not all of it. Singapore-based DBS Bank signed up with AWS for a hybrid environment to complement its traditional data center.

The move was about reliability and agility, said David Gledhill, the CIO at DBS: "As you start to think about the next generation of performance, the next generation of reliability, the next generation of security, [the] cloud looks very attractive," he told *DCD* at the Amazon re:Invent conference.

AWS regions are tightly meshed redundant clusters of data centers known as availability zones that can be deployed in mutually supporting roles. Gledhill admitted that most enterprises, even banks, can't match this: "We don't have the same availability zones Amazon has."

> *Not everything can be made to run in the cloud. Traditional infrastructure may need proprietary hardware*

In contrast to the constraints of in-house data centers, the cloud allows for the creation of new services, he said, such as the bank's DBS PayLah! mobile wallet, a commercial service based on cloud capabilities.

"[The cloud] gives you the opportunity to play with things that you would never possibly imagined to do before, because you were constrained by the ability to scale [and] experiment," he said.

But what of security? Gledhill doesn't think that cloud and security is a zero-sum game. It all boils down to taking the same controls traditionally used to secure non-cloud IT infrastructure, and ensuring that they are properly implemented in the cloud.

"How can the traditional controls that we already have be moved to into the cloud? From a security perspective, there is equivalent lock down capability in the cloud," he noted. "Arguably, it will be more secure there, because the way that AWS implements security, manages it, they've just get better at those over time."

For all its flexibility, Gledhill readily acknowledged that not everything could be made to run in the cloud. This is because existing systems built on traditional infrastructure may use proprietary hardware and databases that are not cloud friendly.

"The issue is the architecture of the core platforms. Our biggest priority is to make those platforms cloud ready," Gledhill said.

The final transition to a cloud-only deployment can only happen when vendors of key systems engineer them to support the cloud. This is likely an issue faced by enterprises, and explains why AWS partnered with virtualization juggernaut VMware to provide the latter's software defined data center (SDDC) offering on the AWS cloud.

The already huge and growing pool of features can bring problems, however, as it causes an increase in complexity. AWS has an answer: Training.

"A big part of our focus is on training. We're spending a lot of time looking at how to help enable our customers and partners to better understand and leverage AWS," said Walton, who told *DCD* that more than 1,400 people had attended AWS training days in Singapore in 2016.

Elsewhere, AWS revamped its management console with a cleaner default layout, and launched a new service called Lightsail with a simplified console for customers who need a virtual private server.

Some of AWS's inherent complexity is a direct result of its sophistication, says Walton: "The maturity of our APIs is often not recognized, [and offers] an ability to automate things in a way that is difficult with other providers. We're confident that the benefits of that kind of product is pretty compelling," he said.

Then again, tapping into features that only AWS offers could be a Pandora's Box for organizations not keen to put all their eggs into a single cloud platform, even one as large as AWS.

Gledhill says AWS does offer capabilities that other clouds don't support: "My view is that we will never go with a single provider."

Of course, Gledhill sees the cloud as nothing more than an enabler, and the onus ultimately rests on organizations to transform to take full advantage of what it can offer.

"The other shift is organizational," he commented. "How do you change the mindset to make [DBS] feel like a 22,000-employee startup? Because if you don't achieve that, moving to the cloud doesn't bring you very far," he said. ●

Power Struggle

Data centers lead the way to a post-fossil world. But it may not be a smooth journey, says *Peter Judge*

Peter Judge
Global Editor

Whatever Donald Trump says about it, renewable energy is the future. Fossil fuels will eventually go away - and data centers are playing their part in the move to more rational power technologies.

Within hours of his arrival at the White House, US President Donald Trump's administration posted an energy policy which said Trump is "committed to eliminating harmful and unnecessary policies such as the Climate Action Plan," under which the Obama administration had promised to encourage alternative energy sources as a means to reduce man-made global warming.

In its place, the Trump administration promises to support shale oil and gas, and to "revive America's coal industry, which has been hurting for too long," in a statement which makes no mention of climate change. Soon after this, Republicans in Wyoming proposed a bill which would support the coal industry in that state - by making large wind and solar installations practically illegal.

These moves may fly in the face of established climate science, but they aren't a surprise. Trump appears to be a climate change denier and spoke in favor of burning coal during his campaign.

But moving away from renewables is actually out of line with the direction of world power generation (see box). Although the majority of the world's electricity is still generated from coal, oil and gas, renewable sources are rapidly moving to price-parity with fossils, and many countries report an increasing proportion of their power comes from renewable sources.

One thing that's undeniable is that fossil fuels are finite, while renewable resources are effectively everlasting. Fossil fuels cause climate change, so we should wean ourselves off them, and leave them in the ground. But even if we don't, they will eventually run out, and (fracking aside) will become more expensive to extract as we approach that point.

So data center operators have been making a shift towards renewable electricity and, at the time of writing, that position has not changed in response to the arrival of President Trump.

"We are the largest corporate purchaser of renewable energy in the world," Joe Kava, Google's senior vice president of technical infrastructure, told *The New York Times* in 2016. "It's good for the economy, good for business and good for our shareholders."

Google isn't alone. Joe Kava will be joined by Christian Belady of Microsoft at the DCD>Enterprise show in New York in March, to explain why the cloud will be run by renewable energy, in a panel which also includes influential data center builder Dean Nelson of Uber Compute and Peter Gross of fuel cell maker Bloom Energy.

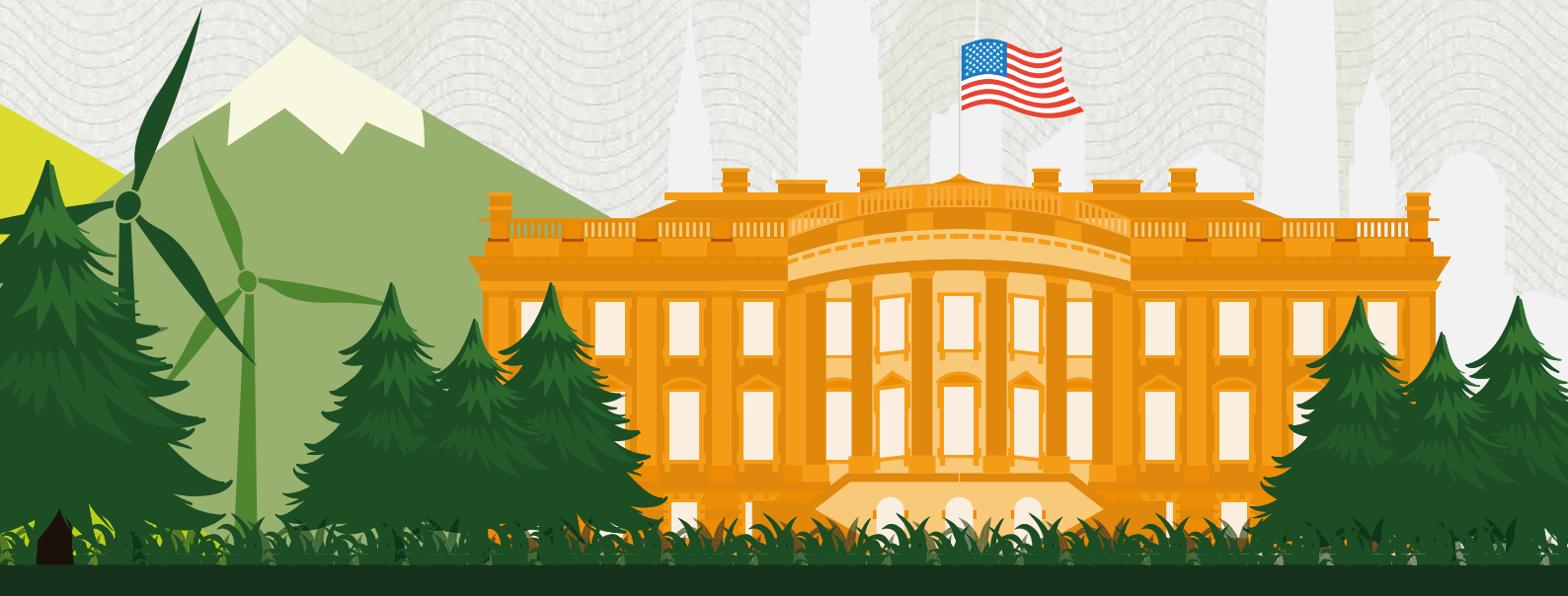
As well as Google, Microsoft and Amazon, others have made similar promises, and other cloud providers including Equinix and Digital Realty are moving to renewables.

On the face of it, however, renewables aren't a great fit for data centers, or for much of the modern world's power needs. Power grids need to have steady baseline power, and other sources which are able to ramp up and down quickly when demand fluctuates. That's why the world has so many fossil fuel power plants.

They work for baseline generation, and it's also easy to burn more coal or gas when more power is needed.

Hydroelectric power is steady and stable, so good for baseline power. Leaving aside nuclear, the other leading low carbon energy sources are solar farms and wind turbines, both of which are intermittent, fluctuating as daylight and wind come and go.

That's why data centers rarely power themselves directly with renewable plants. They buy up the renewable power that is in the mix of the grid, offsetting the fossil ▶



The shift to wind and solar

Coal and gas still make up around 62 percent of the global electricity supply, according to a December 2016 report from the World Economic Forum: "Exponential improvements in renewable technology, both in efficiency and cost, have made renewable energy competitive in the past few years."

The cost of solar energy has dropped 80 percent since 2009, according to data from the International Renewable Energy Agency, and wind energy costs have dropped 30 percent in three years.

At the same time, most fossil fuel costs have been increasing. It's true that fracking has opened up some cheaper reserves but, like all fossil fuels, those reserves are limited.

WEF reckons that 30 countries reached "grid parity" – where fossil electricity and renewable power cost the same. Eighty percent of the global market could reach grid parity in the next couple of years, says the WEF.

As that happens, the amount of renewable power in the grid is increasing. On Christmas Day 2016 in the UK, renewables made up 40 percent of the UK's power grid, up from 25 percent in 2015.

Even with government backing on the wane, renewables are starting to look pretty healthy.

power actually used in their facility. Even when data centers do have a solar farms or wind turbines on site, it feeds its intermittent energy into the grid while the grid feeds the actual facility.

When a data center pays for a "green" Watt, some say this only displaces the "brown Watts" to other users. But Kava and his colleagues say this stimulates the production of more renewable electricity, through the process of supply and demand.

There's a group with the explicit aim of ensuring that more renewable energy is fed into the grid and consumed instead of fossil power: the Renewable Energy Buyers Alliance (REBA) wants to add 60GW of renewable power capacity to the US grid by 2025, and its backers include all the cloud giants: Microsoft, Facebook, Google/Alphabet and Amazon, as well as some 60 other companies.

Data centers are a small proportion of electricity use (around two percent by most estimates) and obviously an even smaller proportion of total energy use, which includes non-electric energy, such as fossil fuels burnt for heat and transportation.

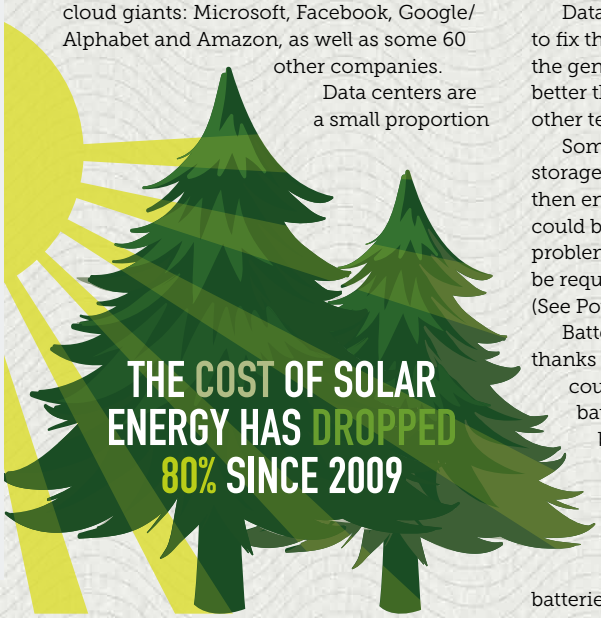
But moving data centers to renewable power has become a campaigning issue for those inside the industry (such as REBA), as well as for groups campaigning from the outside, such as Greenpeace, which castigates the cloud industry for using fossil fuel in its annual Clicking Green report.

The reason for this focus is that data centers are modern and forward looking, and they have a reasonably high profit margin so they can afford to take a moderate hit on power and lead the way to the new economy.

Data centers are also at the heart of moves to fix the problems with renewables, making the generation match the demand of the grid better through demand management and other techniques.

Some of this will happen through energy storage. If data centers had battery storage, then energy from their local wind farm could be stored and used when required. The problem is that huge battery storage would be required, and batteries are still expensive (See Power Supplement).

Battery prices may be due to come down thanks to the electric car market, which could become a source of second-hand batteries. Once the performance of the battery falls below that required for a car, it still has enough capacity to store power on a duty cycle appropriate for providing backup in a data center. An Eaton product combines second-life Nissan batteries into modules which can power edge



data centers.
This is a microcosm of what has to happen on a bigger scale, if power grids are to move to renewable sources. Hydroelectric power is a big win, as it can effectively be used for storage (close the sluices or even pump water back up to the reservoir).

But to make full use of intermittent sources like wind and solar, national grids need storage, to convert renewable power into dispatchable power. Most grids only have a small amount of storage now, which is nowhere near the TeraWatt hours (Twh) that would be required to turn enough renewable power into dispatchable power to support a whole power grid.

All this ignores the world's continued dependence on fossil fuels, particularly for primary energy. As developing nations industrialize, they are still increasing fossil fuel use, leading to an increase in demand.

It's been estimated by energy company BP that we may still be 20 years from the moment of peak oil demand, after which fossil fuel use finally starts to decline.

By that point, the world must be able to use renewable energy effectively.

In many ways data centers are acting as a laboratory for the kind of technology which will be needed by the rest of society terrifyingly soon.

Sebastian says

Do not look to your government for leadership, it is up to you to save the world

Western governments have declared war on climate change. Sadly, they are not battling carbon emissions or inefficient energy usage, but tend to dispute the validity of science.

Perhaps it should not be a surprise that a man part-funded by 'America's Oil Champion' Continental Resources would question whether oil consumption really should be capped, or that the UK government, desperate to start a fracking boom, tried to bury its own report on the dire effects of a changing climate.

But, while we may not be surprised, we should be concerned. Whatever one's political views outside of this issue, the sad reality is that anthropogenic climate change is a scientifically accepted fact. There are no alternative facts on the matter, it is happening. Data centers may be relatively innocuous, but they are contributing.

