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The Business of Data Centers

Ethernet in the fast lane

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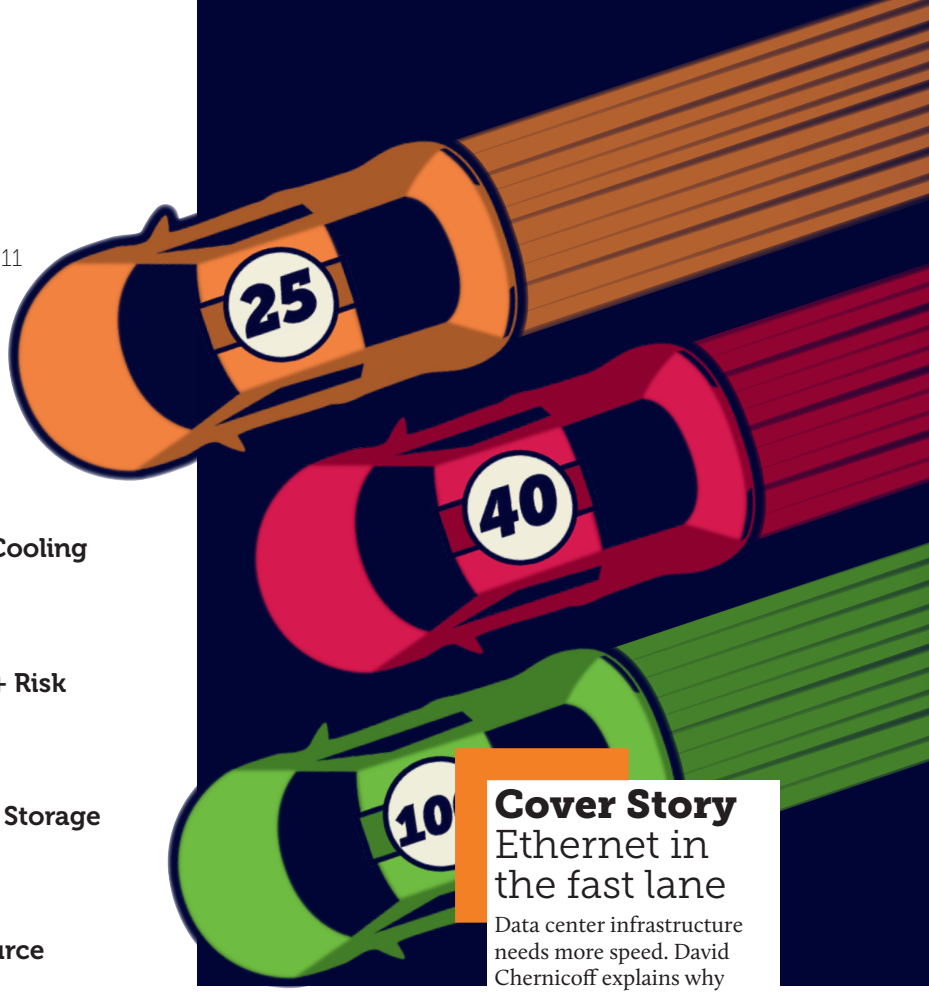
Contents

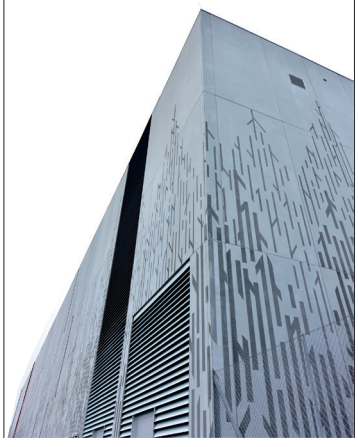
February 2016 VOL 04 ISSUE 11

Our tracks guide your path through DCD magazines, website and events

- Colo + Cloud
- Power + Cooling
- Design + Build
- Security + Risk
- Core>Edge
- Servers + Storage
- Software Defined
- Open Source



Cover Story
Ethernet in the fast lane
Data center infrastructure needs more speed. David Chernicoff explains why
26



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DCD MEDIA

Core values, leading edge

Networks have always been important to data centers – now they are absolutely crucial at every level. This issue, we follow the fibers and track some of the changes that are transforming not just data centers but the whole world. From core to edge, data centers are being reimagined, and the network is the fundamental enabler.

Our Core>Edge supplement starts on page 23. A quick look at the wide area (page 25) shows why links between data centers are crucial, and we follow that by an explanation of how the newest generations of Ethernet are competing for attention inside the data center – at the core – and how their ascendancy will drive major changes in the facility (page 26).

After that, we dive back into the chip itself (page 30). It looks as if optical and electronic technologies are finally converging, so communications can speed straight to the heart of our processors in a way that's never been possible before.

But wait, if networks are important to data centers, why are telecoms firms backing out of owning the facilities (see Vol 4, Issue 10)? The answer is that network cores may be their business, but data centers aren't their core competency. The new edge facilities are shaped by telecoms considerations, not (necessarily) owned by telecoms providers.

This is the sort of insight the industry is throwing at us, sometimes turning our expectations upside down, and sometimes giving us a chance to utter a resounding, "Told you so!"

Meanwhile, a cool site in Sweden grabbed our attention this month. The site DigiPlex built for Evry in Fetsund won a DCD EMEA Award in December, and our feature on it (page 16) explains why. Expect to hear from more ground-breaking facilities and organizations in the coming months, both here and on our website.

Finally, our regional editors consider how 2016 will look in the Asia Pacific region and Latin America (page 14). Asian data centers are approaching the challenges of energy efficiency and cloud migration with planning and foresight (page 12). Meanwhile, commentator Fernando Garcia says Latin America will be fun – like an exuberant board game. In other words, it looks as if people are living up to their regional stereotypes.

We wish all of you a busy and prosperous 2016, in which you can do both – be organized, and have fun. Focus on your core values, but aim for the leading edge!

•

Peter Judge - Global Editor
@PeterJudgeDCD

In 2016, you can have it both ways – focus on your core business, and aim for the leading edge

$4.3bn

Predicted data center spending in Latin America, 2020
Source: DCDi

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Seagate joins helium club

Seagate has launched its first hard drive which uses helium to increase capacity, following Western Digital subsidiary HGST, which pioneered the idea in 2013. First customers for Seagate's 10TB drives include Alibaba and Huawei.

Steel Orca goes bust

Pennsylvania-based Steel Orca went bankrupt in December, only six months after finally opening a long-awaited project in a former pharma lab in New Jersey. Its previous project – a steelworks in Fairless Hills, PA – was later developed by Keystone NAP.

Compass changes tack

Dallas-based Compass Datacenters has departed from its concept of a standard 1.2MW wholesale data center and is now offering a variety of designs. PUE is cut by as much as 50 percent from its previous offering, to as low as 1.1.

Google signs up to renewable energy with 781MW deals

Google announced five new deals to buy 781MW of renewable energy during the Climate Summit in Paris in December. The agreements in the US, Sweden and Chile add up to the biggest purchase of renewable energy by a non-utility.

Most of the figure is made up of wind power, with 625MW coming from three separate US contracts, and another 76MW from a wind project in Sweden. Finally, there is 80MW from a solar plant in Chile's Atacama Desert. Taken with Google's existing contracts, including one announced for 61MW of solar power in North Carolina, these make the web giant the world's biggest corporate buyer of renewable energy.

"We wanted to send the message that corporate America is committed to driving the transition to a clean-energy economy," said Michael Terrell, Google's principal of energy and infrastructure, in a statement quoted by Bloomberg.

The three US deals are made up of two 200MW contracts in Oklahoma for the Renewable Energy Systems Americas Bluestem project, and the EDF Great Western wind project, along with 225MW of wind power form Invenergy.

In Sweden, Google will take 76MW of wind power from the Jenasen project, being built by Eolus Vind in Vasternorrland County.

In Chile, Google will use 80MW of solar power from the El Romero farm to be built by Acciona Energia in the Atacama Desert.

