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# Contents

**Features**






# Giving your facilities a new lease of life

Some people want shiny new things. Others make a point of sweating their assets and keeping equipment in use until it has more than paid for itself.

Neither group is right.

When a facility is no longer capable of maintaining its peak performance, a full replacement can be hard to justify, but there will still be plenty of things that can be done to improve the operation of the building and its contents, without breaking the bank.

This supplement is about the times those choices are made.

**Upgrades and modernization** are a hidden data center sector, obscured by the exponential growth in new facilities (p4). And there can also be very good reasons why an older data center should be simply closed down and replaced, when its infrastructure ages.

Today's data centers are so different from those built 20 years ago, that it may be prohibitively expensive to completely remake an older building.

But the pay-back time for a new build is longer than an upgrade (especially if you include low-investment fixes like airflow improvements). And some buildings are such prime locations that there's no choice but to refit.

**Stack Infrastructure** is presiding over a rebuild of a facility once owned by AOL in the early days of the commercial Internet (p6), and a couple of New York skyscrapers house data centers that have been upgraded multiple times.

Some industrial buildings have been brought into the data center fold, in projects which re-envisage them as efficient installations for digital infrastructure.

For example, Intel took a chip fabrication plant in Santa Clara, and turned it into a facility it calls "the world's best data center" (p15).

Elsewhere in this supplement, you can read how Lamda Hellix turned a redundant cable landing station in Athens into a data center (p12).

**But it's not just about** improving the value and performance of a data center. There's a another, higher priority, which raises the stakes even higher: don't kill the services you are providing (p10).

If you've got a modernization project, we wish you all the best.

**DCD>Debates**
Modernizing your legacy data center - what's new?

**Watch** On Demand

As soon as you build or acquire a new data center, it starts to become outdated, and with each year that passes, operators are faced with several conundrums - when to upgrade, what to upgrade, and how radically one should upgrade.

bit.ly/ModernizingDataCenter

# Modernization - the hidden data center sector

**New data center projects get all the attention, but there are a lot of facilities that are being upgraded and modernized, reports *Peter Judge***

**Peter Judge**
*Global Editor*

Data centers are expanding at a mind-boggling rate. The global colocation market is expected to grow to $50.18 billion by the end of 2020, and regional data center hubs are adding capacity at record rates.

In the US, around 400MW is being built per year, while Europe has been adding around 175MW of new data center capacity per year for some time, just in its four largest markets. These figures come from property specialists like CBRE and Jones Lang LaSalle (JLL): speaking at DCD's London event, Andrew Jay, chief executive of CBRE, said the number of new buildings is increasing, as cloud players buy bigger chunks of capacity: "The big hyperscale guys are talking 500MW in 24 months [in Europe]. That's a paradigm shift."

This is alarming: feeding this demand can seem like an impossible task. But it may also be blinding us to a giant sub-sector of the market: namely, modernization. While the industry is concentrating on building new facilities, what happens when the sites we already have need to be upgraded?

*It's far more effective to upgrade a facility when it only exists on paper*

IT equipment in a data center will need replacing, perhaps every three to five years. The mechanical and electrical parts of the facility have a longer lifetime, perhaps ten to twenty years.

But during this time, they will also need maintenance, and eventually, replacement and upgrading. And these jobs will impact the whole data center.

No one seems to have clear figures on the size of the upgrade and modernization market, perhaps because it is hard to define. Some routine work carried out during the lifetime of the data center can fall into the category of upgrades: projects such as checking and improving the airflow by using blanking plates, brush strips and other components.

Some "upgrades" can actually take place before the data center is even built. "It's far more effective to upgrade a facility when it only exists on paper," one professional told me. This is much more likely to happen to enterprise facilities, where the project may have a long timescale, and the company's requirements may change during the planning process, for instance, because of a merger or a change in business model.

Some upgrades are more substantial, either altering the containment plan in the data center, or adding capacity by changing or upgrading the cooling and power infrastructure.

Modern IT is likely to have greater power density in the racks, and operators are beginning to run their kit at higher temperatures to reduce their cooling bills. This means that an upgrade may require different power distribution - and the addition of bigger power feeds - as well as a change in cooling systems.

Modern upgrades can go as far as adding a modular "pod" unit inside the building, or placing a new modular building or containerized data center alongside it, in the car park. As these modular approaches often bring their own containment and their own power and cooling systems, they may actually have less impact on the existing data center.

Other types of upgrades take place inside the existing shell, but have a profound effect on the resulting facility. These include virtually ripping out and replacing the data center, effectively creating a brand new space within the current building.