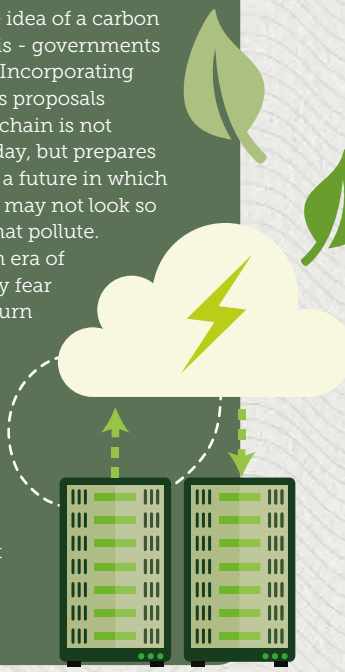
It is here the industry has a chance to lead. While data centers may not use as much energy as once feared, they are still responsible for more emissions than the airline industry.

Do not wait for your government to mandate action, look for ways to improve, no matter how small.

Think about long-term savings, not just capex. Share ideas instead of keeping them to yourself. Embrace new technologies instead of sticking with what works inefficiently.

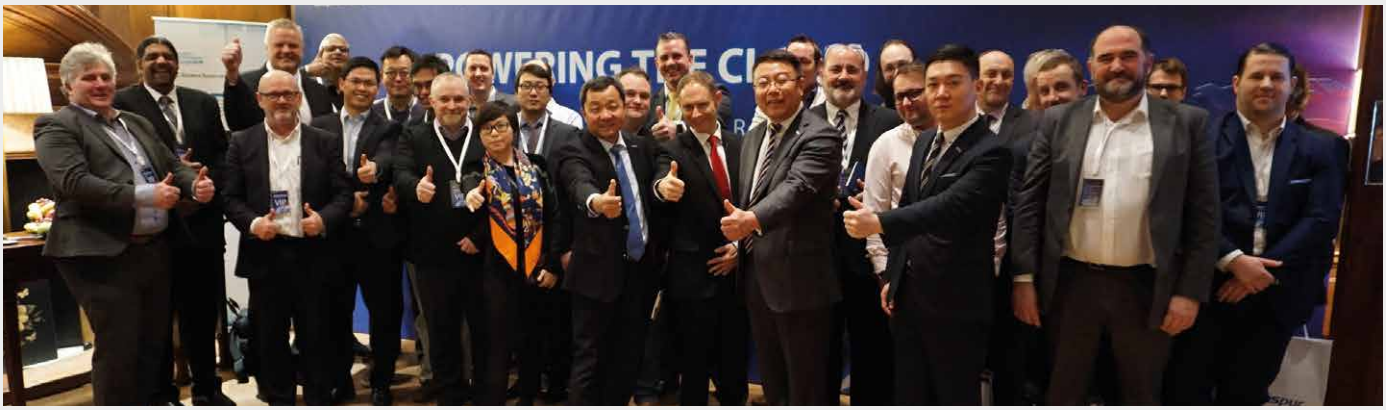
While current administrations lazily toy with the idea of a carbon tax, remember this - governments change, and fast. Incorporating carbon-conscious proposals into the decision chain is not just ethical for today, but prepares your business for a future in which regulatory bodies may not look so kindly on those that pollute.

In this modern era of automation, many fear that people may turn against technological progress. To avoid this dark possibility, we should ensure that technological progress does not first turn against them.



Inspur, the fastest growing server vendor in the world, arrives in the UK

Inspur receives a warm welcome as the UK launch event held at the prestigious Marriott County Hall attracts an enviable guest list



Inspur UK Customer Day concludes with a big success

London, 17th January 2017: Today Inspur hosted their first UK event and attracted attendees spanning leading UK universities, telecom giants and other significant industries. Whilst many may question if there is room for another competitor within this crowded marketplace, the status of the guest list proved there is.

Inspur is a Leading Cloud Computing Total Solution Provider founded in 1945, with a turnover of over $9.8 billion and more than 26,000 employees worldwide. Based on Gartner's latest Global Server Market Report publication, the shipments of Inspur servers in the first three quarters of 2016 experienced a 28 percent year-on-year increase, making Inspur the fastest growing server vendor in the world. We talked to the man behind today's successful event to learn more about why Inspur is causing such a stir in this competitive market.

"After a strong success story in China, we are now going to the European market," Jay Zhang, Vice President of Inspur Overseas, said. "Despite the competitive market we believe there is an opportunity for a new entrant. We welcome competition as ultimately it delivers a higher quality of service and new technologies to a changing world. We want to form partnerships to deliver an exceptional level of service and the latest technologies."

Jay Zhang looks back as he describes how things have changed since his first visit to the UK: "Having visited the UK more than a dozen times since the office opened last summer, we have all been looking forward to this event. I really appreciate that Mr. Benson, Intel Data Center Group Sales Director can give a speech to our customers. We have more than 20 years of strategic cooperation with Intel in China, and I am happy to see that this relationship is now growing globally. Also, I would like to thank Dr Rahim Lakhoo, from the University of Oxford, for his cooperation with Inspur UK. Despite a busy day we are pleased that we have been able to communicate who we are and what we can offer to such an influencial group."

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Are you ready for the fourth Industrial Age?

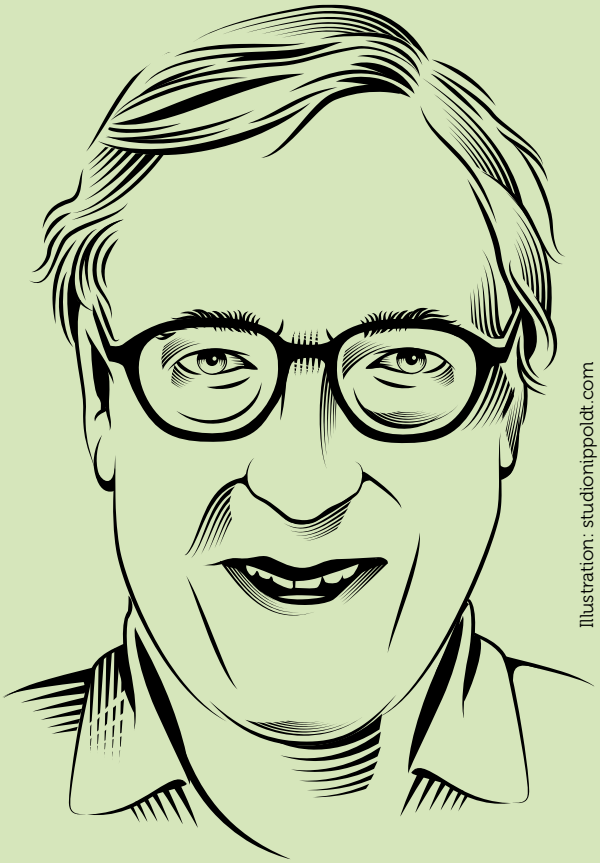

Illustration: studionippoldt.com

Digital transformation will change your infrastructure. *Bruce Taylor* invites you to tell us how you are responding to the challenge of becoming "digital first"

In 2016, US retail giant Macy's announced plans to close 100 stores. The first 63 locations were identified early in 2017, prompting a lot of commentary about the job losses in this latest "failure" of retail.

A different interpretation is that Macy's management has understood that the future is digital-first, and made a bold decisive action to adapt to global changes and ensure Macy's brand leadership continues.

The global economy is experiencing profound, disruptive change. Some call it the fourth Industrial Age, or the fourth Industrial Revolution. Others call it digital transformation.

No economic sector will escape the impact of becoming "digital-first." Those who become digital first fast will have a competitive advantage, and those who wait will struggle to catch up.

We tend to know digital transformation by the various end-user faces it puts on: the IoT; AI, machine learning, robotics, drones and autonomous vehicles; 3D design/print; AR/VR; gaming etc.

These are the hot topics at the front-end of a fundamental economic change. At the back-end, infrastructure will have to go through an equally profound change.

The impact on the infrastructure ecosystem, mud-to-cloud, physical and virtual, is what we're calling digital infrastructure transformation. We may be in the midst of it, but most organizations have only just begun to see it as a whole.

Some organizations are leading the change, while others lag behind. The most natural group to welcome it are the Internet and cloud hyperscalers, and the third party lease and multi-tenant colocation providers who service them.

> *No-one will escape the impact of becoming "digital first," and this includes infrastructure*

DCD began this journey with its Zettastructure conference in late Fall '16. The Enterprise conference in New York in March this year advances the conversation. But it's the Webscale conference for Internet and cloud hyperscalers in San Francisco, right in the belly of the digital transformation beast - Silicon Valley - that is the natural setting for this timely, critical infrastructure discussion.

In this era, customer outcomes and experiences are more central than products and product performance. You don't buy a Tesla, you buy a green lifestyle outcome and an exemplary driving experience.

We think IT, data center and cloud services will be required to provide DevOps-style flexibility and agility, baked into the entire infrastructure to meet the requirements of apps and workloads.

We want your input. Please answer these three simple questions in our new LinkedIn Group: *DCD Enterprise Digital Infrastructure Transformation*.

Question 1: What does Digital Transformation mean to your organization and its infrastructure?

Question 2: Are you now involved in any aspect of planning or implementation of a digital-first program, and at what level?

Question 3: Does your organization have any long-range plans for digital transformation, including the infrastructure?

Will you play with us? We will curate the responses from our LinkedIn discussions. We will publish the most thought-provoking responses, here and on our site, with your permission.

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Telcos push racks to the limit

The OCP Telco Project is developing Open Compute racks that meet a higher standard, says *Max Smolaks*

Max Smolaks
News Editor

Unlike its famous parent, the Open Compute Telco Project does not set out to develop new hardware: instead, it aims to remove roadblocks to wider adoption of existing Open Compute gear in the telecommunications sector.

The organization wants to identify the needs and requirements of the telco market, then verify and realize benefits that OCP can bring to network operators - but this is proving more difficult than expected.

The Project's two working groups, located in different hemispheres, will come together and share their findings so far, at the upcoming Open Compute Summit in California in March. And it's going to be all about racks.

In January 2016, a number of the world's largest telecommunications service providers including AT&T, Deutsche Telekom, EE, SK Telecom, and Verizon became members of the OCP. And thus, the OCP Telco Project was born.

DCD got a sneak peak at the inner workings of the group in late 2016, when our Zettastructure event in London hosted discussions between members of the Project.

Telecoms data centers face specific challenges. Unlike cloud and colocation data centers, telco facilities often have to comply with additional environmental and physical requirements, mandated either by law or internal policy. 'Vanilla' OCP kit simply cannot be used in such environments.

So what exactly bothers telecoms operators? Primarily, it's compliance with the Network Equipment Building System (NEBS), a set of technical requirements developed by Bell Labs in order to make telecommunications networks extremely resilient.

NEBS was originally created in the 1970s to ensure that office equipment could connect to a local telephone exchange. Over time, it developed into the most common set of safety and environmental design guidelines applied to telecoms equipment in the US. It's not a legal requirement, but it might as well be.

NEBS includes provisions on fire resistance, seismic stability, electromagnetic shielding, humidity and noise, all of which need to be taken into account when designing carrier-grade hardware.

Some of the NEBS requirements conflict with OCP philosophy – originally focused around cost optimization, speed of deployment and serviceability. OCP has ▶

"Nokia built an earthquake-resistant OCP-compliant rack, and tested it to death"

▶ often been seen as prioritizing efficiency over reliability, considering resilience as something to be provided at the level of software, running on duplicated low-cost hardware.

There have also been concerns about power, since original OCP kit wasn't designed for 48V DC power distribution traditionally used in the telco space.

The first Open Compute product to go through the adoption process is the famous Open Rack, and attempting to meet the NEBS guidelines has kept the engineers occupied.

Fernando Oliveira, cloud architect at Verizon and one of the leaders of the Telco Project, said it turned out that a single OCP rack would not pass a seismic test – but the situation was completely different when three racks were bolted together, remaining stable through the worst of the simulation.

Nokia, which owns Bell Labs after acquiring its parent company Alcatel-Lucent, chose a different approach. As part of the Telco Project, it built an earthquake-resistant OCP rack using existing rack elements like posts and brackets in new configurations, and testing them to death.

In order to comply with fire resistance guidelines, the Telco Project team reimagined the compute sleds within the three bay cubby as fire enclosures, lined with fire-resistant materials.

Nokia went on to introduce EMI shielding at the compute sled level at the same time as fire resistance.

Juha Klemola, senior hardware specialist at Nokia, said this approach considerably disrupted the airflow, but fortunately not to the point where it became a fire hazard in itself. That would have been too ironic to contemplate.

Even the cabling scheme for the rack required some changes. A typical server requires just one Ethernet connection, and OCP has been pushing smaller numbers of 100G Ethernet ports. Telco appliances demand up to four connections each.

8.3

Richter scale earthquake activity that a NEBS (GR-63) compliant rack must survive in Seismic Zone 4

During the Zettastructure meeting, Kang-Won Lee, senior vice president of R&D at SK Telecom and co-leader of the Telco Project, said the organization did not want to become a standards body – a number of large telecoms companies banding together to shape global standards would definitely set off alarm bells among antitrust regulators.

What it wants to create is a single, international requirements list - but this task might require breaking away from tradition.

Critical telco requirements are still not entirely clear, said Kang. And it might turn out that those requirements are due for an update based on current best practises.

"Traditionally, telco requirements relate to seismic resilience, relate to fire – all of these things are there because the telco network needs to be reliable and highly available.

"But these were defined a long time ago, and when you look at Internet giants like Facebook and Google – their infrastructure is highly reliable, their infrastructure is highly available. If they go down, people go crazy.

"So we have to look at whether we have the right requirements, or whether we need to look at the requirements and the design from a different perspective – we have to revisit it." ●

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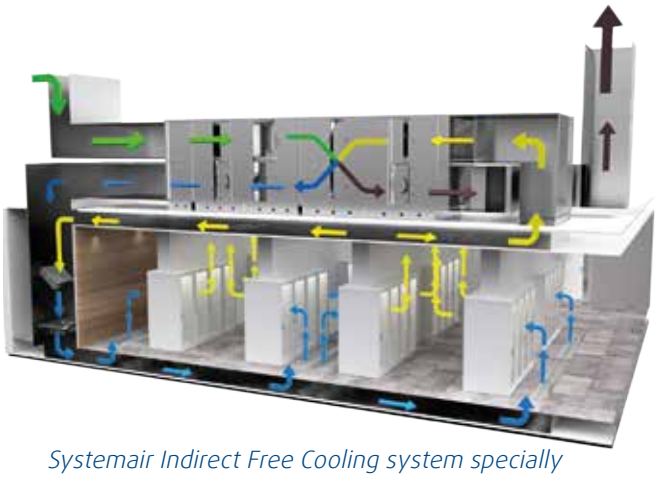

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Is Hybrid IT the holy grail?