Renewable sources tend to be intermittent – only delivering power when the sun is shining or the wind is blowing – so these are power purchase agreements (PPAs), where Google pays for renewable energy to offset the actual energy used in its data centers.

http://bit.ly/204DHax

VOX BOX / DCD VIDEO

Andy Long
CEO
Hydro66

Why offer hydro-powered colo?
We noticed that large internet companies such as Google, Facebook and Apple are building facilities in a more natural environment for data centers, where power is cheap and green, and the environment is cold. By offering a 100 percent hydroelectric-powered colocation facility in Sweden, we can help companies reduce their impact on the environment, while making massive cost reductions.

http://bit.ly/1OD3dfO

Richard Jenkins
SVP marketing
Romonet

How is colocation changing?
We work with a lot of the largest colocation companies in the world, and we are seeing them move to a mixed business model, bringing in pre-fab facilities, edge data centers, and moving to a mix of colocation and cloud, because that's what the enterprise space is looking for now. Monitoring solutions for power and cooling are an expectation now, but they must extend to the financial space.

http://bit.ly/1ZyfG9B

BT wins EU cloud deal worth €24m

British Telecom will be providing public and private cloud services to the major institutions of the EU, after being awarded framework contacts worth more than €24m. Customers include the European Parliament, the European Council and the European Defense Agency.

Following an open call for tenders in 2015, BT won two contracts for cloud services with the European Commission's Directorate-General for Informatics (DIGIT). The first establishes BT as the main provider of private cloud services to the institutions of the EU for the next four years. The second appoints it as one of the five providers that will compete for public cloud projects.

The services will be hosted from geographically diverse data centers and will comply with EU data protection regulations.

http://bit.ly/1SmAcuD

12

The number of AWS regions in the world

Amazon announces renewable-powered Canada region

Amazon will open a new AWS (Amazon Web Services) region in Canada this year. The new cloud facility will be carbon-neutral and follows Microsoft, IBM and others into the country.

The Canada region will open in 2016 in Montreal, Quebec, and will be powered almost entirely by renewable hydroelectric power, according to a post on the AWS blog by Amazon evangelist Jeff Barr. In Amazon's terms, a "region" is an autonomous part of its cloud: the giant currently has 12, with another five, including Canada, due to open in 2016.

"The planned Canada-Montreal region will give AWS partners and customers the ability to run their workloads and store their data in Canada," said Barr. Amazon already has four regions in North America.

Amazon will also add 11 Availability Zones within its regions, each of which has independent power and network connections. AWS currently has 32 Availability Zones.

AWS is inviting Canadian customers using existing US-based regions to move their data "home", and Barr said "the new region will be open to existing AWS customers who would like to process and store data in Canada," perhaps raising the possibility of US customers moving their data there away from the NSA.

There is certainly increasing activity by cloud giants in Canada: Microsoft announced plans for two data centers in Canada in June 2016; IBM opened one back in 2012; Oracle opened a Toronto data center in September 2015; and Salesforce announced two Canadian data centers in 2014.

http://bit.ly/234JfEt

Yandex waste heat warms Finnish city

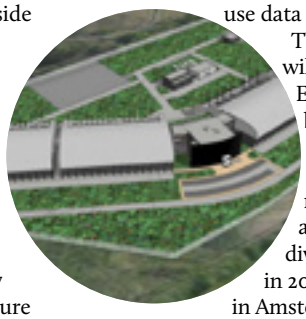
Russian web giant Yandex has switched on a heat-recovery plant at a data center in Finland, which will use the waste energy from the big data-processing site to provide hot water for the town of Mäntsälä.

The heat-recovery system announced at the DCD at CeBIT event in 2015 will pipe waste hot air from the data center into Mäntsälä's existing district heating system, run by Finnish energy company Mäntsälän Sähkö OY. The hot water provided will be enough to reduce heating costs for the 20,000 residents by five percent, says Yandex.

"This is better than a win-win situation," the data center's manager, Ari Kurvi, told DCD in 2015. "It's a jackpot." Yandex says the project will produce surprising cuts in fossil use and emissions, cutting the utility's gas consumption by half and CO_2 emissions by 40 percent.

The data center's hot air output is able to heat water to 30-45° C, and this temperature is boosted to 55-60° C, which is good enough for district heating using heat pumps at the heat-recovery center.

The data center is built to make use of outside air cooling. The whole building is shaped somewhat like aeroplane wings, with an aerodynamic profile that uses the prevailing wind to direct air through the facility at the correct pressure to provide cooling without additional power demands. One phase of the data center is operational so far, with another three due to come on stream soon. When all four are operational, the city's district heating system expects to be able to stop using gas and just use data center heat.



The data center will be used for European projects by Yandex Data Factory, the Russian firm's machine learning and big data division, founded in 2014 and based in Amsterdam.

Yandex Data Factory uses data science techniques to help European firms improve business personalization and productivity.

http://bit.ly/1SS6xcd

Google plans a $500m facility in Tennessee

Google is planning to invest $500m to build a data center in a former silicon factory in Clarksville, Tennessee, which will provide around 70 jobs.

The search giant wants to buy the site of the failed Hemlock Semiconductor factory. Hemlock, a Dow Corning subsidiary based in Michigan, makes polysilicon for electronics and solar panels. Its Tennessee plant was announced in 2011 as part of an expansion plan with Japanese partners Shin-Etsu and Mitsubishi. It was abandoned in 2014 due to a world oversupply and trade dispute.

http://bit.ly/204AU17

China set to back Qualcomm's ARM

Semiconductor vendor Qualcomm and the government of the Guizhou Province in southwest China have established a joint venture to develop ARM-based server chips.

The Guizhou Huaxintong Semi-Conductor Technology Company (GHST) will cater to the domestic market, with an initial capital of approximately $280m. Qualcomm originally planned to release its own 64-bit ARM-based server chipset before the end of 2015, and has promised its silicon will have 24 cores per die.

http://bit.ly/1T1CjUa

1.2
PUE to invoke penalty clause at Fetsund (page 18)

AMD Opteron A1100 takes ARM to data center

Silicon vendor AMD has finally launched its own 64-bit System-on-a-Chip (SoC) based on ARM architecture, the Opteron A1100.

Codenamed 'Seattle', the new SoC is meant to present an alternative to Intel's power-hungry range of Xeon and Atom processors that are dominating the data center market.

The A1100 started shipping to developers and early adopters at the end of July 2015 and is now available in mass-production quantities. "Customers now have access to 64-bit ARM processors from the only silicon provider that also has decades of experience delivering professional enterprise and embedded products," said Scott Aylor, corporate vice president and general manager of enterprise solutions at AMD.

Designed as a cheap (below $150) power-efficient SoC, the A1100 fits multiple use cases. According to AMD, it could be used to build storage servers, web servers, IoT gateways and networking equipment for NFV. Primarily, though, the A1100 is a development platform that's meant to grow the ecosystem and pave the way for AMD's upcoming efforts in the 64-bit ARM space.

Each tiny (27x27mm) SoC features up to eight Cortex-A57 cores designed by ARM and clocked at up to 2GHz. It includes two integrated 10Gb Ethernet controllers, supports 8x PCIe, 14 SATA3 ports and up to 128GB of DDR3 or DDR4 memory. AMD's hardware partners have already announced systems based on the A1100. For example, SoftIron, a British software-defined storage startup that specializes in ARM silicon, has begun selling the Overdrive 3000 development system.

Foxconn subsidiary Caswell has revealed plans to use the chip in NFV platforms, while the 96 boards community, launched by Linaro last year, will work on low-cost server boards.

"The secret of the Opteron A1100's appeal is not just the cores, it's everything around the cores," said Norman Fraser, CEO of SoftIron.

Meanwhile, Silver Lining Systems will develop high-density compute and storage servers that feature A1100 and its SLS Fabric Interconnect, which it claims lower intra-rack networking costs by up to 75 percent.

http://bit.ly/1n65MQQ

Vodafone center hit by Leeds floods

Severe flooding in Leeds took down mobile operator Vodafone's data center during the Christmas holiday. The facility temporarily lost power and repairs took longer than expected since emergency engineers were delayed by the weather. Leeds was battered by floods in December, with Kirkstall Road, where the Vodafone data center is located, completely covered with water when the river Aire burst its banks and sub-stations went dark.

Water reached the Vodafone facility, located just a few hundred feet from the river. The facility operated for a time on batteries. "We had engineers working from Boxing Day to mitigate any customer impact," said a Vodafone statement.

http://bit.ly/1OvtJaI

Investor buys three US data centers

Private equity firm GI Partners has bought three data centers on behalf of California public sector workers' retirement funds. GI splurged on data centers in Chicago, Texas and Colorado, on behalf of DataCore and TechCore, real estate portfolios it maintains on behalf of the California Public Employees' Retirement System and the California State Teachers' Retirement System.

In Chicago, GI bought 601 West Polk Street, a site leased to TierPoint that was originally a department store warehouse, for an undisclosed sum.

In Colorado, it bought Broomfield Corporate Center, and in Texas it bought the Synergy Park, a Dallas facility originally built to serve the University of Texas.

http://bit.ly/1KpgtTv

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Interxion warns customers of security breach that potentially exposes records

European data center provider Interxion has warned its customers of a security breach that may have exposed the personal information of more than 23,000 customers and contacts.