One common factor with most modernization projects is that the business service is live already, and must be kept online. Data centers are live 24 hours a day, often delivering services which are financially important. This means that it can become necessary to upgrade the site without interrupting its operation.

For a large upgrade, it is likely to be be necessary to move the IT load out completely. At this stage, you really are effectively doing a new build. And if you find somewhere good to place your IT on a temporary basis, why not consider keeping it there?

**450,000**
**square feet of technical space at Intergate Manhattan**

Upgrading a live site is fraught with difficulties. There are risks to human life here, if active power systems are being worked on. Even if it is Tier III certified and has two concurrently maintainable power and cooling paths, a planned upgrade will involve powering these down and replacing them one at a time. If nothing else, an upgrade can be a good test of the reliability of the facility.

Malcolm Howe leads the critical systems team at engineering firm Cundall. He spoke from experience for a *DCD* feature on data center life cycles: "Any interruption to power and cooling systems creates risk. You can work on one path, while the facility hangs off the other. But you need to choreograph it so you don't drop the load."

The site may need temporary power and cooling during an upgrade, which increases the risk associated with the procedure.

Data centers in prime locations may be more likely to have upgrades, instead of being shut down at the end of the lifecycle of the original build. This is particularly true of data centers in large cities (see box).

One more thing is certain about data center modernization: by definition, it will change. The sites that are being upgraded today had their technology installed ten or more years ago, and will be brought up to speed with current best practices.

The facilities built today should be much more upgradeable in the future. Aisles that ensure good containment can be upgraded more easily, and the whole facility is likely to have been constructed in a modular way. Pod designs for rack hardware will be replaceable, and placing mechanical and electrical equipment on a skid is intended to simplify configuration and delivery, but it should also make it easier to upgrade or replace.

It's good to know that the process of upgrading is itself being modernized. ●

## Upgrades in New York

Intergate Manhattan, at 375 Pearl Street, wears its history of upgrades on its sleeve. The 32-story building overshadowing Brooklyn Bridge was first owned by New York Telephone, then Bell Atlantic and Verizon. Sabey Data Centers bought it in 2011, but it's still frequently referred to as the "Verizon building," because Verizon has three floors in the facility and pays naming rights to keep its signage at the top of the tower.

Colocation space in New York is in short supply, so it's been worth Sabey's while to invest in modernizing the facility. The company originally planned to develop 1.1 million square feet of data center space, but Sabey vice president Dan Melzer told *DCD*: "the market just wasn't ready for that."

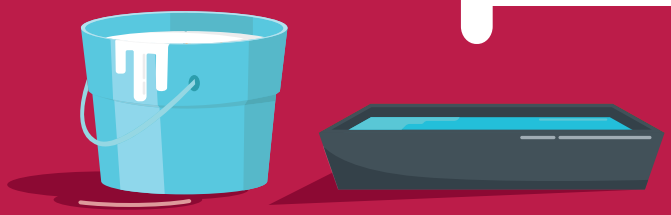
Instead, the company fitted out 450,000 square feet of technical space. The upper floors of the building were repurposed as office space - but for half the tower, this was not possible as it was built to house telephony equipment and has little natural light.

The lower floors house the chillers and generators, including an 18MW substation to support the company's turnkey customers.

Re-purposing space has been made easier thanks to the way the building was designed. It has a massive freight lift to carry heavy equipment up and down the tower, and an underground tank holding enough fuel to run generators for 72 hours in an emergency.

Nearby, 60 Hudson Street was built to last in the early days of communications. It started out as the headquarters of Western Union, dominating the telegraph industry at the time. It has communication lines from AT&T's building, and floors strengthened to support heavy equipment, along with vintage pneumatic communications tubes.

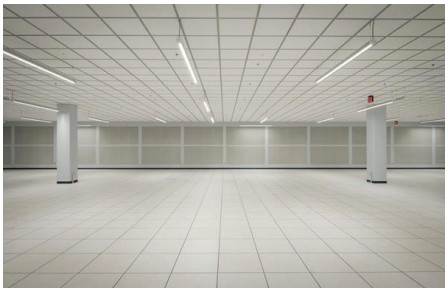
"The building sort of recycled itself for today's age," said Dan Cohen, senior sales engineer for the current resident, Digital Realty. The floors hold heavy racks with ease, and "a lot of those pneumatic tubes are now being used for fiber."