Wednesday 8 March
09:00 PST | 12:00 EST | 18:00 CET

Speaker confirmed:
Adam Levine, CCO, Data4

How do you make the right decisions as to where to host and how to manage your IT assets? Cloud added not just a whole new set of choices to the decision, it has changed the way that IT is consumed and paid for, and how IT delivery can be aligned with business needs.

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Making the Case for Lithium-Ion Batteries in the Data Center

Thursday 30 March | Time TBC

Speakers confirmed:
Peter Panfil, VP Global Power, Vertiv
Tony Gaunt, Senior Director Asia, Vertiv
Thomas McKinney, Director of Data Center Development and Operations, Forsythe Data Centers

Long the refuge of valve-regulated lead acid (VRLA) batteries, the data center industry is increasingly looking for energy storage alternatives. Batteries are universally regarded as the weak link in the data center power chain. As chemistries and construction evolve and prices drop, lithium-ion batteries are emerging as an attractive alternative.

Attendees will be provided with key takeaways to help them effectively evaluate real-life applications of lithium-ion batteries within critical spaces.

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Here comes the flood

Sebastian Moss
Reporter

After all the warnings, giant DDoS attacks are here. But if you handle it right, there could be opportunities in threat mitigation, says *Sebastian Moss*

Security experts and members of the media have spent years saying that companies should take distributed denial-of-service (DDoS) threats seriously, often to little avail. Now, with revenue streams increasingly under threat, the tide could finally be starting to change.

"We've been saying that scale, frequency and complexity of DDoS attacks will continue to increase for a while," Darren Anstee, chief security technologist at Arbor Networks, told *DCD*.

"Last year we were really trying to emphasise it because the rate of increase appears to be accelerating, which is fairly frightening: Since 2013 those things had been growing fairly quickly anyway."

Every year, Arbor releases its Worldwide Infrastructure Security Report, based on survey data and its Atlas threat analysis network. "What this year shows us is that they really are accelerating," said Anstee.

And the stats in the report are sobering - the company tracked 558 attacks over 100Gbps last year (up from 223 in 2015), and 87 over 200Gbps (up from 16).

"That's a massive jump in both the size that we're seeing, and also the frequency of those very, very large attacks. These big attacks used to be considered as kinda black swan events," he continued.

"The way that I see things right now as a security professional is that it's getting much, much worse," said Yousif Hussin, global information security engineer at Equinix.

Data center operators are rarely the target of a DDoS attack, but Anstee pointed out: "Data centers have long been a magnet for attack activity because a lot of the things that attackers want to go after tend to be in them."

This has led to a "significant increase in those seeing revenue loss, up from a third to 42 percent. And a third of them also saw customer churn this year due to DDoS attacks. So they are a big problem from a business perspective.

"Nearly three quarters of data center respondents told us that they'd seen between one and twenty attacks that actually impacted their service."

How have things gotten so bad? One major problem is how much easier launching an attack is becoming day by day: "The tools that are available on the Internet today are less than the ones we're going to see tomorrow," Hussin said. "It's not rocket science right now to be a hacker and break everything on the Internet, and it's going to get a lot easier."

Take multi-vector attacks, which - as their name suggests - are multiple attack vectors launched at the same target at the same time. "Those kinds of complex attacks used to be restricted to people that really knew what they were doing, and could kind of manage the different attack vectors through different botnets and things like that," Anstee said.

"The problem we have today is the weaponization of DDoS. There are lots of bots out there today, even Internet of Things (IoT) bots, that can launch multiple attack vectors at the same target at the same time, with a single command from the botnet controller. So complex multi-vector attacks are now accessible to virtually everybody."

IoT botnets, a perennial bogeyman for the cyber security journalist, finally hit public consciousness late in 2016, when the open-sourced Mirai botnet was used to launch the largest attack of its kind in history against DNS provider Dyn. ▶

▶ Without warning, much of the US found itself unable to connect to its favorite online services. Poorly secured IoT devices in hundreds of thousands of homes were enslaved to pull off the attack.

"There are lots of devices out there," said Anstee. "Various numbers put it between six and 10 billion, growing at millions per day, that people don't think about as Internet-connected computers. What's really changed this year is the mass recruiting of them."

He added: "Given the rate at which attacks are growing, the ease at which these very large attacks can now be generated, this is a key problem for data centers."

The good news is that this ramp up in attacks, especially the ones that affect companies' bottom lines, has "increased the awareness of DDoS and the impact it can have, which is driving an improvement in the defenses that are being put in place," he said.

"We're seeing some very encouraging developments in terms of roll-outs of intelligent DDoS mitigation systems, roll-outs of hybrid defense - combinations of network perimeter and cloud-based defenses to deal with both the application layer and large-scale volumetric attacks efficiently."

But Andrew Shoemaker, founder of DDoS testing company NimbusDDOS, believes that defenses still have a long way to go.

When his company is hired to do a risk assessment "it's usually an abysmal setup," he said. "We do simulated attacks where we attack their production network using real world DDoS attacks. The number of people who have some failure in that baseline test is probably 90-95 percent. The number that completely fails is more like 60 percent."

He continued: "Even in large businesses that we work with, like large banks, which know about DDoS risk and have hardware in place, there's usually something we can find that has been overlooked. Part of it is because their environment is so massive, it's hard to keep tabs on everything that's going on.

"There's always something that we can find and exploit."

A real concern is the fact that a lot of his customers fail the test despite already having mitigation solutions in place, he said: "There's issues where people can configure it wrong, where people maybe don't understand the processes for activating the service."

Another problem is that "90 percent of the people that come to us only do so after they've been attacked, even though our whole business model is about preparedness," he added. "Nobody takes it seriously until it happens to them."

Shoemaker said that he doesn't "know if the DDoS problem is something that is completely solvable, without some massive fundamental changes to how the Internet is constructed."

"It's not rocket science right now to be a hacker and break everything on the Internet," Yousif Hussin, Equinix

But he noted that while "it's almost impossible to be 100 percent protected against DDoS, what you can do is make it extremely challenging for the attacker. You can make it so that it's not worth their time and effort to bother focusing on you."

For most companies it's best to have some on-premise mitigation hardware that "you can use to block any attack that's smaller than your in-bound data pipes."

But really large attacks, which could take out even regional or national ISPs, can only be handled by cloud based mitigation vendors, he said.

There is another, perhaps simpler, way to prevent crippling DDoS attacks - avoid customers that attract them. "That's been happening for a couple of years now," Anstee said. "Some gaming and gambling sites have been asked to move around from data center to data center because they are magnets for attack activity."

Shoemaker also knew of this habit, adding: "They may not remove you as a customer, but what they'll do is black hole your network addresses."

But troublesome customers could become an extra revenue source: "If one of your customers is being attacked, you have the option of getting rid of that customer, or blocking them.

"Or, if you build the infrastructure to support that customer, then you can actually get more money out of them by selling additional DDoS mitigation services." ●

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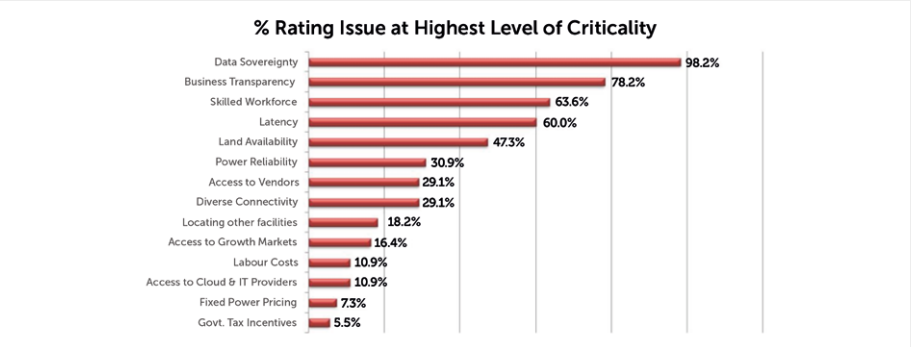

"MDEC sees the cloud as a critical enabler for the digital economy and we have been looking at Malaysia's data governance landscape over the past year to identify any impediments to the adoption of cloud and other technologies which enable digital transformation. Some industries have sector specific regimes which may impede the adoption of public cloud and cross-border data flows. In general, apart from sectors such as banking, finance and healthcare (which are carefully regulated in most countries), Malaysia does not have any impediments to cross-border data flows and we would like to keep it that way. Even for regulated sectors, we are engaging with the relevant regulators to identify specific concerns and address those in order to enable those sectors to also leverage on the advantages technologies like cloud brings."
Wan Murdani Mohamad, Director, MDEC

Just as the world of data centers and corporate IT has been disrupted by cloud, so the requirements for locating a data center outside the home country have also. Location has to some extent been superseded by interconnection, the quality of facility has been balanced against access to quality service providers, and resource provision against the technology and expertise to deliver efficiency. The market also has changed from a focus on attracting end-users to a focus now almost entirely on colocation, cloud and service providers.

And the drivers for relocation and the issues of concern have shifted also. A survey of 55 executives in American multinationals responsible for decisions on data center location nominated **data sovereignty** as the most important consideration when considering locations for siting an overseas data center. And while the rankings emerging from a survey of this size can only be indicative, another 'intangible' – **business transparency** – is ranked second. Both are rated at some distance ahead of the issue ranked third, which concerns the level of **workforce skills**. Might data sovereignty and the local business and governance culture emerge as significant risk factors for today's investment in offshore data centers?

An intangible risk to invisible data

So, why the importance attached to data sovereignty? Data sovereignty is the principal that data is subject to the laws (privacy, IP, censorship) of the country in which it is located rather than those of the country where the owner or tenant of the data center is located. Possibly, as the data center industry gets more adept at dealing with the resource issues that marked its legacy phase through better practice, more efficient technologies and through cloud, data sovereignty represents a new and less tangible challenge to the international free-flow of data. While the key enablers of the data center industry have always come from within the industry, through technological or operational evolution, both data sovereignty and ease of doing business means that the industry is reliant on external factors and decision makers. If the complaint of a single individual against one of the key, pioneering companies of the cloud era was able to invalidate an agreement (Safe Harbor) that had existed for 15 years between the EU and American organisations then the industry has a real cause for unease. OK, Safe Harbor was flawed, founded largely in an era before cloud and the volumes of data and traffic now seen, and it papered over some of the key cultural differences in regard to privacy that exist between Europe and the USA, and when it was invalidated in the European Court of Justice, this represented a block to American companies transferring data on EU citizens out of Europe.

The potential disruption to data centers which are part of international networks or which are operated by companies outside their home legislature can be caused by failure to comply with the privacy regulations of the country in which the data is stored, and also by the possibility that data held in another country may be subject to subpoena whereby the data may be requested, sought or seized. These situations have occurred recently in relation to multinational American companies operating outside the USA, and both have major implications for the siting and the operation of a data center. In the words of one respondent to the survey:

"Politics is the biggest influence. We want a location with good track record on being good for business, open and a climate free from political burden."

Unseen and unmeasurable risk is of greater concern than risks that can be modelled as part of a risk assessment process. It is a situation riddled with uncertainty – in Europe, how will the successor to Safe Harbor – Privacy Shield – track data 'abuse'?

So, how does an international data center operator interpret and deal with the cluster of laws and regulations that legislate and enforce data sovereignty? Locate in the market with the legislation most like that of their home country? Locate in the market with the fewest constraints? Or locate in the market with the most? The decision obviously depends on many other factors and it depends also on how different the legislation in one market is viewed in others. While many of the drivers of data sovereignty might reasonably be expected of ethical data management, the political dimension adds uncertainty to the mix. For companies seeking to eliminate as many of the risks of data sovereignty as possible options of separate national data centers, cloud segregation or a clear statement of global policies (not of separate policies for separate jurisdictions) should be evaluated together with their business model and cost consideration.

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HYPERSCALE VS MICROSCALE

Some say the future of the data center is diverging widely. *David Chernicoff* sees a bigger picture

David Chernicoff
US Correspondent

On the surface, hyperscale and microscale data centers seem like opposing ideas for the future of data centers. But the reality is that they are opposite sides of the same coin, or at least complementary concepts. The goal of both sets of technology is to be able to deliver data and applications when and where they are needed, efficiently and effectively.

On demand services can enhance business productivity, improve the life of the knowledge worker and enable the Internet of Things. But in order for this end-to-end process to function well, all the pieces of the puzzle need to be in place. Both hyperscale and microscale data centers are critical components to deliver information to the end user.

Let's first look at the current concept of hyperscale data centers.

With this model, the goal is to deliver a single compute architecture that is massively scalable. Combining the use of virtualization, the software defined data center, software defined networking, and software defined storage with standardized compute, networking, and storage nodes, the goal is to be able to continually scale the IT load of the data center to meet the demands of the users.

At the moment, when we consider hyperscale data centers we think of huge cloud services like Amazon, Facebook, Google and Microsoft, which is a reasonable presumption as they provide "cloud" services that demand the type of growth and support that can be delivered by the hyperscale data center concept.

The fundamental design of the hyperscale data center needs to take account of three resources that need to scale - compute, networking, and storage. A new deployment should be able to start off small, building a baseline configuration of servers, storage, and networking that can be added to as necessary, allowing the data center to grow with demand. This means that hyperscale isn't just for those huge infrastructures; the basic concepts can be applied to any size data center or deployment.

It also means that the cornerstones of the data center don't have to scale simultaneously; only those aspects of the infrastructure that need to grow to meet your requirements have to be adjusted. Because the software defined data center is decoupled from the underlying infrastructure, there is no fixed relationship between the various components. ▶

"Hyperscale changes the way data centers are designed, microscale changes the way they are delivered"

The most important takeaway from this should be that a hyperscale data center isn't defined by its size but by its architecture and growth capabilities. The hyperscale model has taken off significantly in the last two to three years, and is commonly believed to be limited to giant mega-scale data centers - but this may be somewhat over-simplified.

While giant data center deployments get the lion's share of attention, the biggest growth in data center development seems to be in the edge data center - smaller facilities positioned at the "edge" of the network, where end users and devices need a quick response, and don't want the delays associated with routing to a centralized data center.

In many ways, thanks to the rise of digital services, what was once the edge has moved front and center. Smaller data centers are being built in cities that weren't considered good candidates for tier 1 facilities. These cities have been considered prime locations for the opening of new data centers.

Although these are smaller facilities, they are prime candidates for hyperscale model development. The demand starts off small and continues to grow. Many of the providers/operators of this class of facility have begun deploying their own cloud networks for their customers, which meshes well with the density capabilities of the hyperscale model.

These highly capable edge data centers, running on the hyperscale model, are well positioned for the growth in demand for their services and for the expansion of IoT. These edge data centers will become especially important as the number of connected devices continues to rise and the availability of backhaul bandwidth grows at a slower pace.