In December, an outsider gained access to Interxion's customer database and ran a report listing up to 23,200 contacts, including names, job titles, email addresses and phone numbers. Interxion became aware of the breach and informed its customers in an email from UK managing director Andrew Fray. The customer data was held in a customer relationship management (CRM) system, provided by a third-party supplier.

"No financial or other sensitive customer data was accessed or is stored within this system," said Fray. "We emphasise that this incident only affected Interxion's CRM system and did not impact or involve any of the data centers or services that Interxion provides."

Fray said the breach was "temporary and localized," and assured customers that they did not need to take any action.

Interxion said the weakness is fixed: "Upon learning of this incident, Interxion collaborated with our CRM supplier and has worked closely with our security team to ensure that all CRM information is secure," said Fray. "Measures have been taken to address this specific vulnerability. We have also informed the authorities in all of the appropriate jurisdictions."

http://bit.ly/1QbhXXy

Foxconn plans Prague facility

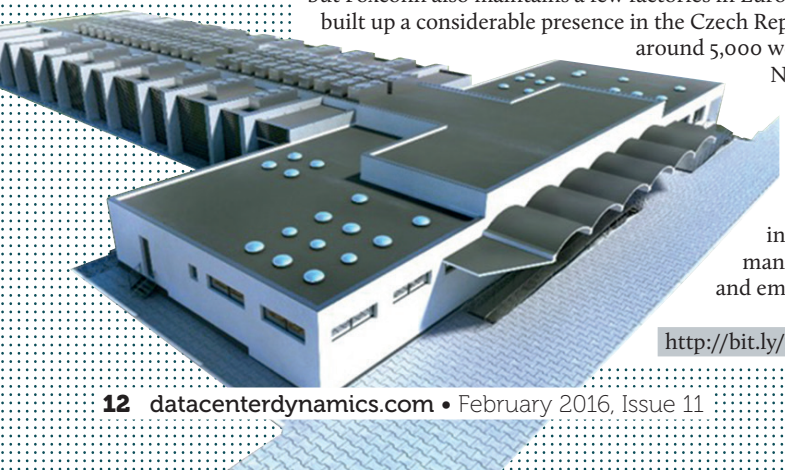
Taiwanese electronics giant Hon Hai Precision Industry, better-known overseas as Foxconn, is set to build a "medium-size" data center in Prague, in a joint venture with local investment group KKCG. The venture will be called SafeDX and the partners will take a 50 percent stake each.

According to a press release, the new facility will aim to help customers from Asia comply with strict European data-protection rules. Foxconn says it will become an important element of the previously announced plan to expand its business into the data center segment.

"Foxconn's new investment strategy focuses not only on building data centers but also, and more importantly, on providing related services," said Alan Macintyre, CEO of Foxconn Technology CZ.

Foxconn is the world's largest electronics manufacturing contractor – its factories build consumer and enterprise products later branded and sold by companies such as Apple, Dell, Microsoft, HPE and Sony.

Most of the manufacturing facilities are located in mainland China, but Foxconn also maintains a few factories in Europe. For example, it has built up a considerable presence in the Czech Republic, where it employs around 5,000 workers.



Now the country has been chosen as a beachhead for Foxconn's assault on the European data center market. Its local partner KKCG is an investment group that manages assets worth €1.6bn and employs 2,500 people.

http://bit.ly/1WeVUQg

Alleged hack cuts power in Ukraine

Hackers apparently brought down the power grid in Ivano-Frankovsk, Ukraine, marking the first time such an attack has been successfully carried out in the wild. According to local news agency TSN on 23 December 2015, more than half the residents in the region were left without electricity for several hours. Specialists in industrial control systems have been sent a malware sample and tentatively identified it as BlackEnergy, a strain that deployed against targets in Ukraine last year.

Digital attacks against physical infrastructure have been long predicted by security professionals, but until now the most notorious example of such an attack was Stuxnet, a virus that sabotaged a uranium-enrichment facility in Iran back in 2009. It was later reported that Stuxnet was developed by US and Israeli intelligence agencies.

According to TSN, anonymous hackers managed to take control of the mechanical systems that were updated to be managed remotely – presumably via the programmable logic controllers (PLCs), which are basic computers responsible for automation of industrial processes.

After being infected by malware, grid substations owned by local energy provider Prikarpatjeoblenergo suddenly started shutting down. Power was restored around six hours later, when some of the systems were switched into full "manual mode".

Samples of the apparent malware were then shared with several major cybersecurity vendors, including the SANS Institute, iSIGHT Partners, ESET and Trend Micro. Meanwhile, the Security Service of Ukraine was quick to blame Russian intelligence agencies for the attack.

http://bit.ly/234NhN5

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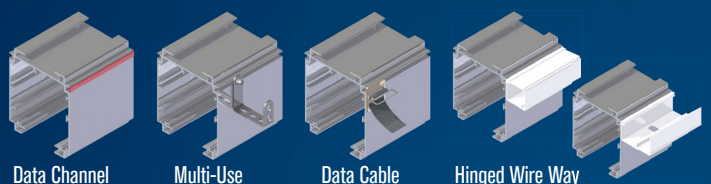

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*Accessories are only compatible with new systems of 250, 400 & 800 amp STARLINE Track Busway.

Asian sites get leaner and greener

Paul Mah expects more efficient data centers, more networking and more cloud in 2016

Paul Mah
SEA Correspondent
@paulmah

What will 2016 bring to the data center space in the Asia Pacific region? We spoke to some top data center executives – many of whom have either very recently launched, or are soon to launch, new data centers in 2016.

Sustainability remains one of the top considerations that was mentioned as an area of concern in the new year. "With the increasing growth of data center size and scope, it's hardly surprising to note that energy consumption is also on the rise," said Kevin Wee, the director of CenturyLink's colocation business in Asia Pacific. "To address the sheer power demands of data centers and society at large without increasing our carbon footprint, we predict a shift from fossil fuels towards renewable green energy."

Wee said next-generation fuel cell energy could help reduce carbon footprint, assuming that it can be produced at a cost-effective level.

"While 'green' has been a theme for the industry in the past few years, we've seen a greater focus on this in the past year and expect this push to continue," agreed Krupal Raval, senior vice president for finance at Digital Realty. "We saw a renewed focus on sustainability in the data center industry in 2015, with more renewable energy commitments and drivers from across the industry for green IT."

"Moving forward, Green IT will move up the C-suite's agenda as corporations accommodate greater demand for sustainability by governments and consumers. Data center operators and cloud providers will also look at innovating around improving efficiency in an effort to meet these demands," said Raval. Digital Realty recently announced its second data center in Singapore.

There is still room for innovation when it comes to designing an energy-efficient data center, according to Taylor Man, the executive vice president of NTT's cloud business division.

"Power consumption accounts for a major operating expense (opex) of data centers today. But so many data centers in Asia Pacific are still hanging on to conventional thermal management and continuous cooling designs that are not as effective to drive TCO down," said Man. "There is a pressing need to look into developing more cutting-edge, energy-efficient data center designs." He highlighted NTT's new Financial Data Center Tower (FDC2) in Hong Kong, which uses a front-flow cooling design with hot-aisle containment. NTT says the improved air-flow management offers an energy-efficiency improvement of 20 percent over legacy cooling systems.

Slowly but surely, IT is inching its way to the cloud. Enterprises are embracing a hybrid architecture in which sensitive data is stored on-premises, while the rest of the infrastructure is a mixture of private or public cloud in data centers. And this looks set to continue in 2016, says Raval, as businesses look to digitization to better position themselves over their competitors.

"The way IT is viewed within businesses and enterprises is expected to change and businesses need to be positioned for digital transformation in order to fully capitalize on the opportunities of the IoT [Internet of Things]," said Raval. He cited an IDC prediction that almost 65 percent of companies' IT assets will be housed off-site by 2018, either by colocation, hosting, or deployments within cloud data centers.

"We could predict the market to adopt the cloud quicker than ever, as more and more people realize the benefit of cloud and incorporate it into their strategy," said Voradis Vinyarath, the executive director and acting managing director of TCC Technology (TCCT) in Thailand. "Just like mobile, cloud will soon become a 'must-have' instead of a 'nice to have'."

Rapid changes in IT demand new tech standards that look beyond the physical infrastructure, such as the Multi-Tier Cloud Security (MTCS) Standard for Singapore (SS 584), which looks at a variety of factors, including business and data controls to certify the security practices of cloud providers. "In the cloud space, Infocomm Development Authority (IDA) has been actively encouraging service providers and vendors to provide their services on MTCS-certified platforms," said Septika Widyasrini, CEO of Telin Singapore, which is currently building the first data center in Singapore's Data Center Park, which will be ready for operation in Q3 2016. "We have a full infrastructure with redundant architecture and technical capabilities to support different cloud user needs for data sensitivity and critical business applications."