# Upgrading the birthplace of the commercial Internet

**Twenty years ago, the public Internet took off in AOL's Dulles Technology Center. *Peter Judge* sees the building coming back into play, ready for the 21st century**

**Peter Judge**
*Global Editor*



Data Center Alley, a few square miles of Loudoun County, North Virginia, is the greatest concentration of data center space on the planet. And it's where a new provider is upgrading one of the world's oldest Internet data centers.

Locals claim that 70 percent of the world's Internet traffic passes along the fiber cables that run beneath Loudoun County Parkway and Waxpool Road. There are some 10 million sq ft of data center space here, consuming something like 1GW of electrical power.

It's growing fast, and with a stream of trucks hauling steel and prefabricated concrete to giant construction sites for Digital Realty and CloudHQ, it's easy to think that everything in Data Center Alley is new. But it's been an infrastructure hub for more than 20 years, and alongside the new builds, some historic locations are being rebuilt too.

Today, the Equinix campus in Ashburn is the leading Internet exchange. Equinix DC1 was the company's first data center in the late 1990s, and DC2 is reputedly the most connected building on earth. But before Equinix arrived, Virginia had MAE-East, one of the earliest Internet exchanges, and the first data center in Ashburn is believed to be the former Dulles Technology Center, a bunker-like building on Waxpool and Pacific Boulevard, created by AOL in 1997 to serve its growing army of dial-up Internet users.

Now more or less forgotten, AOL was the leading Internet provider of its day. New fiber arrived to serve it, and the Alley snowballed from there, as other providers and data centers arrived to feed on that fiber. AOL is no longer a power in the land (it's a Verizon brand), but its data center is still there, under a new owner, on prime fiber-connected land close to Equinix DC2.

Stack Infrastructure is selling wholesale data center capacity to hyperscale providers. It launched in early 2019 (see News pages), taking over the facilities previously owned by Infomart, a provider which picked up the 10MW AOL site in 2014.

Under Infomart Data Centers, 6MW of capacity had been re-opened in the Dulles facility by 2017. Now the work is continuing under the brand Stack Infrastructure, created by Infomart's new investors IPI.

The result, according to Stack sales vice president Dan Ephraim, is a wholesale colo site offering up to 18MW, playing to the building's strengths but still meeting current demands.

"You are in an absolute unicorn," Ephraim told *DCD* during our visit. "This is totally unique."

The building is designed to withstand a jet crashing into its roof, Ephraim told me: "Being the first data center here, these people were hypersensitive to the risk of being on a glide path [i.e. close to Dulles International Airport]," he said. "It's borderline foolish. But the design was: if a Cessna or a Hawker private jet hits one of our data halls, that hall will collapse, but it won't affect the other five data halls."

The building's internal and external walls are built from reinforced "rebar" concrete, and the double-tee roof has six more inches of concrete above it. As well as crashing airplanes, it can also withstand winds of up to 200mph.

With a facility this old, the best approach was to almost completely replace the mechanical and electrical assets, Ephraim explained: "We ripped out everything AOL had from a mechanical perspective." Chillers, pumps and cooling towers were replaced, along with uninterruptible power supplies (UPS), power distribution systems, mechanical cooling, fire preventon, and security systems.

This gives major benefits: the facility is a new, flexible data center, inside a super-robust shell. Standing next to the new cooling towers in the yard outside the building, Ephraim said: "Everyone else in the market, for their utility yard, has a dog-pound fence. We've got a 30ft concrete wall. They just overbuilt."

Inside, there are five data halls, up to 15,000 sq ft each. It could be our imagination, but as we talked, the echo seemed stronger and louder than in other facilities. Could that be the rebar talking?

The data halls support power densities of up to 600W per sq ft, and the building can deliver a PUE (power usage effectiveness) of 1.2 to 1.25. That's impressive for today's shared colo space, and even more so in a building that was created with no consideration for efficiency. When AOL built in 1997, data centers focused on delivery not efficiency, and the term PUE wasn't coined till 2006.

*The outside wall is concrete, the inside walls are concrete. It's effectively a bunker, inside of a bunker, inside of a bunker*

There's a NOC control room built with a view into the power systems: "They designed it so you could not sit in this room without seeing at least two generators." Each hall is set up for 2MW but, thanks to AOL's overbuilding, they can be upgraded quickly to 3MW: "As long as it takes us to order the equipment, that is how long it takes to give the client another MW of compute."

Rebuilding in an older space has created opportunities for creative thinking. AOL built a row of UPS rooms between the mechanical and electrical section and the data halls, but in twenty years, battery technology has moved on. Infomart replaced lead-acid batteries with more compact and intelligent lithium-ion cells, leaving it with whole battery rooms to repurpose.