So where does that leave microscale computing? As long as the cost of backhaul bandwidth remains significant there will always be a general demand for the ability to shorten the path that data has to travel to get to the ultimate consumer. There will also continue to be a need to minimize the response time between server and end user in order to provide a quality user experience. And, of course, there will always be geographic locations where the placement of a data center of any significant size and capability is unrealistic.

Vendors appear to be looking at the microscale data center in two ways. The first is slotting into the current model. This gives a hierarchical view of data centers and their traffic, with mega data centers at the top of the pyramid, edge data centers in the middle and micro scale data centers at the bottom. All information eventually filters up the pyramid, but only that needed by the lower tiers filters down. This approach builds on the current investment in data centers and allows for deployment if specialized, microscale data centers as needed.

The second approach looks at the microscale data center in a multiple node model, where instead of feeding back to a central facility, the individual microscale data centers are effectively in the role of an individual node in a hyperscale facility. Data and services, for example, can be stripped across the multiple small data centers, giving a level of resiliency and availability that would otherwise require specialized services and/or facilities in the current data center delivery model. This view requires buildout almost from scratch as the primary purpose for an existing data center in this model would be to eventually provide the data and applications that would migrate to the multi-node microscale data centers.

Unlike the hyperscale data center, where the concept represents a major change in the way the underlying architecture of the IT load components of a data center are designed, the microscale data center represents a change in the way the facility infrastructure is delivered.

Microscale data center designs are focused more on the packaging than the contents. Power and cooling must be delivered in a small package, often self-contained, to the IT load hardware, and this defines the design constraints of a microscale data center. However, there is no reason why the concepts that define a hyperscale facility can't be applied to some extent in the actual compute, storage, and networking components of a microscale design.

Planning for the next generation of your data center design will require considering all aspects of information use and delivery. Building a flexible data center infrastructure that matches the flexibility required to drive business growth will likely require considering many different architectural issues in your design choices.

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THE DAILY SHAKE UP

HERE'S OUR PICK OF THE MERGERS, ACQUISITIONS AND SPIN-OUTS FROM 2016-2017 WHICH WILL HAVE THE MOST IMPACT ON THE DATA CENTER INDUSTRY

10 CORPORATE DEALS OF NOTE

DELL COMPLETES $60 BILLION MERGER WITH EMC

Dell's merger with EMC, the largest tech merger in history, was completed in September 2016 - just under a year after it was announced by CEO Michael Dell (left). The combined company has some $74 billion in revenue.

The deal takes Dell in the reverse direction of peers such as HP, which has been spinning off non-core businesses including services and software. Dell now owns EMC's core storage business, as well as its subsidiaries, including cybersecurity firm RSA, cloud company Pivotal and virtualization giant VMware - although VMware remains a separate company, held via a tracking stock.

Dell became a privately-owned company in 2013, delisting from stock exchanges to gain freedom to take new directions. The merger was by Silver Lake Partners among others.

VERIZON DELAYS $4.8BN ACQUISITION OF YAHOO CORE

Once valued at $100 billion, Yahoo could only command a price of $4.8 billion when telecoms company Verizon announced it would buy it in July 2016 - and since then the deal has looked rocky.

Yahoo was founded in 1994, and was the most popular Internet portal for several years before losing to Google. In 2008, Yahoo fought off a $44 billion takeover by Microsoft.

Marissa Mayer (above) was appointed CEO in 2012 and had limited success halting the decline with a strategy of buying startups such as Tumblr.

Verizon announced it would buy Yahoo's core in July 2016. Yahoo's large stake in China's Alibaba and Yahoo Japan will continue as Altaba.

However, the Verizon deal has been delayed after two record breaking security breaches were announced, one affecting up to 500 million Yahoo accounts, the other a cool billion accounts.

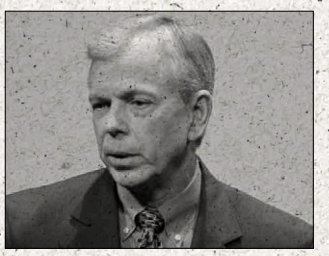
EMERSON NETWORK POWER SPINS OFF TO BECOME $4BN VERTIV

Emerson Network Power developed within Emerson Electric through acquisitions dating back to the 1980s, including Liebert, Chloride and Knurr.

In July 2015, Emerson Electric announced a plan to spin off the division as an independent $5 billion business, hoping to reverse a decline in revenue.

The name Vertiv was announced in April 2016, but the spin-off became a sale as Platinum Equity announced a deal to buy the division for $4 billion in August 2016.

The whole deal, including the new name, finally completed at the end of 2016. A new CEO was appointed: Rob Johnson (below) who formerly led infrastructure power firm American Power Conversion (APC), which was bought by Schneider Electric for $6.1 billion in 2007.



EQUINIX BUYS VERIZON DATA CENTERS FOR $3.6BN

Mobile operator Verizon is in the process of selling around 60 data centers to colocation provider Equinix.

Verizon, headed by Lowell McAdam (above), bought Terremark in 2011 for $1.4 billion and built up its data center business, adding a cloud service called Verizon Cloud. At the end of 2015, rumors began circulating that the business was up for sale, along with other assets including MCI Communications.

Equinix emerged as the purchaser in late 2016, with an estimated price of $3.5 billion. In January 2017, the company was reported to be raising around $1 billion to finance the deal.

The deal coincided with other telcos divesting themselves of data center real estate, in an apparent realization that running data centers is different to their core business.

GTT TO BUY HIBERNIA NETWORKS FOR $590M

American communications firm GTT is buying Hibernia Networks, a submarine cable operator best known for the Hibernia Express linking the US and Europe via Ireland.

GTT has a network connecting 100 countries with 250 points of presence (PoPs), while Hibernia has a smaller network of 200 PoPs in 25 countries.

Hibernia's transatlantic network was originally built by Tyco, which went bankrupt in 2001.

The 4,600km Hibernia Express cable system, which came online in 2015, is one of a number of new transatlantic cables, and claims the fastest transit time (60ms) between New York and the UK.

Hibernia's CEO since 2004 has been Bjarni Thorvardarson (above).

THE DAILY SHAKE UP

MICROSOFT TO BUY LINKEDIN FOR $26.2 BILLION

In June 2016, Microsoft announced its plan to buy professional networking site LinkedIn for $26.2 billion.

LinkedIn has 433 million users, and runs its own data center network, with sites in the US and Singapore.

Microsoft runs its Azure cloud service on a network of its own data centers, with 32 regions around the world and plans for six more.

Both companies have developed in-house data center IT and rack technologies, and shared them.

Microsoft has shared server specifications, through the Open Compute Project (OCP) and proposed a distributed UPS design. It has also shared Project Olympus - a server design which is partially finished to encourage further customization by partners.

LinkedIn has created its own data center 19" rack design, called Open19, intending to give the benefits of OCP's Open Rack without moving to a 23.5" wide rack. The company has also created its own network devices including a top-of-rack switch called Pigeon.

As the merger nears completion, Microsft has hired a new CTO, Kevin Scott from LinkedIn. Scott will report directly to Microsoft CEO Satya Nadella (above).

ORACLE TO BUY NETSUITE FOR $9.3 BILLION

Oracle bought cloud business software vendor NetSuite for $9.3 billion in November 2016, after NetSuite shareholders voted to dismiss allegations of a conflict of interest involving Oracle founder Larry Ellison (left).

NetSuite was founded in 1998 as NetLedger, and its software was briefly licensed as Oracle Small Business Suite. Its acquisition comes as Oracle is engaged in a bid to expand and develop its cloud services.

NetSuite's small business focus is said to complement Oracle's strength with large enterprises.

The deal faced criticism as Ellison and his family owned around 45 percent of NetSuite stock.

CENTURYLINK TO BUY LEVEL 3 FOR $25BN, AND SELL DATA CENTERS

Communications firm CenturyLink, led by Glen Post (above), is buying network provider Level 3 for $25 billion, it was announced in October 2016.

The deal adds 200,000 miles to CenturyLink's fiber network.

Meanwhile, the firm sold its 59 data centers to investors BC Partners and Medina Capital Advisors for $2.3 billion and merged with cyber security startups.

The investors will set up a new company, to be led by Manuel Medina, one-time leader of Terremark, which was bought and sold by Verizon.

The data center sale was first rumored in late 2015, but finding a buyer was hindered by complicated leases.

SOFTBANK TO BUY ARM FOR £24.3BN

Japan's tech giant SoftBank bought British silicon firm ARM Holdings for £24.3 billion in July 2016.

ARM designs the ARM processor cores which are used by multiple chip makers and dominate the mobile device market, thanks to their low energy requirements.

The energy efficiency benefits of ARM-based chips have been the basis for several attempts to dislodge Intel from its market-leading position in data center server silicon, by vendors including AMD, Cavium and Applied Micro.

The acquisition is seen as a bid for SoftBank to dominate the Internet of Things (IoT) market. It has also been asserted that the sale was partly a result of the decision by the UK to leave the European Union.

ARM CEO Simon Segars (below) won *DCD*'s Business Leader of the Year Award in 2014.

EQUINIX BUYS TELECITY FOR $3.8BN, SELLS EIGHT SITES TO DIGITAL REALTY

Completing a deal begun in 2015, Equinix has sold eight data centers to rival Digital Realty, a move it was ordered to make to receive permission from EU regulators for its $3.8 billion acquisition of European colocation provider Telecity.

The sale to Digital Realty was ordered when the EU ruled that its acquisition of Telecity would give it too dominant a position in the European colocation space.

Equinix, led by Stephen Smith (above), made a pre-emptive bid to buy Telecity in 2015, to prevent a merger between Telecity and fellow European provider Interxion.

Eight data centers were sold to Digital Realty, five of them in London. At the same time, Equinix took over a facility in St Denis Paris, which was owned by Digital Realty and leased to Equinix.

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Dan Robinson
Freelance

The serverless cloud could swallow up hardware

The next step towards utility computing is a serverless model, where users buy functions, and the underlying hardware disappears from view, says *Dan Robinson*

Cloud computing has already had a profound effect on the way data centers are operated, but recent trends in the cloud sector could deliver another shake-up in the form of serverless computing, which promises to move customers a step closer towards utility-based computing.

Serverless computing is actually something of a misnomer, as it most definitely does not do away with servers. Rather, it takes away the need for the consumer of cloud computing to have to deal directly with servers, either in provisioning them or managing them, and instead focus on developing and deploying the business logic to power their own application or service.

This sounds a lot like PaaS, or platform-as-a-service, a long established and well understood cloud service model, but the serverless approach sees applications and services broken down into smaller, more discrete functions. Some serverless proponents have even coined the term functions-as-a-service (FaaS) to describe it.

The current craze for serverless computing can be traced back to Amazon's introduction of the Lambda service into its Amazon Web Services (AWS) cloud portfolio in 2014. Lambda is an event-driven function that enables developers to create code that will run in response to some event or trigger.

However, a key aspect of Lambda is that it automatically manages the compute resources required to run and scale the code with high availability, and customers pay only for the CPU compute time consumed when the code is actually running.

As an example, Lambda could be used to drive a web server, and would consume little or no resources until kicked into life by an incoming request. AWS has published a ▶

reference architecture for just such an implementation on Github, along with a handful of others such as an Internet of Things Backend.

The traditional way of developing and operating a cloud-based service would be to provision enough servers and storage resources to run the code and handle the data, with the customer taking responsibility for provisioning the correct capacity, monitoring performance, and designing for fault tolerance and scalability.

In addition, the resources required to operate such a service typically have to be available continuously, ready to be used at any time, which means that the customer is paying for them regardless of usage, unless they develop their own system to provision resources on demand and release them when not required.

All of this means that building up a cloud-based infrastructure to deliver applications and services can prove to be a more complex and time-consuming task than the cloud providers care to admit, and this is part of the problem that serverless computing seeks to address.

"Serverless computing does make sense as the next level of cloud computing," said Clive Longbottom of analyst firm Quocirca.

"I have commented before on how the likes of AWS and Azure are still reliant on having very clever systems architects in place that can architect the basic underlying resources before any software stack built on top is turned on. A move to a platform where it is more based around desired outcomes means that we start to move to more of a capability to say 'this is what I want to do – please make it happen'," he added.

In other words, serverless computing represents another level of abstraction intended to hide the underlying infrastructure. And, while AWS is perhaps the most visible proponent of this approach, similar services are starting to be offered by other sources such as Google Cloud Functions, Windows Azure Functions or IBM OpenWhisk. One developer, Iron.io, has a serverless application platform called IronFunctions that is open source and can run on public or private clouds, and is compatible with AWS Lambda.

While serverless computing may have some advantages from the customer viewpoint, it could also deliver some benefits to service providers that implement such capabilities. If adoption of serverless computing functions such as AWS Lambda grows, then it could lead to fewer resources being tied up at any given moment in order to operate a customer's cloud-based application, which could allow the service provider to cut back on the amount of spare capacity they need to keep available at all times.

However, to pull off this trick may require more sophisticated data center monitoring and orchestration tools, and predicting demand could become more complex if customers make greater use of functions such as Lambda that are able to automatically scale in order to meet peaks in demand.

Meanwhile, serverless computing does not address one of the major pain points of cloud services for customers, according to Longbottom, which is being able to accurately forecast how much it is going to cost them to operate their applications and services in order to meet required levels of demand with an acceptable quality of service.

"It is really down to the customer to ensure that they understand how pricing could vary with usage, and this is one of the darkest areas with AWS," he said, although the same applies for many other cloud providers.

"Although it publishes its charges very publicly, it is like saying that the cost to drive a car is easy to work out – it is based on miles per gallon, plus the wear of the tyres, which is dependent on the types of road being driven on, and so on. Serverless should hide some of that darkness – but only if the customer can get AWS to be very public in how it will charge, and on a very simple basis," Longbottom added.

This is why enterprise customers prefer to negotiate contracts detailing in advance what capacity they require, and how much they are going to pay for it.

Then there is the old bugbear of vendor lock-in. With serverless computing based on proprietary functions, it may well prove difficult to migrate a service from one cloud provider to another, if a customer needs to do this.

"For those still providing their own code, then orchestration systems may well be able to deal with the vagaries of individual systems at the hardware level. But if a codeless (or code-light) approach is used, the customer is putting more faith in the service provider," commented Longbottom.

"This is probably fine for smaller organizations where systems architects and great coders are often as rare as hen's teeth. Here, the risks of creating a duff system heavily outweigh the risks of being over the barrel with a supplier."