The data center corridor will connect strategic data centers in cities in Asia

The class of 2016 will need to offer new levels of deployment flexibility and be future-proof in growth areas such as mobility, big data and IoT. Apart from the evolving needs of IT, the constraints of land-scarce, high-rent hubs such as Singapore, Hong Kong and Tokyo are driving the construction of data centers that are more cost effective in terms of land use and can meet increased power requirements, according to Man.

"While the onset of server and virtualization technology evolution could make the power density stay high at the 8-10kVA level," wrote Man, "there is no doubt that rising power density would become one key trend to watch, which will further filter down to the need to better integrate energy-efficient technology in future data center designs for optimizing total cost of ownership."

The executives also agreed that network connectivity beyond the walls of the data center will become increasingly relevant. Faster 100Gbps connectivity between data centers is still the exception rather than the rule, though 2016 could be the year where prices of these dedicated pipes come down to a level where more businesses can tap into them. "We have also observed a growing east-west traffic trend from our customers and expect this to continue over the next five years," said Wong Ka Vin, managing director of 1-Net, which is set to launch its 1-Net North data center in Q1 this year. "ASEAN integration presents significant opportunities for trade, flow of services and information; the adoption of the data center corridor would be integral in connecting strategic centers within cities in Asia."

"Data centers are no longer just a physical structure where larger enterprises store their data. Today, data centers are smart, integrated, cloud-enabled, always connected and scalable," said Widyasrini, who also pointed to technologies such as micro servers, the use of flash-based storage, and software-defined networking to interconnect with both regional and global data centers.

Ultimately, the days when data centers were nothing more than well-defended buildings with robust power and network connectivity are at an end. Rather, the need to meet the evolving needs of IT and the ever-changing deployments scenario means there are more considerations than ever. The silver lining is how this offers an opportunity for nimble operators to further innovate.

Trends for 2016

- Green data centers: renewable energy, fuel cells, improved cooling systems
- IT continues to move to remote facilities, including the cloud
- Power densities remain at the 8-10kVA level
- Network connectivity beyond the data center becomes crucial

Fast facts

These figures include software, colocation and outsourcing:

- 2015 data center spending in the region was $20.9bn
- 2020 data center spending is expected to reach $34.3bn
- 2015 power consumption 3.2GW
- 2020 power consumption 4.5GW
- Brazil and Mexico combined made up 65 percent of 2015 spending

Source: DCD Intelligence

Latin America's game of Risk

This year will be a game-changer south of the Rio Grande, and data centers would do well to play, says *Fernando Garcia*

The data center industry in Latin America (LATAM) is going through one of the most hectic and exciting transitions in memory. The recent frenzy is due to a combination of forces pulling in different directions, and last year left behind some winners and losers, and successes and failures, redrawing a new playing field for the upcoming year – something like a game of Risk for data centers.

It seems huge technology companies are suffering from a major identity crisis. Some are being split up, some are merging, and some are losing ground to small companies with disruptive business models. The age of cloud computing, big data and the Internet of Things is barely starting out, yet market excitement could not be more intense.

Infrastructure manufacturers are feeling slightly adrift and blame their bad results on the economic crisis. There are those who want to sell complete, integral solutions in competition with their own channels, wearing themselves out and creating unnecessary friction, while others are paying the price for implementing short-term business strategies (feast today, famine tomorrow).

There is no longer a clear, well-defined role in the value chain: today, everybody wants to do everything, and few are able to achieve it. Some channels and regional integrators want to redraw the playing field but are failing in their attempt to scale up and replicate business models that only work on a national or local scale.

The economic context in LATAM is not favorable and will not be for several more years, according to some industry

observers. Rampant corruption in various aspects in the region, the price of oil and minerals, and currency devaluations compared against the dollar have weakened Latin economies. But it is also certain that investment in technological infrastructure is being a-cyclical; in other words, it does not seem to be following economic cycles. Countries including Mexico, Ecuador, Peru and Bolivia have seen major spikes in data center investments, and public and private enterprises have to play catch-up because their customers and citizens are demanding more and better access to online services.

In 2015, the trend toward tier certification of data centers was consolidated, with an increasing demand for operational certification – and that's what really counts. One trend that everyone is talking about, which has yet to pay off as expected, involves prefabricated data centers (not modular, or containers). These can achieve economies of scale and lower prices, and will become more popular over the next two to three years.

Last year was not very prolific for large greenfield projects or new data centers – there were fewer than there were in 2013 or 2014 – and data center providers completed some that had been started a year ago. There are some who will say the industry is in crisis, but that is not entirely true. Actually, what is happening is that the industry is changing and the traditional players are playing a losing game.

However, the market for brownfield projects – in other words adjustments, remodels and updates for existing sites – is bullish since companies are beginning to make common sense investments in infrastructure by capitalizing on the existing infrastructure and optimizing investments.

This year will be a very good year for data centers, despite the economic context, the identity crisis and the defunct business models – and even despite Brazil. That's why it's a good idea not to ignore Argentina, Peru, Mexico and Colombia.

It will be a great year for DCIM, tier certification, and prefab facilities

Fernando Garcia, Ingenium

To sum up, major trends include greater public investment in data centers for e-government and education. Banks will have to invest to implement Basel III, with its operating risk requirements.

It will also be a great year for data center infrastructure management (DCIM), and demand for operational certification will rise. There will also be a substantial increase in prefabricated data centers.

This year will also be a year for inflections, where the playing field transforms itself. Chinese and European companies will take on more relevance, and Brazilian and American companies will lose their starring role.

Investment in PE/VC (private equity/venture capital) in the sector will clearly continue, despite the drop in foreign investment in general due to the dollar's strength. Thus, PE/VC companies will capitalize on the situation by getting out of purchasing, taking advantage of the low price of assets in the local currency. These investments will be visible on two key fronts: purchases of real estate assets (data centers) by service providers, and investments in startup and technology companies that offer IT services and infrastructure. Whatever happens, there will be considerable activity in the region – and it's sure to be exciting. ●

Fernando Garcia is CEO of Ingenium Engineering in Miami, Florida

A breath of fresh air in Fetsund

Air cooling, hypoxic fire prevention and an innovation in funding made the Fetsund facility that DigiPlex built for Evry stand out, says *Bill Boyle*

Bill Boyle
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Evry is the Nordic region's second-largest IT services provider – and still expanding. It needed a data center fast, as leases on some of its facilities were due to expire, while others were below par. It set out to consolidate its 10,000 sq m of operations into a new facility with 4,200 sq m of white space in Fetsund, near Oslo.

Evry had already developed a concept design for the new facility and wanted to consolidate its operations quickly to improve both operational stability and its bottom line.

So it turned to DigiPlex to bring its plans to fruition and gave it a deadline of 15 months. The lease agreement included a challenging performance specification with a power usage effectiveness (PUE) of 1.1.

With time of the essence, DigiPlex developed and enhanced Evry's existing performance requirement for 4,200 of white space, located in two combined buildings, to enable it to be built quickly.

An Evry penalty clause meant that DigiPlex would fund any additional energy costs if the PUE exceeded 1.2 or greater, with DigiPlex paying for the cost of the additional power consumed over the life of the 20-year lease.

Gisle Eckhoff, CEO of DigiPlex, said: "We were determined to meet the business and technical goals that Evry presented us with, which were particularly stringent. It needed a low PUE within a strict

The Fetsund site uses indirect evaporative cooling

sustainability framework, which we were able to fulfil," he explained.

The budget was also challenging. It required DigiPlex to design and deliver two data centers to satisfy the client's challenging performance and space criteria, for a budget of US$59m in Norway, where construction costs are higher than some other European nations. DigiPlex adopted an innovative, multifaceted approach to ensure it delivered on time.

"We have been going for 14 years and have a high-quality customer base," said Eckhoff, so we knew we could produce the data center to specifications and to budget." However, Evry had one more surprise in store – it wanted DigiPlex to supply the funding for the facility as well. Eckhoff said: "This was no problem for us, since we are such a well-known company we were easily able to raise a bond to build the data center."

DigiPlex shareholders injected funds initially to enable a speedy start to the project. These were rapidly supplemented by funds raised by DigiPlex issuing a bond on the Oslo stock exchange – the first time a publicly traded bond has been used to fund the construction of a data center.