"We recycled 1,800 tons of lead-acid batteries from this building, and replaced them with lithium batteries," he said. "I have regained 12,000 sq ft of rental space."

It's specialist space, though. The old battery rooms are smaller than today's typical wholesale colocation space, but they are super-resilient: "This is the most hardened and fortified space in the building. The outside wall is concrete, the inside walls are concrete. It's effectively a bunker, inside of a bunker, inside of a bunker."

Who would want such a space? Ephraim doesn't spell it out, but he says the phrase "hardened and fortified" is a code in the US colo market, for "federal-ready." Governments might use this space, as well as big cloud providers, for activities that require a heightened level of privacy and security.

Despite the emphasis on reliability, the site has not been given an Uptime Institute Tier certificate. In part, that's because the building predates the Tier rating system, and in part because this is a sophisticated market that will look beyond the certificate to the components of the building.

The site has N+1 power and UPS infrastructure, and meets many Tier IV requirements, even though it doesn't have two utility feeds (just one from Dominion). If the power goes, it does have 80,000 gallons of diesel fuel, half of it below ground. "That's enough for five to seven days," Ephraim boasted. "Everyone else in the market guarantees one day. If we lose power at Dominion, we have three generator rooms, and they can pick up a full load."

It also has 650,000 gallons of water storage, fed from two wells. "It's a closed loop," Ephraim said. "There's little evaporation. We're effectively 3N on water."

One thing the building doesn't feature is a glossy exterior. Inside, there are all the things a customer would expect, such as office space, storage and lounge areas. But outside, this is the least imposing data center *DCD* has visited. Compared to nearby facilities from RagingWire, Digital Realty and Equinix, it's nearly invisible.

"What I like about our building is we are selling on anonymity," Ephraim said. "It's industrial; it's not sexy. 25,000 cars drive through this intersection a day, but not one percent of them know what this building is."

It's not just security by obscurity: AOL made sure the exterior can subtly deflect physical attacks as well as crashing airplanes. Bollards with 8ft roots block any vehicle from directly ramming the gates, and a high berm deflects any attacks to vehicle-arresting cables, as well as blocking casual sightseers.

If this building is a unicorn, as Ephraim says, it's a unicorn that's had an extreme make-over. It's an armor-plated energy-unicorn, wearing a cloak of invisibility.

# Modernize or outsource?

**There are several ways to modernize a data center, including low-investment fixes, major upgrades and replacement. But which approach should you adopt?**

Data centers are changing fast, and it is sometimes said that a facility becomes obsolete on the day it is built and commissioned. In most cases, this is far from the truth. As data center technology has matured, it has become possible to upgrade an existing site - and, more importantly, it is now possible to understand the likely financial implications of any decision to modernize your facilities.

Modernization covers a range of situations. Some facilities may be aging, and need improvements such as more space, more efficient cooling, or more flexible power infrastructure.

Others may have reached the end of their useful life. This can mean that maintenance costs are too high, or the systems are antiquated and becoming unreliable.

Modernization includes a range of options, from low-cost fixes that address simple problems, through a formal upgrade, to building an entirely new data center. Beyond this, some or all of the IT functionality can be offloaded to cloud or colocation providers. And of course, the choice is not either/or, as the way forward will surely involve a combination of these options.

When choosing between approaches to modernization, it is wise to consider the total cost of ownership associated with your choice, calculated over 10 years.

A total 10-year cost of ownership (TCO) analysis might favor a major data center refit or even a brand new facility. However, the business may be sensitive to cash-flow, and face other strategic considerations such as regulatory requirements, and the life expectancy of the data center and its services.

**Easy fix modernization**

In some cases, the CFO cannot authorize funds for major investment in a data center. The CIO will then have to take a minimum investment approach, aiming to buy time, perhaps six or 18 months.

The data center team will then have to evaluate the existing infrastructure and come up with ways to improve it on a limited budget. This translates into an approach which could reduce waste, increase capacity, improve efficiency, and make the facility more reliable.

This set of modernization procedures will address the IT load, reducing or consolidating it through virtualization, to cut down on the number of servers in the facility, and also by locating and decommissioning unused or underutilized servers. Many servers are under 10 percent utilization, and are simply wasting resources. It is also possible to manage the energy usage, so that the maximum power drawn by any server is limited.

Another major upgrade avenue is in cooling systems, where it is usually possible to make great improvements to airflow. In an older facility, as much as half of the cold air recirculates back to the cooling systems without reaching the racks. These problems can be fixed with blanking plates, brush strips and aisle containment.