NoOps

Serverless computing is a step beyond DevOps

Serverless development with AWS Lambda

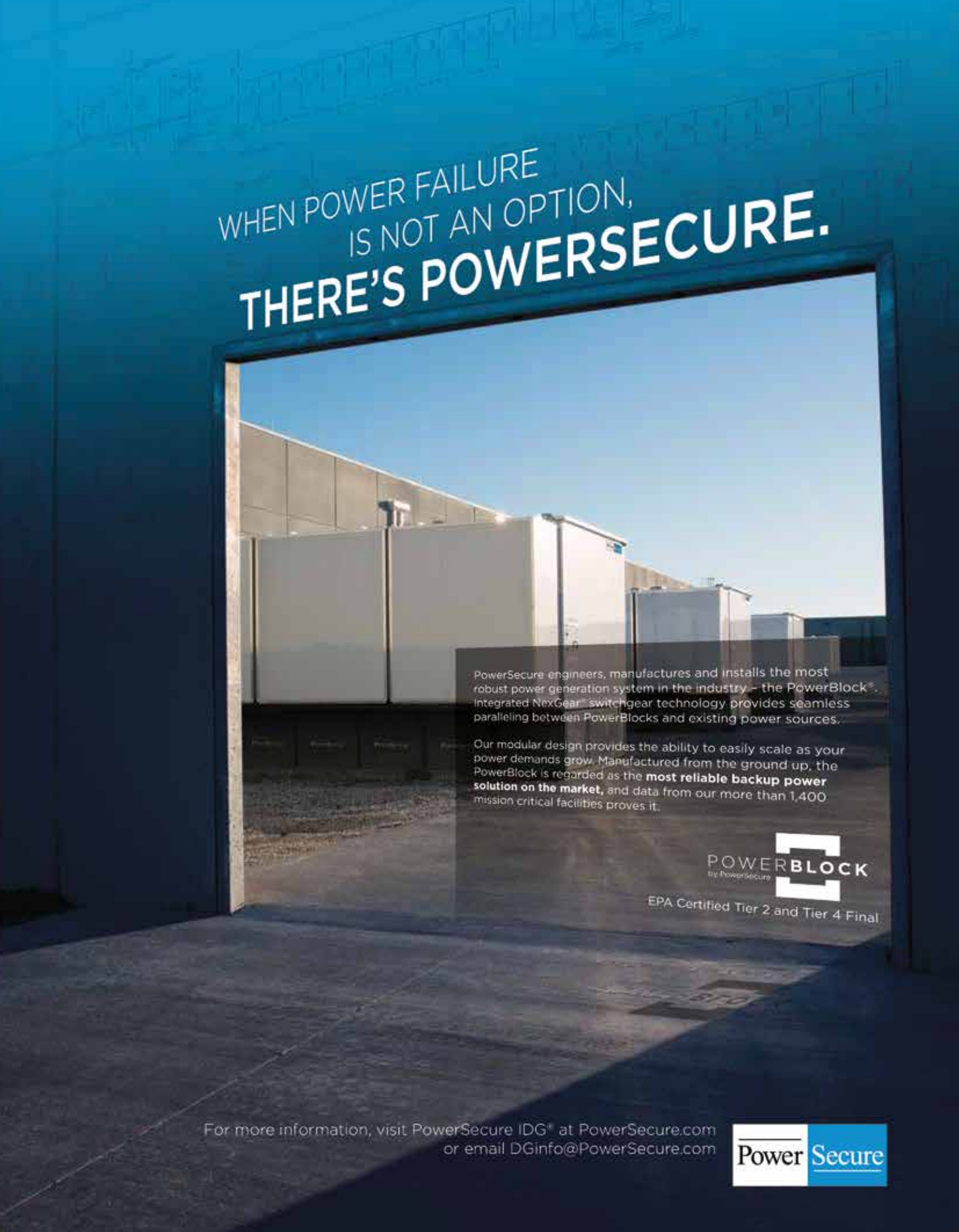
Amazon's Lambda is perhaps the archetypal example of serverless computing. Introduced in 2014, AWS Lambda allows developers to create code that operates as a "Lambda function" that runs in response to some event or trigger.

Other AWS services will often be the source of these events, such as a new object appearing in a particular bucket on Amazon's S3 storage service, an update being made to an Amazon DynamoDB database table, or new data being delivered in an Amazon Kinesis Stream.

Because Lambda functions only run when required, users should pay only for the compute resources consumed while the code is actually running. For this reason, AWS bills customers for usage metered in increments of just 100 milliseconds, rather than on an hourly basis, which is typically the minimum unit of charge for a virtual machine instance.

AWS now has a Serverless Application Model (AWS SAM) for developers to create serverless applications. This is natively supported by AWS CloudFormation and uses simplified syntax for specifying resources.

Developers deploy applications using the AWS Serverless Application Model, defined using a simplified version of a CloudFormation template, and can create code using a number of programming languages, such as Node.js, Python, Java, and C#.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DCD > Enterprise | New York

EVENT PREVIEW

Becoming digital

March 14-15 2017 // **Marriott Marquis**, Times Square

Enterprises have a tough job transforming into fully digital organizations. DCD>Enterprise is here to help them

Cloud-native companies and service providers have it easy. They can be vertically integrated, and they are fundamentally structured around networks, cloud and the Internet. The average broadly-based enterprise can be just as big as these entities, but it has more work to do to fully move into the digital world.

Enterprise IT organizations have to support thousands of applications, and deal with multiple kinds of access by diverse groups including employees, partners and customers. They are aiming for the same sort of tightly integrated, well-planned and flexible services, delivered from efficient facilities. But they have a different kind of job to get there.

That's where DCD>Enterprise comes in. Taking place at the Marriott Marquis, Times Square, New York on March 14th-15th, it will give the US East Coast its annual opportunity to find out how to align business strategy and goals with digital infrastructure services. It will focus on delivering those objectives at the "right scale" - with the right levels of scalability, agility, cost, performance, risk, reliability, resiliency, and sustainability.

It's the latest in DCD's global conference series, and covers the holistic ecosystem of data center infrastructure – from mud to cloud, where mud now includes the ocean floor. It goes from south of the rack physical facilities and mechanical technologies, to north of the rack digital, logical IT infrastructure technologies.

This event brings more focus to strategies to create IT, data center and cloud infrastructure which can support the 21st Century, zettabyte-era digital enterprise.

Here are some important topics:

+ Artificial intelligence and the smart data center

Among those looking into the not too distant future at the conference is Charles-Antoine Beyney, CEO at Etix Everywhere who takes an in-depth look into how data centers are harnessing AI (including facial recognition technology for CCTV, stricter access controls and alarms, and DCIM) to optimize facility performance and increase automation, with the goal of creating unmanned, "lights out" data centers.

Also getting smart will be Intel and Digital Realty, pleasing the crowd by demonstrating the successful adoption of analytic and automated solutions in their data centers to realize energy savings.

+ DevOps continually covered

Attendees at DCD>Enterprise can expect to see examples and case-study models for how enterprise leaders are innovating (and even automating) the planning processes to match DevOps-style apps, leading to rapid develop-and-release digital infrastructure deployment and operations.

Big Discussions include one led by Rick Drescher, Managing Director at Savills Studley, which will explore whether the dynamics of flexibility and agility in the age of this digital-first DevOps framework sit at the same level of strategic design criteria and requirements such as cost, technology feature sets, and operational efficiency. In a world where new application cycles and revenue opportunities are measured in hours and days, is the decision-making process now very different?

Detailing DevOps back-to-basics process insight, Brian Mericle of Choice Hotels will get behind the buzzwords – Build Automation, Continuous Integration, Continuous Delivery and Continuous Deployment to provide practical actions to consider as it relates to the people, processes and technology necessary in your organization to be successful on your journey.

+ Green energy

Opening the conference will be Joe Kava, setting out Google's vision for running its entire fleet of data centers using renewable energy. Joe will also join a panel of other industry luminaries - Dean Nelson (Uber), Christian Belady (Microsoft), and Peter Gross (Bloom Energy) as they examine the broader renewable energy strategies of mega clouds.

All of the above and much, much more, will be delivered using invite-only briefings and Big Discussions, thought-leadership presentations and panel debates, and 15-minute, rapid-fire Solution Stage demonstrations providing plenty to stir grey matter. The extensive networking opportunities complete the set up for DCD>Enterprise to deliver, once again, on its promise as the East Coast's most anticipated cloud and data center infrastructure event. Join Us!

www.**dcd**.events

DCD > Community

> The conference helped me to better understand what other enterprise end users are doing in their data centers and gave me some good ideas on what to focus on into the future when continuing to design, build, and maintain our portfolio of data centers.
>
> *Russell Carpenter*
> ***Verizon Wireless***

Training

Data Center Design Awareness
London, UK
February 27 - March 1 2017

Open Compute Project
Aegis Data Center, London, UK
February 28 2017

Data Center Power Professional
London, UK
March 6-8 2017

Data Center Technician
London, UK
March 9-10 2017

Data Center Cooling Professional
London, UK
March 13-15 2017

Events

> **España** | Madrid
April 5 2017

The congress on digital infrastructure and cloud

Training

Data Center Design Awareness: Madrid, Spain
March 13-15 2017, TBC

Data Center Design Awareness: Lima, Spain
March 27-29 2017, TBC

Events

> **Enterprise** | New York
March 14-15 2017

Infrastructure transformation for the data center-scale enterprise

> **Webscale** | San Francisco
June 20 2017

The global summit for webscale infrastructure builders

Events

> **Argentina** | Buenos Aires
April 25 2017

The congress on digital infrastructure and cloud

Training

Data Center Design Awareness: Quito, Ecuador
February 20-22 2017, TBC

> It was a wonderful experience learning about emerging data center technologies. A very well organized conference with an excellent agenda. It's a must attend event for anyone working in information technology.
>
> *Surendra Yadav*
> ***Salesforce***

> Excellent technical and trending insights to the high-tech market segment.
>
> *Jerry Hutchison*
> ***PG&E***

Events

> **Indonesia** | Jakarta
> April 6 2017
>
> IT transformation and hybrid architecture

> **Focus On** | Hyderabad
> April 27 2017
>
> The future of India's digital infrastructure

Training

Data Center Design Awareness: Bangkok, Thailand
February 20-22 2017, TBC

Data Center Design Awareness: Tokyo, Japan
February 20-22 2017 at Hikarie Conference C

Event Highlight

> **Energy Smart Summit** | Amsterdam
> June 13 2017

The Summit will gather business, operations and technology executives in one of Europe's most energy aware capitals to discuss how operators can become "energy smart." Open source, AI, better UPS, smart grid integration and green power resources will drive the industry towards the energy smart data center.

GreenIT Amsterdam, The Uptime Institute, The Green Grid, Open Compute and many others will meet with policymakers, regulators and utility executives under one roof.

The event will raise questions including:

- How will data centers feed off the energy networks?
- Can edge strategies work with future energy grids?
- How can we secure critical infrastructure in the age of IoT?

For more details, head to www.DCD.events or contact Merima Dzanic at: merima.dzanic@datacenterdynamics.com

> This Summit will shed light on this very urgent topic and move towards a sustainable solution to the energy problem.
>
> ***George Rockett, CEO & Co-Founder of DCD***

Mother nature still kicks our ass

Data center owners are obsessed with reliability and go to great lengths to ensure uninterruptible operation. They deploy spare generators, store thousands of liters of fuel and install redundant cooling systems that waste away most of their life just waiting for disaster to strike. There are additional networks that will kick in if the primary connection fails, and offsite locations to store backup data. But data center owners can't do a single thing about squirrels.

Every year, squirrels, and other small animals, carry out hundreds of attacks against the electrical grid. They chew through cables, climb into transformer boxes and store their nuts in the power distribution panel. Some cyber security professionals joke about rodents as the ultimate adversaries, responsible for more damage than any nation state.

'Cyber Squirrel 1' – a website created by Cris 'Space Rogue' Thomas – has been tracking the number of power outages attributable to these little critters. Since the project began in 2013, Thomas managed to collect data on 879 faults caused by squirrels, 434 outages triggered by birds and 83 instances of snake electrocution.

In frequency of attacks, snakes were followed by raccoons, rats, martens and beavers. Jellyfish were implicated in 12 outages – although they mostly attack the water supply of power plants, not the grid itself.

Thomas created the website as a response to the doomsday preachers of the security world, who have long warned about cyber attacks against national critical infrastructure. We've all heard about Stuxnet and power outages in Ukraine in 2015, the work of Russian hackers, right?

It turns out that since 2013, there were just three attacks against physical infrastructure that could be directly attributed to human actors. Meanwhile animals were responsible for several thousand such attacks.

The project teaches us to trust evidence, and not give into the hype. It also serves as a reminder that, while working at the cutting edge of technology, we are still very much at the mercy of nature.