The brief called for an air-cooled data center. DigiPlex responded with the first application of its newly developed Air-to-Air indirect evaporative cooling technology (a DCD Award winner in 2012), developed in conjunction with Munters, which is designed to allow the facility to run on free cooling from ambient air all-year around to minimize energy use, thanks to the naturally cool, moist Norwegian air. This will deliver 'free cooling', which will save up to 25 percent on operational energy. The system uses rain collected from the building's roof as evaporation water. To cut the scheme's environmental impact and improve resilience, rainwater run-off from the building's roof is harvested in a pond and used to supply the evaporative coolers. The brief called for an inert air fire-suppression system. DigiPlex responded with a passive, low-energy, environmentally friendly hypoxic fire-prevention system.

DigiPlex designed the data center as two independent halves, which are linked so data replication/mirroring can run between the two. The entire complex will be built in six phases and should be completed in April.

> *We need IT such as this if we are to reduce greenhouse gas emissions*

Evry's servers were migrated from its existing data centers to its new facility in stages. On completion of each phase, the engineering services are tested by DigiPlex to prove their performance.

DigiPlex worked with Munters to mimic the part-load operating conditions for Munters' climatic simulation chamber at Spa, Belgium. This simulated all possible combinations of indoor and outdoor climate, including extreme summer and winter conditions, which proved the units' capability to perform as designed.

Electricity sourced from 100 percent hydro is used to power the energy-efficient facility: "Evry's data center will be world class as far as the environment is concerned," said Tine Sundtoft, Norway's Minister for Climate and Environment. "We need IT industries such as this if we are to meet our goal of reducing greenhouse gas emissions while maintaining economic growth," she added.

The build exceeded Evry's minimum N+1 infrastructure specification and a 2n UPS power distribution topology. DigiPlex had to develop a design that was robust enough to function for the 20-year duration of the service agreement. Working with the contractor, it developed a construction solution using precast concrete, which allowed the building components to be prefabricated in a factory while the groundworks were underway on site. In addition to being fast, the solution had the advantage of being a technique with which the contractor was already familiar and it was independent of Norway's weather, which minimized program risk. So while the contractor was erecting the building's shell, DigiPlex refined the scheme's engineering design.

DCD Awards

The Fetsund facility, built by DigiPlex for Evry, won the Enterprise Data Center category in DatacenterDynamics' EMEA Awards 2015. The DCD Awards recognize the most outstanding projects, teams and professionals in the field.

Previous winners include world-leading brands, and this year's winners were from across the region, including the UAE, the UK, Ireland, Turkey, The Netherlands, Greece, Spain, West Africa, Finland and Djibouti.

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Time to lay down your ARMs?

AMD's ARM-based Opteron is late. *Max Smolaks* thinks the micro-server revolution may have been cancelled

In January, AMD finally released the Opteron A1100, its first-ever chipset based on processor cores designed by ARM. It sounds like a decent, highly functional piece of silicon, but it sure took a long time to get here – and this could be its undoing. Delayed by almost two years, the Opteron A1100 has entered the market at a time when enthusiasm for ARM-based servers is waning and the flow of case studies has reduced to a trickle.

The delay gave the market leader Intel time to convince its customers (ie, everyone) that the low-power Atom C2000 range could tackle the same types of workloads previously thought a perfect fit for ARM chipsets, without the need for big software changes. Indeed, the Thermal Design Point for the C2000 series is lower than the TDP for A1100. That's right, some existing Intel x86 server processors actually consume less power than AMD's new ARM chipset.

And then there's the threat from the OpenPower Foundation, which began licensing IBM's tried-and-tested take on RISC architecture in 2014, for the same workloads.

AMD planned to start shipping the octa-core A1100 – formerly known as Seattle – by the end of 2014, when everyone was really excited about the prospects of ARM in the data center.

Startups such as Cavium, Applied Micro and even defunct Calxeda did all the groundwork. All AMD had to do was join the party. But there was no AMD ARM chipset in 2014. The launch moved to 2015, everyone was still excited, AMD widely publicized its plans, but once again failed to deliver. Now, in the year of our Lord 2016, I'm starting to think this revolution, that ARM said would put low-power SoCs in 20 percent of servers sold in 2020, has been cancelled.

If AMD released the Opteron A1100 in 2014, it would have hit the apex of Gartner's Hype Cycle, surfing the wave of inflated expectations.

Today, we're making our miserable way through the 'trough of disillusionment'. The industry is realizing that the number of uses for ARM-based servers is fairly limited, and nobody but HPE even mentions 'micro servers' any more. That's the same micro servers that IDC predicted would have a 10 percent market share in 2016.

AMD openly admits the A1100 is aimed at developers 'building the ecosystem', not huge deployments in hyperscale data centers. This means AMD's partners for the launch are a mix of start-ups and companies from Asia that you've never heard of, with the exception of Caswell, a subsidiary of Innocon, which is a subsidiary of Foxconn. See, a familiar name there!

Compare this with IBM's Power – a well-established architecture that has been going strong since the late eighties, backed by the might of Big Blue. White-box makers such as Tyan, Quanta and Wistron are on board – and these guys build servers for many of the world's largest digital businesses.

AMD's best hope might be more competition in the ARM space. The company might have been late, but the prize for the most obscure low-power server chipset actually goes to Qualcomm, which, despite its expertise in all matters ARM, has repeatedly delayed its unnamed 24-core processor while refusing to provide any real information on it.

If and when Qualcomm releases its own take on server-side ARM, the two companies can start to climb the 'slope of enlightenment' and figure out what to do with all this stuff.

AMD's current ARM development roadmap culminates in a chipset codenamed 'K12' that will use cores designed in-house by AMD. It could deliver lots more compute than Seattle, but has already been delayed from 2016 to 2017.

Both the ARM-based K12 and the hotly anticipated Zen architecture for x86 need to succeed if AMD is to remain relevant. Somebody needs to keep Intel on its toes, right?

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Bruce Taylor
EVP, North America

The edge has it

Edge data center facilities exist to provide the highest-possible telecommunications services with the lowest-possible data transfer latency, and the ability to interconnect all devices at the network edge – and at least cost.

This new class of critical environment facility is partly the result of the need for Netflix, YouTube and Amazon Prime, etc, to provide a high-quality user experience in underserved secondary and tertiary regional markets. As well as content delivery networks (CDNs), these facilities serve wireless mobility and mobile apps, gaming and interactivity, social media, IoT, cloud services, robotics, 3D printing, virtual reality (VR), autonomous cars, big data capture and analytics, and so on.

Today's data center design world is pulling in two directions: there is the mega "industrial" data center, built remotely using whitebox hardware, where energy is cheap and clean; and there is the faster, lower-latency "sports car" edge facility, built close to consumers in an underserved urban area.