Max Smolaks
News Editor

> *"Frankly the number one threat experienced to date by the US electrical grid is squirrels"*
>
> *John Inglis, Former Deputy Director of NSA*

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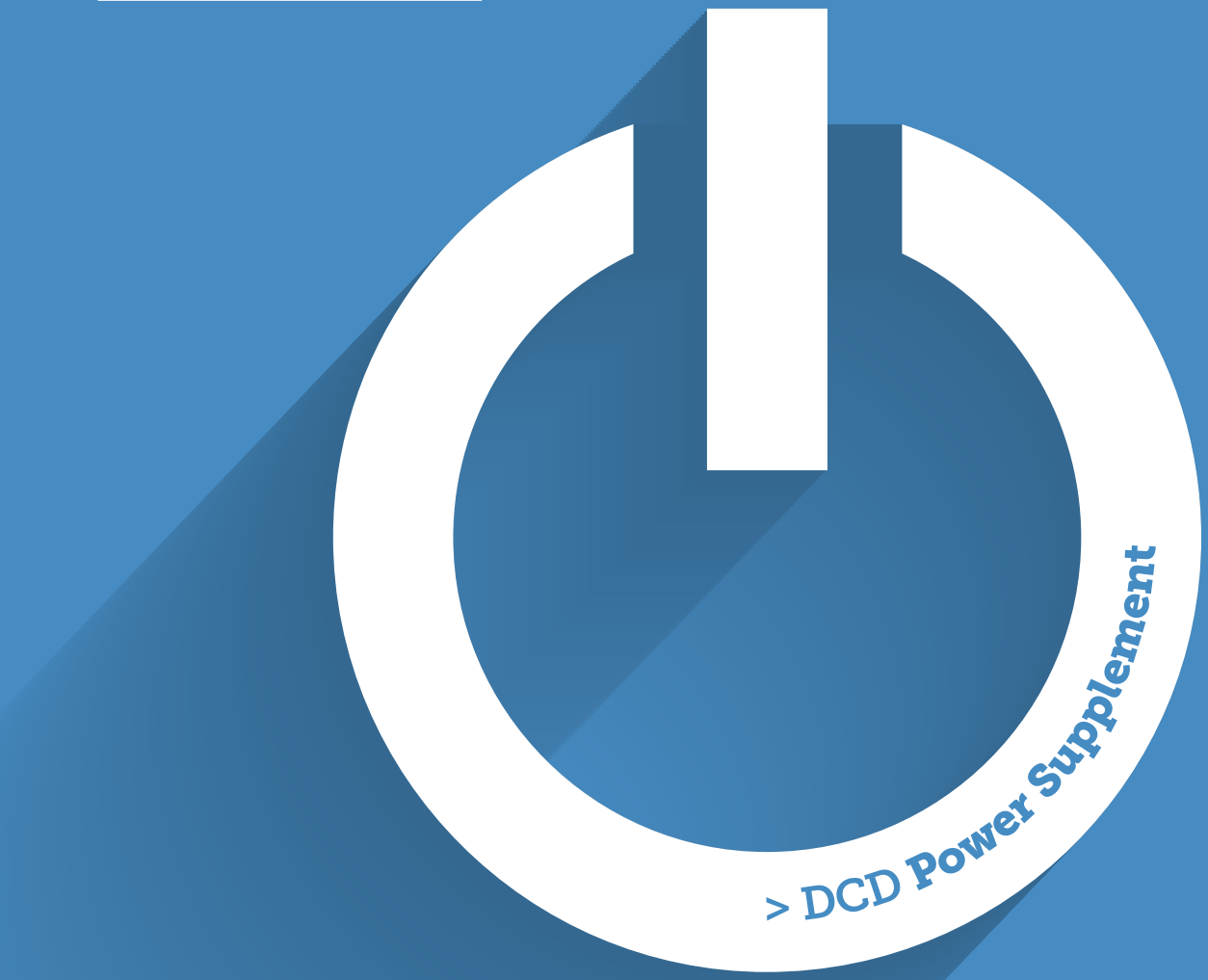

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INSIDE

Why lithium-ion batteries are coming to your facility

> Lead acid has had a long reign, but Li-ion saves space and energy. It could be time to switch

No one dethrones the PDU

> DC power distribution is great in certain circumstances, but the vast majority of data centers still need PDUs to power the racks

Carborundum may grind out eco-mode UPS

> If silicon carbide can reduce the losses in high frequency power silicon, The UPS may change

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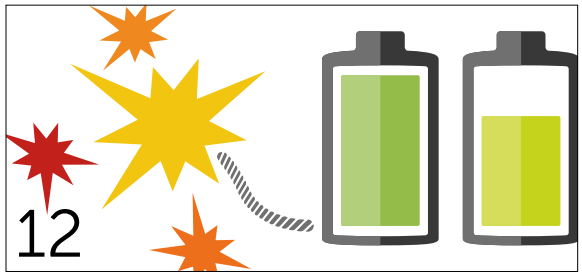
Contents



It's all about the chemistry

You may be thinking that the basic science for power distribution is all done and dusted. If you do think that, you would be wrong. It seems like all the leading edge research that will impact on data center power systems is being carried out by people in white coats, using steaming test tubes.

In other words, it's all about the chemistry.

Lithium-ion batteries could revolutionize data center uninterruptible power systems (UPS). They're lighter, longer-lasting and more efficient. Vertiv makes a cogent case for a rapid switch to the new technology (p8). So why isn't it happening immediately?

Part of the reason must be the steady stream of stories about exploding batteries in various consumer devices, like Samsung's Galaxy Note 7.

Of course, the comparison isn't a fair one, it just affects perceptions, and data center people can be very conservative.

In fact, the Lithium-ion industry is expanding rapidly, tracking the growth of the electric car sector. Reliable Li-ion batteries are now available, so this switch is only a matter of time (p12).

Silicon carbide or carborundum is normally used as an abrasive. Professor Ian Bitterlin (p14) believes it could also smooth the transition of UPS systems between the grid and battery power.

The benefit is that silicon carbide (SiC), used instead of plain silicon, can allow currents to be switched quickly with a much lower loss than silicon.

Fast switching is essential in a UPS, and low power loss is an ideal to aim for. So silicon carbide could be an answer to our prayers.

Gallium arsenide (GaN) was once seen as a competitor with silicon carbide in the race to replace silicon in power chips. SiC reached the market first, but the GaN proponents say there's a niche for for their alternative. GaN promises more efficient power conversion, and could allow data center efficiencies to continue improving beyond the end of Moore's Law (p10).

As with many new developments, the field is currently going to early developers. You can't buy this yet, but in not too many years, you may well want to.

PDUs have little to do with chemistry. They distribute power within data center racks, and have done so for some time.

When bodies like the Open Compute Project (OCP) suggest we can shift to DC power distribution (p4), without a PDU, we sit up and take notice. Could data centers all get on board the OCP's bus bar?

We asked the the industry, and it seems that so far the vendors selling PDUs are not exactly quaking in their boots.

The bus bar can really improve efficiency in the right kind of data center - large monolithic web scale facilities. But so far these facilities make up a small proportion of all data centers.

Peter Judge
DCD Global Editor

No one dethrones the PDU

Despite proposals for DC power distribution, the PDU industry sees a healthy future, *Peter Judge* reports

Peter Judge
Global Editor

The Open Compute Project (OCP) was supposed to spell doomsday for power distribution units (PDUs). The Facebook-backed project proposed a DC power distribution system with no PDU in the rack. But the power industry, it seems, is not concerned.

Facebook started the OCP in 2011, planning to spread the use of no-frills customized data center hardware beyond its own webscale facilities to the enterprise.

Large users like Facebook and Google with giant monolithic data centers can afford to have hardware built to their own specifications, dismissing "vanity" features such as badges and cases and using other short cuts.

Through OCP, Facebook shared this approach, and its hardware specifications, as open source, so any organization can use them, including general purpose data centers, run by enterprises and outsourcers.

Ideas within OCP included server designs and switches, but its attack on the fundamentals of data center building created a stir.

Among OCP's flagship ideas is the Open Rack, a wider than

Eaton built an Iron Throne of PDUs

usual 23-inch rack that distributes DC power through a live "bus bar" at the back. This would have no traditional PDU. Other ideas followed, including a normal-sized Open19 19-inch rack from LinkedIn, also powered from a bus bar.

It's immediately obvious that the DC bus bar in the Open Rack and Open19 specifications replaces the power distribution unit or PDU, which delivers AC power through metered outlets in the rack. If OCP took over, said some commentators, it spelled the end of the PDU.

PDU vendors take a more long-term view than that. First of all, the attention given to OCP is out of proportion to its actual market size.

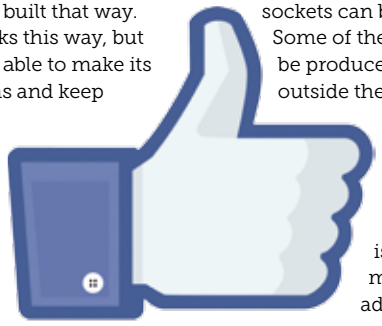
Even if bus bars take off, this is just another step in the evolution of the industry, said Gordon Hutchison, vice president of international operations at Geist: "The OCP approach is relatively new, and may not be embraced by the entire industry. It still requires power distribution, it just changes the nature of it."

In fact, OCP has actually solicited and shared power distribution devices, according to Hutchison's colleague Brad Wilson, president of Geist Global: "These were PDUs in every sense of the word. They have a normal PDU form factor, but just didn't use the connectors we are used to seeing. They had a mix of AC and DC."

<5%
best guess at bus bar market share

Those systems are designed to be easier to customize, and predate the Open Rack with its bus bar, which Wilson says is more of a "radical departure." DC power is distributed directly to servers and other equipment in the rack.

This is more efficient for large homogeneous installations, where every item in the rack is made specially for a customer like Facebook or Google, but very few organizations are built that way. Amazon also works this way, but is bigger still, and able to make its own specifications and keep them hidden.



The people going with Open Rack are the giants who are webscale to an absurd degree - and they still make up a very small proportion of the total racks in the world, vendors told *DCD*. In enterprise data centers, or even cloud providers, the equipment is heterogeneous, and much of it has to be bought off the shelf.

"Not all customers are made alike," said Henry Hsu, vice president of product management at Raritan. "Today, very few of them have the kind of homogeneous data center, made up of standard compute and storage units, that can make use of architectures like Open Rack."

It's tough to estimate, and no vendors could provide a figure, but it seems only a tiny minority, a few percent at most, use bus bars.

Plenty of customers have kicked the tires of the concept, coming along to conferences, or even commissioning bus bar based installations. But in the enterprise these are more or less test rigs.

They have a power shelf to convert between AC and DC, and the customer probably ends up with only one or two cabinets.

In these situations, AC power distribution is cheaper because of the economy of scale. A bus bar in itself is a solid piece of metal, and it is expensive to retool individual equipment to work with it.

Ironically, while the power connectors in conventional power distribution systems are totally standard, the connectors for the bus bar can turn out to be available from a small number of vendors, say PDU players. "As OCP has rolled on, a lot of proprietariness has crept in," one vendor commented.

Even where the connectors are standard, the fact that they are not so widely used as normal power sockets can be a drawback.

Some of these designs may be produced by people from outside the PDU industry. They can be radically different, but might fall down on issues including manufacturability, adding costs and potential incompatibilities, vendors warned. If they don't work first time, there can be fingerpointing by the different vendors involved.

Conventional PDUs have standards from ANSI, IEC and ISO, which are created by people literally spending 15 years around a table agreeing on them. The downside is that 15 year delay, but the upside is the standards are completely solid.

By contrast, OCP and Open19 are "structured more like Wikipedia," PDU vendors said. They can be modified and evolved, and aren't locked down. This gives flexibility, but can be risky, unless you are a giant player. ▶

What is a bus bar connector?

The OCP (Open Compute Project) specifies 12V bus bars to distribute power up the back of a rack from a power shelf to the so-called Innovation Zone where IT components reside. The specification has gone through two versions, v1 and v2.

The Open Rack v1 design includes connectors from Methode, but the specification says that equipment makers are free to deviate from the exact connectors specified in that design, and use a different clip or method to attach to the bus bar. The responsibility to ensure that the equipment always mates with the bus bar and the rack rests with the designer.

A number of suppliers provide these connectors, including Methode and TE Connectivity. Connectors are hot-swappable and plug-and-play, taking the power from any part of the bus bar to cables leading to the components. Typical products handle currents up to 120A, and consist of open-sided single-pole connectors with typical nickel, silver or gold surface plate, mounted in pairs to provide current loop connection.

It's notable that cloud player Microsoft has also offered hardware through the Open Compute Project, but its Orion project uses AC power, not a bus bar, and has a PDU-like structure. And even this will take a significant investment. Microsoft will be approaching white-label equipment makers, and asking them to meet a specification, but this is not simple.

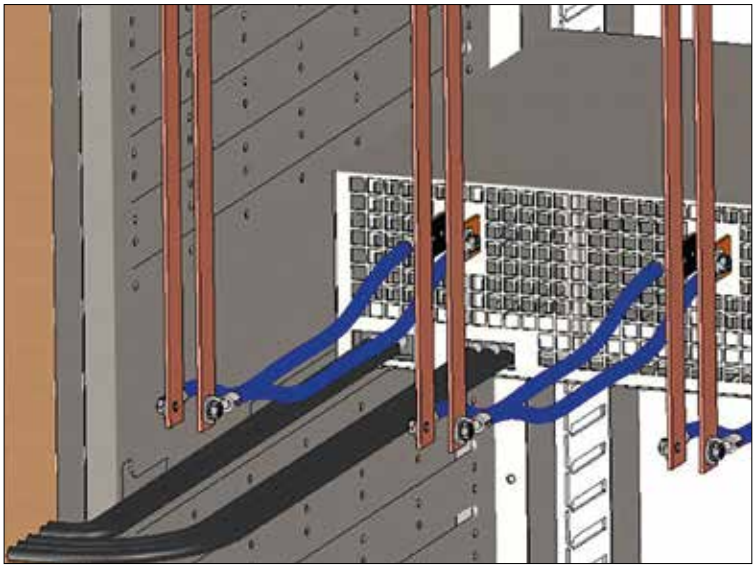
This is an interesting concept, and Wilson sees the industry moving to a world where "the cabinet is the new blade server."

Servers in 1U or 2U of space share power and network, much like vertically mounted servers in the proprietary blade server systems which emerged in the 1990s. A scheme like that would require a new standard for power distribution.

A couple of years back, IHS analyst Sarah McElroy said it clearly: "The Open Compute Project is something that is peripheral to the rack PDU industry that may prompt more customers to request some level of customization in PDU products which will in turn motivate suppliers to offer more customization."

It's possible that as data center applications consolidate, and technology becomes more standardized and commoditized, more of the world's data centers will evolve into the kind of monocultures which can be built with OCP hardware throughout.

But Wilson says that no matter the level of excitement around OCP hardware, it's actually a long way from any sort of take over: "That would be a very very long slow bandwagon for everyone to jump on."



The bus bars in OCP's Open Rack v1

Peter's random factoid

The data center PDU market is predicted to grow by 6.8 percent per year till 2021 (Research & Markets)

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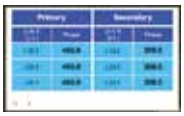

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Changing of the Guard: Making the Case for Lithium-Ion Batteries

They're smaller, they're lighter, they last longer... and they're already powering a data center near you. Is it time to switch? By Peter Panfil, Vice President of Global Power, Vertiv

There was a time, not that long ago, when entire buildings were filled with computers performing the types of functions now handled routinely by the phones we hold in the palms of our hand. Technology isn't just becoming more powerful; it's smaller, lighter and, most significantly, it's mobile. We're always connected, part of a real-time global conversation that never stops. The airplane may have shrunk the world, but the smart phone made it pocket-sized.

Powering it all is the lithium-ion battery. Before lithium-ion technologies became viable, energy storage for phones, laptops and tablets was a significant problem. There were crippling limits to just how small these devices could be and how long they could function between charges. Lithium-ion batteries changed everything, providing compact, light, long-lasting energy storage and transforming modern consumer electronics from moderately functional to virtually irreplaceable.

Even as lithium-ion applications became the dominant choice for consumer electronics and increasingly moved into aircraft, automobiles and countless other walks of life, the data center remained the refuge of valve-regulated lead acid (VRLA) batteries. And why not? Data center UPS systems rely on batteries for transitional power. They need to be reliable, and they need to provide just enough power to bridge the gap between utility and generator. VRLA still gets the job done, and is a perfectly fine choice for some data centers.

But there are reasons VRLA batteries are universally regarded as the weak link in the data center power chain. They're big, heavy, they don't hold a charge long, and they need to be monitored regularly and replaced often. The enduring benefit of VRLA batteries is cost, but that gap is shrinking. Today's lithium-ion batteries are about 1.75 times the price of VRLA, on average. That's down significantly in recent years, and there's even a compelling financial case for lithium-ion when you look at total cost of ownership.

Consider this: Lithium-ion batteries store more energy in a smaller space, reducing the battery footprint. They last significantly longer, delaying replacement and reducing replacement costs over time. Most lithium-ion batteries can tolerate higher operating temperatures, reducing cooling requirements and costs. And lithium-ion batteries require less maintenance than traditional VRLA batteries. These are significant and important advantages. Let's take a closer look.

- **Reduced footprint:** Depending on construction and cabinets, lithium-ion batteries can be as much as 70 percent smaller and 60 percent lighter than VRLA, significantly reducing the space required for battery storage. That can reduce construction costs on new builds or increase the amount of usable space in existing facilities. In some cases, lithium-ion batteries can be stored in the row, reducing cable runs.

- **Longer life:** Lithium-ion batteries can last as much as four times as long as VRLA and routinely last two-to-three times as long. Why does that matter? The most significant cost associated with batteries is replacement. In most cases, VRLA batteries would need to be replaced multiple times before the first replacement of a lithium-ion battery.

- **Reduced cooling costs:** There are a number of variables that influence the cooling required for batteries and the associated costs, but most lithium-ion batteries can operate at higher ambient temperatures than VRLA. In some cases, it can reduce battery cooling costs by as much as 70 percent.

The cautious adoption of lithium-ion batteries in the data center isn't surprising. The industry by nature is conservative when it comes to technology change, and echoes of airline and consumer headlines taint any potential discussion of lithium-ion. But the lithium-ion batteries being applied in data centers are a different chemistry – one more akin to that used in the automotive industry – and eminently safe.

Also, VRLA batteries have been a mostly reliable option, and data center managers who stake their careers on reliability and uptime tend to stick with what they know. The problem is, "mostly reliable" isn't exactly accurate and isn't remotely good enough. Understand: A 2013 study from the Ponemon Institute, commissioned by Vertiv, found UPS and battery failure was the leading cause of data center downtime. At some point, the weak link has to be replaced.

As lithium-ion batteries evolve and become more and more viable as an option in the data center, it's becoming increasingly difficult for data center managers to accept the shortcomings of VRLA. New chemistries and construction practices have improved battery safety, reduced capital costs and rendered some of the arguments against lithium-ion obsolete.

Bottom line: Today's lithium-ion batteries are safe, reliable alternatives to VRLA with a compelling TCO case.

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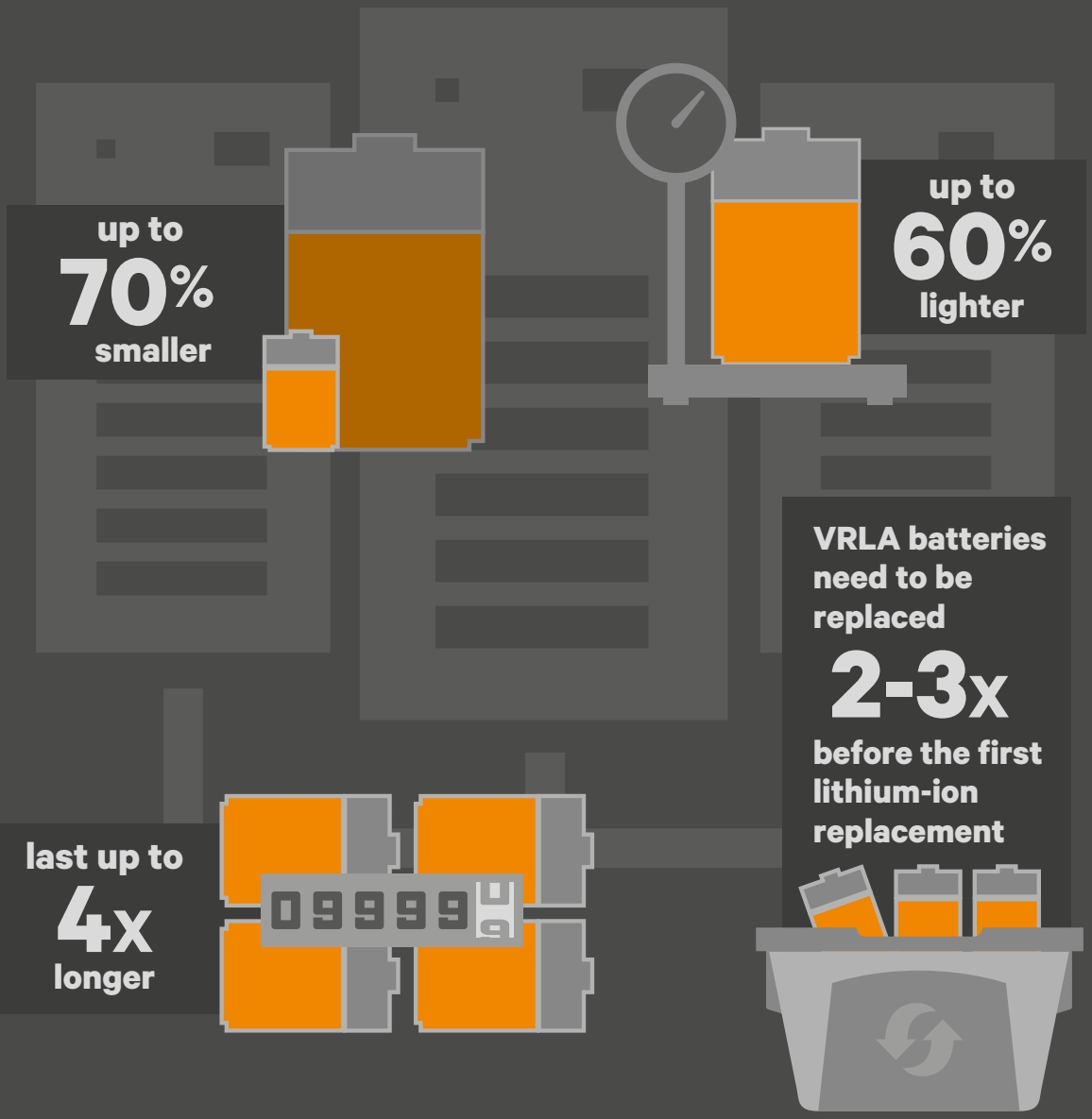
Lithium-ion batteries are

[compared to valve-regulated lead acid (VRLA) batteries]



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Power chips, but not as we know them...

Max Smolaks welcomes a new material which will replace silicon in the power chain

Max Smolaks
News Editor

For the past 35 years, most power supplies have relied on power MOSFETs (metal oxide semiconductor field effect transistors) – voltage-controlled devices made of silicon that are used to switch and condition electricity.

These little black squares have done a great job, scaling their performance with Moore's Law and making their way into all sorts of data center equipment, from PSUs to routers, switches and servers.

But the entire power MOSFET family is about to become history, killed off by a class of devices that will be smaller, more efficient and cheaper too – at least in the long run. Enter gallium nitride (GaN), the wonderful semiconductor that is going to cut your electricity bills.

Thanks to a precedent set by Alexander Graham Bell, intermediate voltage comes into a data center at 48V and must go through multiple stages of power conversion before it reaches components on the board, losing a portion of its useful energy at every stage.

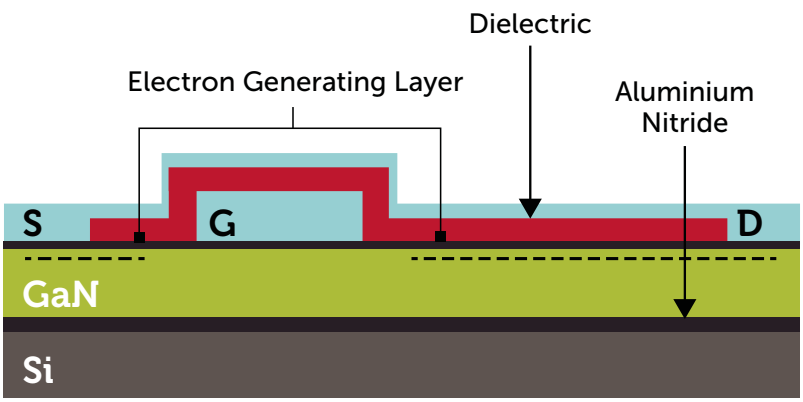
"Silicon wasn't fast enough to get from 48V all the way to 1V," Dr. Alex Lidow, chief executive of Efficient Power Systems (EPC) and one of the inventors of the original power MOSFET told *DCD*.

"So what we [as an industry] did was create a whole bunch of very expensive power supplies that get you from 48V to 12V, and another set of power supplies that get you from 12V to 1V. And with gallium nitride, since it's so damn fast, you can get rid of that whole intermediate bus and go directly from 48V to 1V."

In 1999, Lidow became the chief executive of International Rectifier – the world's oldest independent power semiconductor company, established by his father Leon. In 2014 International Rectifier was sold to Infineon for $3 billion, liberating Lidow to focus on his other venture, built on the belief that gallium nitride would change the world of electronics.

EPC has been manufacturing GaN chips since 2000 but the initial production costs were prohibitively high. Early applications included LIDAR lasers, wireless power transmitters and the 'colonoscopy pill' - the first ingestible imaging capsule that uses low-dose X-rays for cancer screening. As the costs went down, EPC turned its attention to data centers.

Fig.1. EPC's GaN power MOSFET structure employs an AlN isolation layer between the silicon substrate and the GaN (below)



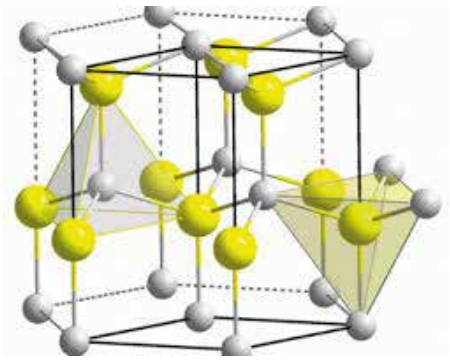


Fig.2. Gallium nitride has a Wurtzite crystal structure, and a wide band gap of 3.4eV, useful in high frequency devices

"Now it's becoming a significant market for us. It has taken many years to convince data center people that GaN is reliable enough – and to get our costs down to the point where it's cost-effective for them to take the plunge," Lidow said. "Maybe even more telling, Texas Instruments uses our product inside their products for data centers."

48V power distribution throughout the rack is a hot topic, being investigated by major data center operators like Google, Facebook, AWS and Microsoft. Lidow told us most hyperscale companies are already testing GaN chips in their equipment - without naming any names.

According to EPC, transmission and power distribution losses mean that today, keeping a 580W machine switched on actually requires 860W of power to be produced. With GaN chips implemented every step of the way, we would need just 770W at the source.

It is not just power efficiency: GaN chips are also much smaller than their silicon counterparts, and produce less heat. Traditional power distribution components, together with the attendant heat sinks and fans, occupy valuable space on a server board that would be better spent accommodating additional CPU cores or RAM modules.

"It used to be that the server was like a mouth, ears and a brain – a lot came in through the ears, went out the mouth, but the brain didn't have to do very much. Now with artificial intelligence and cloud computing the brain is really cranking, and there's not that much more coming in through the ears or going out the mouth," Lidow said.

"What this means is a server has to communicate internally a whole lot more, and that puts a different metric on performance: there's a big push to condense the boards and pack the servers much tighter, so that you can get this thinking process going. That is limited by the heat and power density of these systems, so you need more efficient power conversion – that's one of your largest sources of heat."

The manufacturing process for GaN chips involves growing a thin layer of gallium nitride on a standard piece of silicon, but the chips themselves are much smaller, therefore you get more chips for every manufacturing batch. During manufacturing, GaN is encapsulated in silicon, so it doesn't require packaging - or additional protection.

"Moore's Law kinda ran out of gas in power distribution before it ran out in digital," Lidow said. "But with gallium nitride, our first chips were five to ten times better than the theoretical performance of silicon. We've been doubling that performance every few years, and we're about to double it again."

And there's still room for growth: "Even with all that doubling in performance, we are still going to be around 300x away from theoretical performance of GaN."

Next up for GaN chips, it's the long slog up the supply chain. Texas Instruments uses EPC's chips in products like the LMG52000 half bridge power stage, which are sold on to firms making power supplies, which are built into servers, storage and networking equipment. Hyperscalers could fast-track this, by adding components to their own hardware built to exact specifications.

A 580W system needs 860W of raw power. GaN could cut this to 770W

Another company using gallium nitride for power distribution is GaN Systems, established in 2008 to capitalize on research carried out by now-defunct Nortel.

"The entire industry recognizes that GaN is the future, it's much better than silicon, it's not an 'if', it's a 'when,'" Paul Wiener, VP for Strategic Marketing at GaN Systems told *DCD*.

Wiener thinks that 'when' can be brought much sooner if C-level executives at giant data center customers like Google, Facebook, Amazon and Microsoft shift their focus.

"The incremental purchase price is drowned out by the savings in opex and additional revenue," he said. "Servers generate revenue - bits per dollar. The more data that those servers can process, and more servers can be put into a rack, the more revenue that rack generates."

According to calculations published by GaN Systems, switching to gallium nitride can increase server space capacity by 14 percent. And that alone, without taking higher efficiency of chips into account, can boost the 'incremental revenue potential per rack' over three years by $31,686 - with one-time capital investment already subtracted.

Early adopters can buy equipment powered by GaN chips from a number of lesser known vendors: they will see considerable efficiency gains, but at a higher initial cost. GaN Systems expects its own chips will reach price parity with silicon-based power MOSFETs in 2019 or 2020 - making the latter all but obsolete.

Chasing lithium nirvana

Lithium-ion batteries could save money in data center backup, says *Sebastian Moss.* The trouble is, they have to live down the exploding Galaxy Note 7

Sebastian Moss
Reporter

The coming lithium-ion UPS revolution has been prophesied for some time, with lead acid batteries long seen as a technology of the past. On paper, it's easy to see why people have thought this - Li-ion is lighter, it's smaller, and it lasts longer. Surely, it is the superior technology, one might think.

And yet, here we are in 2017 and the only viable competitor to valve-regulated lead acid (VRLA) seems to be the flywheel. Why is this?

One of the major problems some have had with Li-ion is its tendency to explode. "Just like with terrorists, there are too many bad stories of Li-ion in the news, people are intimidated," Schneider Electric's Simon Zhang told *DCD*.

"People see explosions everywhere, from hoverboards, to Boeing, to cellphones."

Perhaps most prevalent on the public's mind is what happened with Samsung's Galaxy Note 7, which had to be recalled after units kept catching fire.