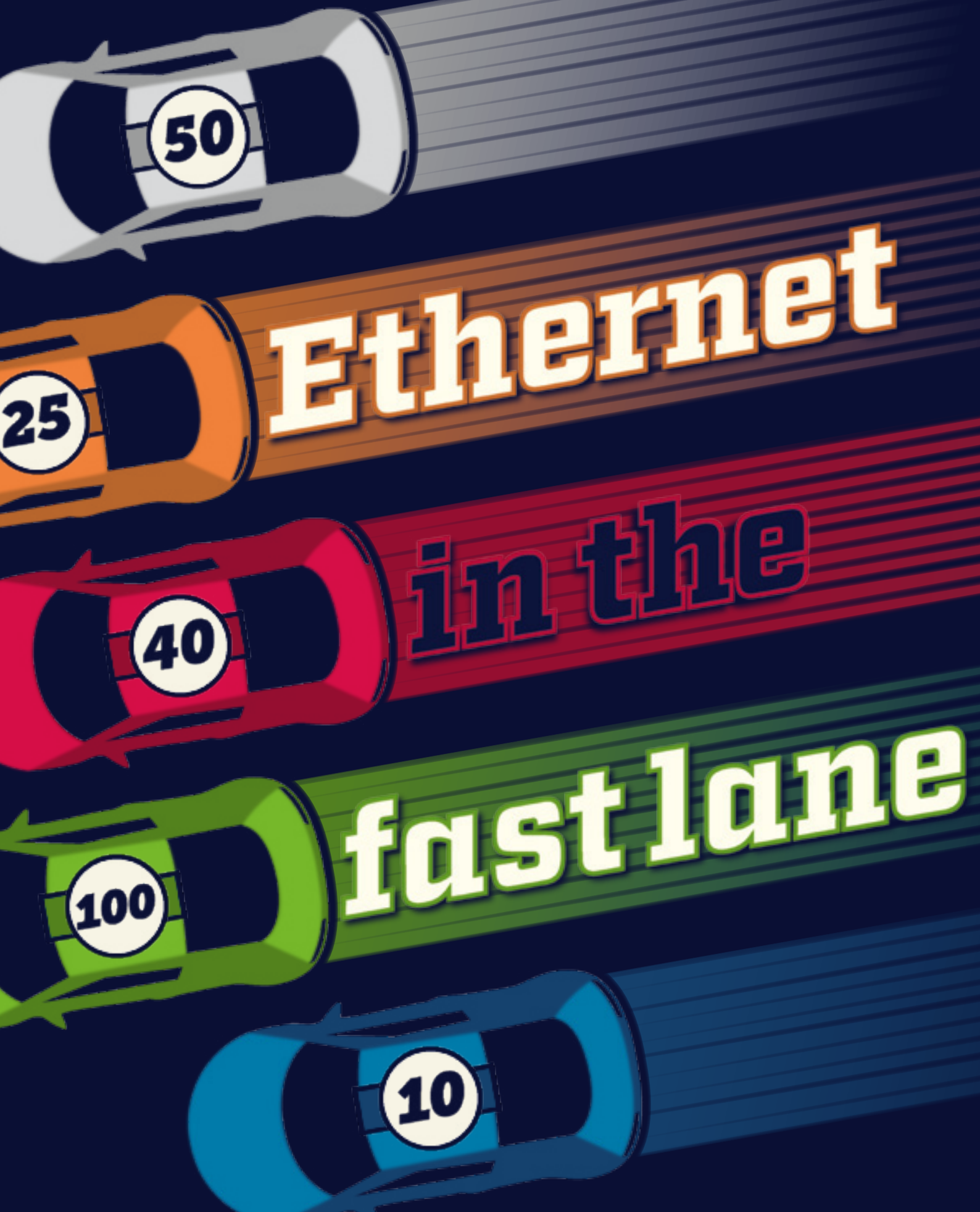
This crystallization has an impact on network architecture. A study by telecom analyst ACG Research (funded by EdgeConneX but useful nonetheless) found that caching content locally before serving it to a Tier II population center of a million inhabitants may displace $110m in telecom carrier costs over a five-year period, saving 50 percent of costs.

The form-factor of data centers is now far less important than the logical network environment architecture. What matters most is the telecom and internet infrastructure, the LAN/WAN networking technologies, where core network superhighways split to the on/off ramps, separating them from users. Core networking technologies and edge networking services can even co-exist in the same physical facility, particularly in Tier I cities.

At the network edge, brains count more than in the brawnier world of core networks. This is where innovations such as software-defined networking (SDN) and network functions virtualization (NFV) are driving automation and making those on/off ramps autonomous.

•

Bruce Taylor - *EVP, North America*


50
25
40
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Ethernet
in the
fast lane

Data center infrastructure needs more speed. *David Chernicoff* says the confusion is clearing between 10, 25, 40, 50 and 100GbE

David Chernicoff
US Correspondent
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With the approval of the IEEE 802.3ba reference standard in May 2010 – the first-ever Ethernet networking standard that was for two different network speeds – the doors were open for standardized implementations of 40 Gigabit Ethernet (40GbE) and 100GbE networking. With applications ranging from top-of-rack switching to backhaul and data center interconnect, it would seem the stage had been set for a significant leap in performance from the 10GbE infrastructures that were themselves only recently deployed.

While the demand for greater performance than 10GbE was clear, due significantly to the move towards cloud computing and the need to provide high-speed connectivity between disparate resources, it seems that 40GbE has been adopted rather slowly. Part of the reason is that as 40GbE began to hit its stride, 25/50GbE appeared to muddy the waters.

Despite the fact that formal adoption of the 25/50GbE IEEE standard is not likely to happen until later in 2016, by mid-2015 chips and products supporting the technology began to appear from vendors such as Broadcom, with its high-density 25/100 Gigabit Ethernet StrataXGS Tomahawk Ethernet switch series, and Mellanox with its 25/100 Gigabit open Ethernet-based switch.

With the performance capabilities of the most recent generations of Intel processors allowing data to be moved faster than 10Gbps, a technology that allows incremental growth in networking performance without additional networking infrastructure looks like a good idea. Simply adding additional 10GbE ports increases the number of required switches and the associated costs. 25GbE also has the advantage of using a single lane, the same as 10GbE connection with only a single set of appropriate silicon. 40GbE aggregates four 10GbE lanes requiring significant additional hardware costs. Early adopters were seeing costs at 1.5 times the cost of 10GbE for 25GbE performance. As production increases and standardization is achieved, the cost is expected to be the same as 10GbE for 2.5 times the performance.

The lane aggregation technique, as applied to the 25GbE technology, simplifies the introduction of faster network speed, as the 50GbE is simply two lanes and the 100GbE four lanes, which matched the specifications developed for the exiting 100GbE IEEE standard. The ability to scale the technology should be effective in reducing total deployment costs from end to end as you are effectively using the same technology – from top-of-rack, through data center interconnect, to appropriate cloud resources.

What we started to see in 2015 was the release of switches that were capable of handling both the current standards and proposed standards for high-performance networking. Switch hardware with out-of-the-box support for 10/25/40/50/100GbE networking became available from end-to-end solution vendors including Dell and Cisco, as ▶

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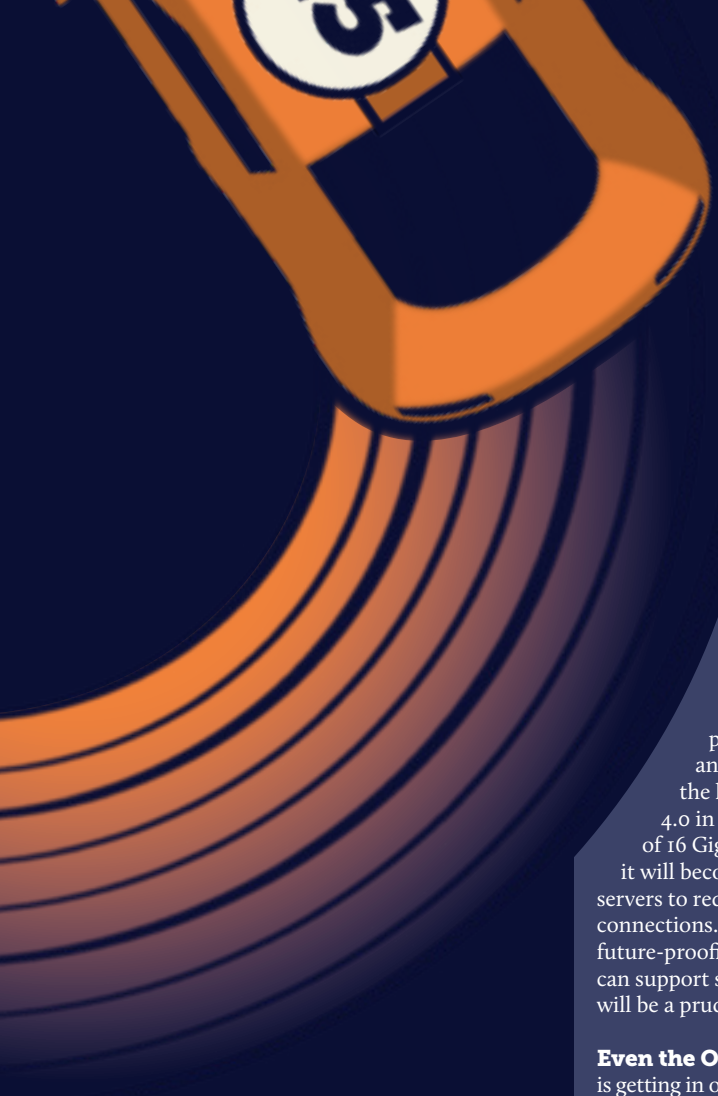


well as providers of specialized networking equipment such as Juniper and Arista.

25GbE is supported by the 25 Gigabit Ethernet Consortium, which, along with hardware vendors that make the silicon and switches, also includes Google and Microsoft, which make use of the technology in their own data centers. The goal of the group is to promote widespread acceptance of the 25GbE and 50GbE technology.

At present, 100GbE is primarily used for aggregation and interconnection, but with the likely release of PCI Express 4.0 in 2017, with a maximum bit rate of 16 Gigatransfers per second (GT/s), it will become possible for individual servers to require dedicated 100GbE connections. While not a guarantee of future-proofing, top-of-rack switches that can support server connections at 100GbE will be a prudent choice.