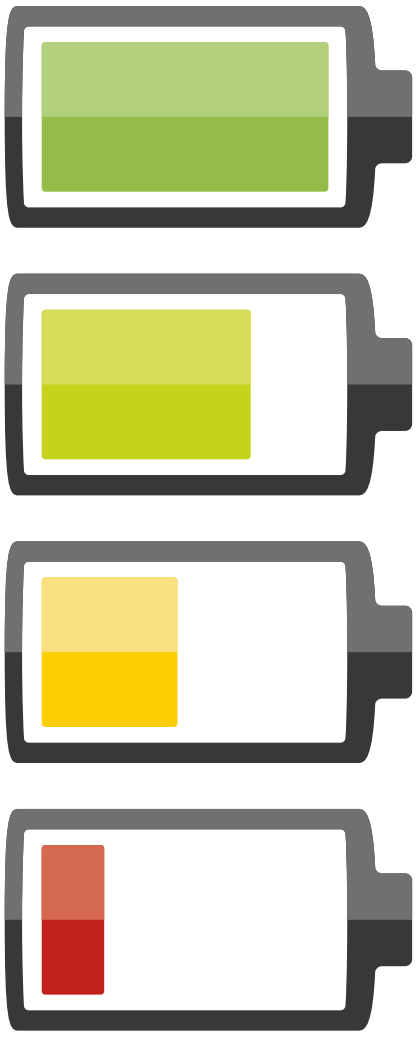
"For this reason people are cautious, especially for mission critical facility operators and managers. They're a very cautious, very conservative group of people," Zhang said.

"They don't want to risk their facility with this relatively new technology, even though it's been there for 30 years."

Peter Stevenson, senior technical coordinator at GS Yuasa Battery agreed: "If you lose a data center, the costs are so much more than anything you're going to save on fitting a different battery, so I can see why the reticence is there."

Indeed, the idea of filling one's data center with a host of giant Galaxy Note 7s could seem rather off-putting, but "that's why it's mandatory to have a battery management system (BMS)," Zhang said. "If anything goes wrong, or there are any safety concerns, it will shut off the battery, take that string of batteries offline."

This safety feature differentiates it from the exploding device in your pocket: "Because we have the BMS, we have the whole visibility of the battery's performance. You can see the remaining capacity of the batteries, when it needs to be replaced, etc. All this information will become really valuable."



It also differentiates it from lead acid, Stevenson added: "With lead acid, really the only way to know that it's going to work and perform as necessary is to actually do a discharge on it - it's a bit like Schrödinger's cat. But if you do that every week, then it's not going to last so long.

"Li-ion will soak up a cycle a day for ten years quite happily, so you can see how things are changing day by day, so really

Li-ion is the ultimate security battery," said Zhang.

Unfortunately, if done poorly, a BMS can bring its own risks, particularly due to incompatibility, said Zhang: "I heard that the Boeing incident was caused by the battery vendor and the BMS vendor being different."

This difference between vendors is an issue still plaguing the nascent industry, Zhang continued: "At this stage it's a pretty fragmented market, the batteries are not standardized, even the voltages are different, the chemistry, the form factor, technical specifications, everything is different."

"That's why you see so many incidents, all due to the fact that the safety standards are different from manufacturer to manufacturer."

Stevenson concurred, adding that "there are many alternatives, but they all use the same principle of shuttling lithium-ions backwards and forwards."

There's a mass of different materials that can be used, and they're developing all the time, and they have some quite different characteristics which make them suitable for different applications. If you only make one type you tend to push that for everything."

There is a debate in the industry over which type of Li-ion battery is best for which scenario, but Zhang is hopeful that the sector will organize itself: "Let the free market help us to filter through and consolidate to two or three vendors."

But if you do trust your vendor and the solution that they offer, it is clear that Li-ion does bring some genuine benefits to the data center. "The general rule of thumb is that we save two thirds of the footprint and weight," Zhang said.

The battery lasts longer, too, on average chugging along for 10-15 years, rather than three to six years for lead acid systems. "Another good thing is that it doesn't collapse like lead acid. With lead acid, towards the end of life, you can get some sudden failures," Stevenson said. "With Li-ion you get a gradual deterioration that can be measured quite simply."

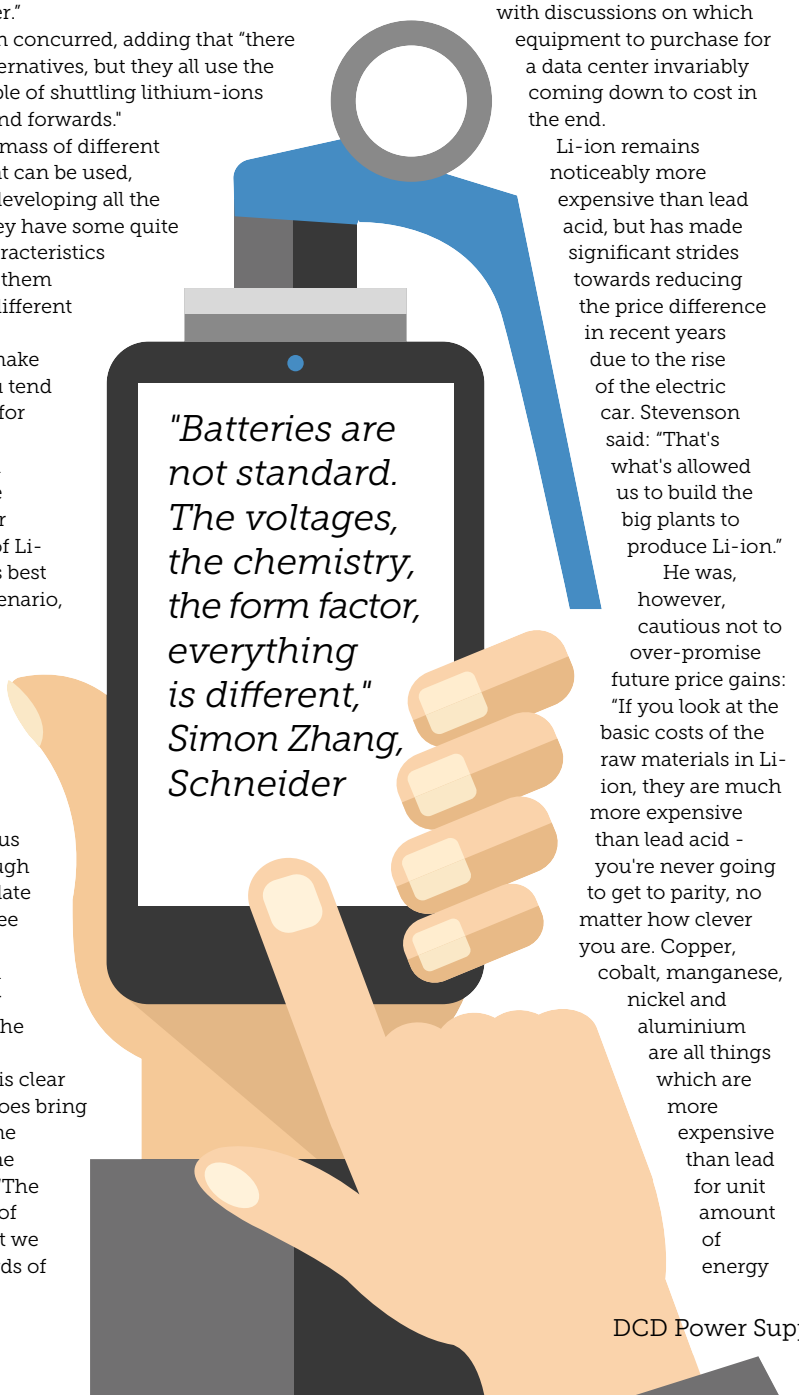
Li-ion can also bring cost savings as it can run efficiently at higher temperatures. While VRLAs perform optimally at 20 degrees, Li-ion can operate in temperatures closer to that of an average ambient environment.

"So you've got big savings on HVAC systems," Stevenson said.

Savings are important, with discussions on which equipment to purchase for a data center invariably coming down to cost in the end.

Li-ion remains noticeably more expensive than lead acid, but has made significant strides towards reducing the price difference in recent years due to the rise of the electric car. Stevenson said: "That's what's allowed us to build the big plants to produce Li-ion."

He was, however, cautious not to over-promise future price gains: "If you look at the basic costs of the raw materials in Li-ion, they are much more expensive than lead acid - you're never going to get to parity, no matter how clever you are. Copper, cobalt, manganese, nickel and aluminium are all things which are more expensive than lead for unit amount of energy stored."



But people should not look at just the ticket price of the battery, both Stevenson and Zhang agreed. Data center operators should look at the long term savings that a Li-ion battery can offer. Unfortunately, as of yet, few make this comparison.

"You can make a lower Total Cost of Ownership (TCO) case, but they still buy on capex, or up-front cost," Zhang said. "If it's two times the cost, it's hard to justify, because normally the buyer is different from the people who run the facility."

Stevenson said that "some of the telecoms companies have actually put their money where their mouth is and looked at 15 year whole life costs, but very few people are willing to look more than four or five years. They want the payback in that time."

Time is what will prove the true arbiter on whether Li-ion will manage to make a mark in the data center, as operators wait to see how the market unfolds, each hoping for someone else to take the plunge and test out Li-ion at a large scale. If that happens successfully without facing any dramatic issues, it could pave the way for much wider adoption.

"We've been trying to get the message across, but so far I don't think it's been swallowed," Stevenson said. "It needs one or two of these data centers to go big time, and people will understand it and see the benefits."

"It's on a cusp," he continued. "We could be on that cusp for many years, or it could change very quickly. It really depends on if people can be convinced."

Zhang said: "Education is the first thing we need to do. We see some early adopters, we've got a few. If they install them, that will help convince later adopters that this is a safe technology to use." He added optimistically: "We feel like we're at the turning point of switching to this new technology."

But for those hoping for a rapid transition of power storage, Stevenson offered a sobering anecdote.

His company had recently been chosen to supply Li-ion batteries for the International Space Station - a hugely valuable contract - but getting the world's space agencies to feel comfortable putting a device sometimes associated with explosions on man's single most expensive construction in history was no easy task.

"We've been putting Li-ion into space for 20 years, but they certainly didn't put them in the manned space stations until just recently," he said. "It's taken that long for people to change for manned space flight, and you work up to it through less critical situations first.

"You can't force things, you have to wait for people to make up their mind."

Carborundum may grind out eco-mode UPS

Illustration: studionippoldt.com

Eco-mode saves power but increases the risks associated with a UPS. *Ian Bitterlin* says silicon carbide could give the best of both worlds

Power losses in static UPSs have gradually decreased over the past 20 years. Early thyristor based on-line systems (referred to as double-conversion or IEC 'VFI') with transformers at the input and output had full-load operating efficiency of 83-85 percent. Now to transistor (IGBT) based line-interactive (VI) transformer-less machines achieve 97.5-98 percent.

Energy efficiency has increased by 15 percent while cooling demands have fallen. Reliability has increased, with a module MTBF rising from less than 25,000h to more than 150,000h. Output voltage waveform distortion has gone down from five percent to one percent. Noise is down from 95dBA to 70dBA, and the physical footprint is down by a staggering 90 percent.

Even double-conversion (VFI) has reached 96.8 percent efficiency, and the cost per kW capacity has fallen to its lowest level ever.

This is good for the purchaser, but the only way to make a profit from UPS is to provide after-sales-services. By 2008, where was there left to go?

In Europe, all UPSs had already become transformer-less, thanks to Europe's four-wire distribution, while in North America, transformer-less UPSs are still a minor novelty and often regarded as somewhat exotic. At the same time, vendors like APC adopted line-interactive topology (IEC 'VI') which saved energy, albeit without any frequency protection – not technically 'on-line', although advertised as such, but working well enough in stable grids.

'Eco-mode', introduced by Invertomatic in Switzerland in the 1990s but dropped due to lack of sales, was resurrected (along with 'modular' UPS, which overcame partial load problems endemic in most data centers). The principle of eco-mode is simple: when the utility is stable, the UPS switches itself into bypass mode and the losses reduce, especially in transformer-less designs. The rectifier still floats the battery (needing far lower power than a flywheel) but the inverter is throttled right back and, in the best designs, the cooling fans are dropped off.

The automatic bypass (a thyristor switch) keeps the load on the utility until the utility shows the first sign of deviation – at which point the static switch transfers the load back to the inverter, all in under 4ms and within the (rather outdated) ITIC/CEBMA PQ Curve. The UPS then monitors the utility for stability and, after a period, usually one hour, switches the load back to bypass. The advantages are clear; 99 percent efficiency for more than 95 percent of the year on stable grids, with the bonus of excellent low-load efficiency.

> *Who will need to worry when you can get protection with one percent loss?*

Some unscrupulous salesmen mention 'low-power state' for the inverter but, make no mistake, the UPS is in bypass with no power quality improvement and the critical load fed by 'raw mains.'

Now, there are some 'advanced eco-modes' which operate at 2ms instead of 4ms, and some that monitor the load distortion and make decisions about the grid, but the basic concept remains – if the utility is stable you save energy.

Rewards usually come with risk and eco-mode is no different. Every time the utility deviates, the load is switched – the very opposite of the protection offered by 'double-conversion.' This switching represents a risk to the load, which may be small but the user must balance it with a return - which can be high enough to cover the entire UPS cost in less than two years.

As energy costs rise and the concept is proven, eco-mode is being accepted. Energy effectiveness is not always the most important metric that users aspire to, but there are even a few high reliability dual-bus facilities that are hedging bets by enabling eco-mode in one bus and running VFI in the other, alternating each week.

The risk, whether real or perceived, will remain and limit the adoption of eco-mode but a development emerging from Japan could negate any advantage of eco-mode.

Transistors are currently manufactured with layers of doped silicon. The best to date, for UPS, are of the Insulated Gate Bipolar (IGBT) type and have become increasingly powerful and reliable.

One drawback is that the faster you switch them (to achieve more precision), then the higher the losses.

This is what mainly contributes to the upper limit of 96.8 percent module efficiency.

However, a change from silicon to silicon carbide (better known as carborundum or occurring in nature as the extremely rare mineral moissanite) can increase UPS module efficiency to 99 percent in double-conversion.

Synthetic silicon carbide powder has been mass-produced since 1893 for use as an abrasive, for instance in silicon carbide paper for finishing metals.

Silicon Carbide IGBTs will initially cost more but the energy saving will rapidly be recovered – and all without switching the critical load to the raw utility and increasing risks of transfer.

Hence, silicon carbide will spell the end of worrying about the enablement of eco-mode and possibly even kill off line-interactive (VI) UPS. Who will need to worry when you can get total protection of voltage and frequency protection with less than 1 percent loss?

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