Even the OCP (Open Compute Project) is getting in on the act as the 40GbE Wedge switches that Facebook introduced make use of the Broadcom Trident II silicon, which is capable of supporting all of the previously discussed standards. Originally with 16x40GbE ports, OCP's updated Six Pack configuration is a 128x40GbE setup that uses 10G channels that can be upgraded to 25GbE to form the basis for the 100GbE interface.

Facebook still hasn't reached its goal of adopting the Wedge top-of-rack switch design throughout its data center enterprise, but it does have thousands of Wedge switches in place. As Facebook develops and deploys the 100GbE versions of the Wedge, it will have the advantage of directly comparable performance data to evaluate the efficiency of higher-performance networking technologies.

With plans to use 400GB optical connections, Facebook could get a start on the next generation of networking performance – the IEEE 802.3bs 400GbE Ethernet technologies, which are currently at the taskforce level in terms of development and standardization.

How you choose to architect your data center networks is primarily dependent on the amount of network traffic you expect to see through your next hardware revision cycle. Certain specific features, such as high-density computing, high-performance computing, fast storage networks, etc, will push your design needs towards faster networking and interconnects. Heavily investing in deploying cloud networking services also lends itself to deploying faster networking capabilities.

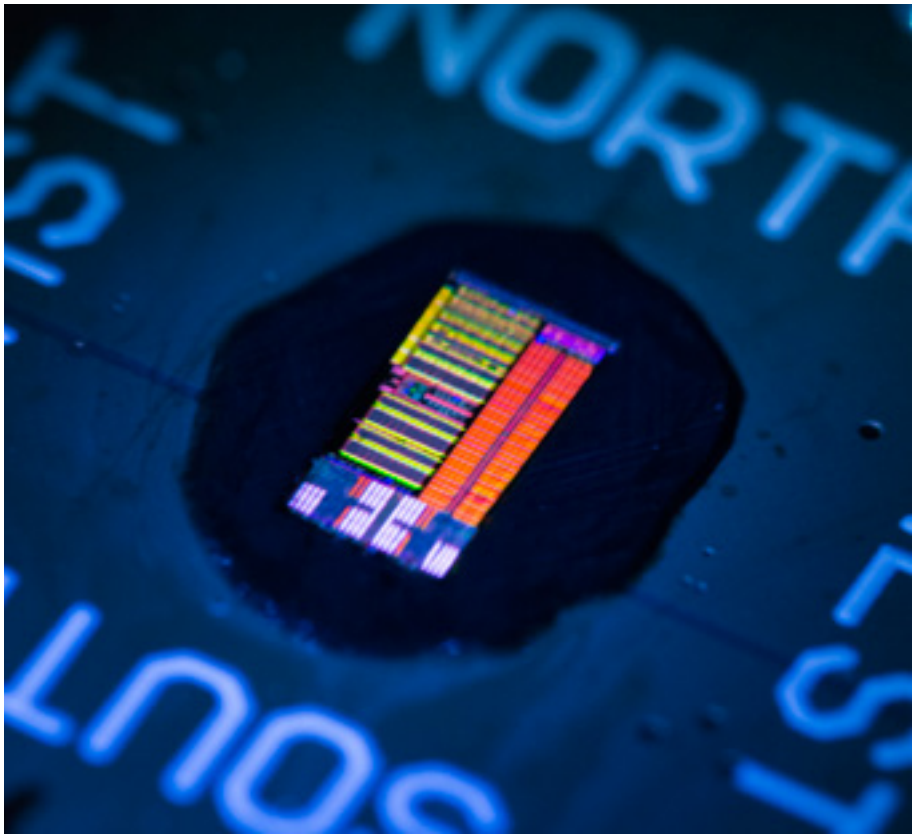
Also consider the fact that having fewer faster connections reduce the power and footprint demands of your data center networks, reducing both capital expenditures and ongoing operational expense. You may find that to be the case even in a spine and leaf architecture network. Your decision could also be based on the projected decrease in cost of 100GbE switches as adoption increases. Analysts have suggested that prices will drop as much as 50 percent year to year for the next few years, looking at the deployment and pricing pattern for 40GbE switching.

So, to a significant extent, accurate capacity planning for the future growth of your data centers will be critical to determine if, and when, you plan to adopt higher-performance networking technologies across the board. Nothing in this planning should prevent specific deployments for customers or projects that have a need for a higher-performance solution.

> *Just as 40GbE began to hit its stride, 25GbE appeared to muddy the waters*

Standalone projects, or high-density computing deployments that require or benefit from early adoption of networking technologies that are unneeded by the bulk of your data center operations, can get you an early heads up on the benefits and issues you will face when you begin deployment of higher-performance networking backbones.

As the current crop of switches indicate, future products are likely to be compatible with a broad range of network performance, meaning that not just switch gear, but also your choices of cable plant and physical interface, will be important when you plan for your next-generation deployments.



The chip that saw the light

Researchers have finally put electronic and photonic components on one chip. This could be a game-changer, says *Michael Kassner*

Michael Kassner
US Correspondent
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Microprocessors can now see the light. A multi-university research team has combined electronics and photonics, putting 70 million transistors and 850 optical modulators, filters, photodetectors, and couplers on to a single 3mm x 6mm chip. The disparate technologies are integrated with each other, and communicate via light with the outside world.

This is a long-awaited and much-needed breakthrough. Chip electronics are fast approaching electrical and thermal limitations (current leakage, crosstalk interference and heat build-up). Before long, electronics alone will not be enough to build more powerful microprocessors.

Optical components do not suffer from the problems that plague electronics, but putting them on silicon is not without its challenges, because silicon does not transmit optical signals nearly as well as glass.

Research labs such as Intel's Photonics Technology Laboratory have developed silicon-based lasers, optical modulators and photodetectors, but any recent news about silicon-photonic development has dried up. Giacomo Losio, head of technology at ProLabs and former lead optical engineer of Cisco's transceiver module group, says that combining those components to make a working prototype could take years: "If there is a mistake in the chip design, the prototype chips are scrapped, the design changed, and the entire chip fabrication process starts over."

But that wait could now be over. "This is a milestone. It's the first processor that can use light to communicate with the external world," says Vladimir Stojanović, associate professor of electrical engineering and computer sciences at the University of California, Berkeley, in a press release. "No other processor has the photonic I/O in the chip."

The team also includes fellow UC Berkeley professor Krste Asanović, Rajeev Ram at the Massachusetts Institute of Technology, and Miloš Popović at the University of Colorado, Boulder. "This is the first time we've put a system together at such scale, and have it do something useful, like run a program," adds Asanović, who designed the instruction set architecture (RISC-V).

But the research team didn't just design the first-ever electronic-photonic chip system. They circumvented custom manufacturing processes, designing on-chip photonic components to be fabricated using standard microprocessor foundry technology.

One of the team's key innovations was getting optical signals to move though silicon with minimal loss. "The researchers used the silicon body of the transistor as a waveguide for the light," says the press release. "They did this by using available masks in the fabrication process to manipulate doping,

which is the process used to form different parts of transistors," it states.

Next, the team managed to modulate the optical signal. "They designed a silicon ring with p-n doped junction spokes next to the silicon waveguide to enable fast and low-energy modulation of light," explains Stojanović. They also used existing silicon-germanium processes to build a photodetector, using germanium's ability to absorb light and convert it to electricity. The last hurdle was talking to the outside world using optical signals. The research team built a vertical grating coupler using the chip's existing poly-silicon and silicon layers.

> *This is the first processor to use light to talk to the outside world*

One advantage of optical transmissions is that the same amount of power is used to send the signal a few centimeters, or a few kilometers. "For high-speed electrical links, one meter is about the limit before you need repeaters to regenerate the electrical signal, and that quickly increases the amount of power needed," says study co-lead author Chen Sun. "For an electrical signal to travel one kilometer, you would need thousands of picojoules for each bit."

When asked what's next for the research team, Stojanović said it will be commercialized by an outfit called Ayar Labs, and ultimately ported into bulk CMOS.

The team is not done researching either. "From a systems perspective, we're starting to look at how this photonic interconnect can help change the switching architecture of the data center, not just get more bandwidth and less energy per existing link," he explained.

Losio thinks this changes things well beyond chip architecture, by allowing hardware designers more freedom: "Devices that handle huge amounts of information, almost always need a memory, and given the limitations of copper interconnects, these components need to be placed close by," he says. "With optical interconnects, we could envision systems sharing a large memory pool located elsewhere."

It should also help data centers go green. "Since moving data in the optical domain takes less power, and large data centers host thousands, maybe tens of thousands of servers, it is easy to see how this development could save a lot of money on the electric bill," says Losio.

"We feel strongly that this is truly a game-changer technology," writes Stojanović. "We're talking here about the introduction of a major capability into an advanced process node, without any process development or any additional cost."

If he's right, the future looks bright for electronic-photonic chip systems.

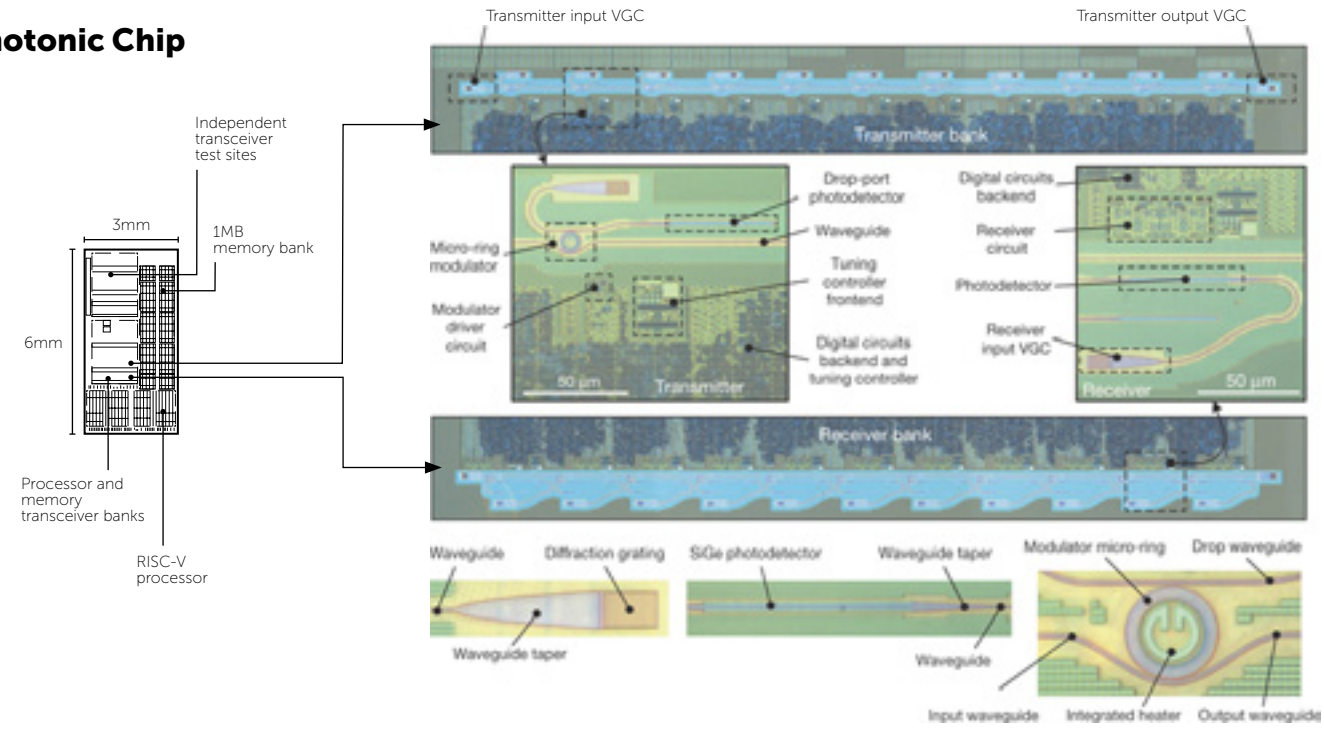
Sources

The paper, *Single-chip microprocessor that communicates directly using light*, was published as a Letter, in *Nature*, Vol. 528, 534-538 (24 December 2015).

Authors include Vladimir Stojanović, Chen Sun and Krste Asanović of the University of California, Berkeley, who are quoted in this article.

Other authors include Miloš Popović and Mark Wade of the University of Colorado, Boulder; Yunsup Lee, a PhD candidate at UC Berkeley; and Jason Orcutt, a graduate of the Massachusetts Institute of Technology, who works at IBM's Research Center in New York.
http://bit.ly/1YxVedU

Photonic Chip



DCD Com

Awards and Converged highlights

DCD EMEA Awards 2015, Internet Data Center Award Winner - KPN NV - KPN Datacenter Eindhoven (DCE)

DCD EMEA Awards 2015 host, Alexander Armstrong

Antonella Crimi
Equinix
I really want to thank you all for putting together such a successful event. It gets better and better every year! The DCD team put so much hard work into this event - well done!

DCD Turkey 2015

DCD Turkey 2015

DCD Converged upcoming events

munity

2016 is well under way, with **DCD at CeBIT** approaching in March. And don't forget **DCD Enterprise** in New York in April, also featuring the **DCD US & Canada Awards 2016.**

Research

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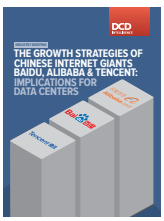
REPORTS

Metropolitan Hub Series: London



The Growth Strategies of Baidu Alibaba and Tencent: Implications for Data Centers

Colocation Provider Investment: Co-opting the Cloud for Future Growth

UPCOMING RESEARCH

- Case Study: Google – Strategy and Prospects
- 2016 Global Data Center Predictions

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Data Center Power Professional
February 4-6 – New York

Data Center Design Awareness
February 29-March 2 – London

Critical Operations Professional
February 29-March 2 – London

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Mention Promo Code **'Magazine'** for 5% discount on these training dates

New webinars from the leaders in data center technology

"SINGLE PANE OF GLASS" COMES TO YOUR DATA CENTER FACILITY AND IT OPERATIONS

Wednesday, February 24, 2016
10am (PST), 1pm (EST), 6pm (GMT)

Has the growth of your data center been accompanied by an increasingly complex infrastructure that makes operations difficult? The complexity of multiple disparate systems causes increased errors in our understanding when systems goes awry, and data center performance and availability are impacted.

Today, the ability to converge OT/IT data gives a granular insight never before possible. This insight improves energy utilization and data center availability.

Join **Hewlett Packard Enterprise's** Cloud Director of Global Data Center Operations, Matthew Brown, and **RoviSys**, data center solutions provider and systems integrator, as well as **OSIsoft**, the leader in real-time infrastructure software, for a webinar hosted by DCD's Stephen Worn, as they discuss the implementation of a "Single Pane of Glass" solution and some of its resulting benefits:

- Estimated 10m kWh saved in the first full year of operation
- Easily meet "best practices" throughout center operations

Register: www.datacenterdynamics.com/osisoft-webinar

DatacenterDynamics
AWARDS
US & Canada 2016

Drinks Reception starts at 6:30pm, followed by Dinner & Awards Ceremony
Wednesday April 20, Marriott Marquis, NYC

Deadline for entries: **February 12**

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Banking blockheads

Deconstructing and disaggregating whole industries has become such a way of life in Silicon Valley that the entrepreneurs of the region are often surprised at the survival of many of the old industries – and top of their lists are the banks. At the very least, the banks represent the lumbering past of finance capital when straight, be-suited bank managers handed out cash to those who could make a good case. These days 'fintechs' – or financial technology startups – get their money from the venture capital funds that are the only organisations that can afford to stump up startup money.

And so it is that Jamie Dimon, the CEO of JPMorgan Chase, can say in his annual letter to shareholders: "Silicon Valley is coming." It is the Fintech movement in San Francisco, Stockholm and Shanghai which is doing business at a level of the old established banks – in the tens of billions of dollars – companies such as the Lending Club, which is shelling out sums in the region of $10bn. *The Economist* recently estimated that the Lending Club will finish 2016 doing business well over $1bn of credit per month.

New entrants are offering regular banking through current accounts, which alarms many

This year's technology is blockchain, which Bitcoin is built on. More new Silicon Valley lenders are offering regular banking through current accounts – a trend that is highly alarming to the old-school banks. Not only does JPMorgan Chase consider 2016 the year of blockchain, so does Goldman Sachs. As Bruce Taylor, DCD's executive vice president, says in the article on our website: *Blockchain – Goldman and IBM care, should you?* "Why is this even a topic for a DCD conference that focuses solely on infrastructure? Because it points to two important factors: first, it demonstrates how quickly technology innovation can go from unheard of to attracting startups and investors. That has an impact on full-stack infrastructure planning – even if small right now. Secondly, it suggests a new cloud model that wasn't even in the lexicon two years ago, but may be a massive boost in decentralized computing productivity.

Blockchain is important because the technology it's built on – distributed-ledger technology – provides the basis for non-tamperable shared, replicated, decentralized transactional databases. This means that distributed ledgers create independent opportunities to rely on the same, shared, secure source of information that cannot be altered by one individual. That alone is progress.

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Bill Boyle - *Global Managing Editor*
@billboyleDCD

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