An often-overlooked quick-fix option is to add preventive maintenance to the operation of the data center. Many components become less efficient with age - for example, batteries - while factors such as low refrigerant levels, clogged filters and overheated capacitors can reduce efficiency. Batteries, fans, capacitors and HVAC equipment can be monitored to identify early signs of failure.

Much infrastructure equipment is supplied with firmware that that can perform remote monitoring. For a recent plant, this

functionality simply needs to be "turned on;" for an older plant, it may need to be installed. This can even be shared with the equipment provider to make the actions automatic.

Easy-fix modernization is a low risk process, but there is a danger. It can morph into a "band-aid" approach, which ignores major long-term needs. Eventually, a strategy of patching equipment which is becoming outmoded will lead to lower reliability.

**Upgrading an existing data center**

If a data center is running out of cooling or power capacity, but still has room in the data hall, it may be time for a major upgrade, especially if easy-fix options have been exhausted, or deemed impractical. This approach typically adds one or more rows of racks to a low-density data center.

The simplest approach can be to add a "pod" - including a number of racks, bundled with their own dedicated row-based cooling. This can be deployed as a single unit without impacting the rest of the data center. It allows high-density, high efficiency racks to be deployed within an otherwise low-density facility.

Because they are self-contained, pods don't require changes or upgrades to raised floor cooling, and don't need computational fluid dynamics analysis before installation. The pods enable a modern, modular approach to data center architecture.

Obviously, the choice of whether to invest in a pod for ten years will depend on how long the requirement for in-house capacity will continue.

If the basic infrastructure for UPS, power distribution and heat rejection is already at capacity, then another option is to add an external module, or a containerized data center. These are pre-integrated, pre-engineered and pre-tested, including their own power and cooling systems, and shipped to the site ready to use.

Such units can be delivered on a skid, or else in their own modular building. Once delivered, it is simply a matter of connecting power and chilled water piping. They can be installed in a parking lot or other level ground.

Installing containerized units is quicker and easier than adding new capacity or a new facility, and more reliable than upgrading existing plant. They can be significantly faster to deploy than other forms of new capacity, and up to 13 percent cheaper as well.

If you intend to keep the data center going for three years, this is a better option than outsourcing it. Adding one or more high density pods can extend the life of a facility.

**Building a new data center**

When an existing site has no more available power, cooling or space, and there are new IT requirements, it can make sense to build or buy a new data center. It will be more efficient and ensure a longer lifespan than upgrades or quick fixes. The drawback is the high capital investment required, and the risks associated with capacity planning

Of course, building a data center would incur many other costs, including the cost to lay fiber and the cost to migrate hardware and software from one facility to the other.

For more information, use these Schneider Electric resources:.

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*bit.ly/SchneiderCalculator*

*Modernize or Outsource: Evaluating Your Data Center Options (eBook)*
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# Data center surgery

**Dr. Peter Judge**
*Global Editor*

**Looking forward to your improved and upgraded data center? *Peter Judge* finds you may have to suffer some inconvenience along the way**

Retrofitting a live data center is not all that different from open heart surgery," says Frank McCann, principal engineer for project management and implementation at Verizon Wireless. Just as the heart surgeon has to fix a problem without killing the patient, he points out: "A successful data center is a living, breathing entity - and we have to keep the customer equipment up and running while improving the overall environment."

McCann has plenty of facilities to keep healthy. Even though Verizon sold its colocation business to Equinix, and its managed hosting to IBM, it still has a number of data centers running its core applications and services.

Unlike the surgeon, the data center engineer actually does have the option of killing the patient - and resurrecting them in a new body. In some cases shifting all the services into a new facility is possible. But McCann says this is rarely simple: "You have to deal with the ancillary things such as locating energy and telecoms, and relocating your employees," he explains. "In the South, a new build might make sense as the savings make up for ancillary costs."

> *One thing that gets overlooked in retrofits to older buildings is the people*

In his home territory of New Jersey, he sees plenty of upgrade work, as urban data centers generally don't have the option to expand or move: "In the New York metro area, a retrofit makes sense because there isn't space for a new build."

The biggest problem with an upgrade is the fact that it may have to be done while the facility is live. "If it's not concurrently maintainable, then you either switch it off, or work on live equipment," McCann says.

This is not impossible, but it requires care. Engineers can work on different sections of the facility, by moving IT loads. Power is switched away from the racks which are no longer supporting live services, which can then be worked on. Then the loads are moved back, so the rest of the facility can be updated.

The most important thing is to test this procedure before using it on live facilities, but operators are rightly reluctant to test reliability in this way: "I don't want to test the airbag in my car," McCann observes.

**70°F**
**Cooling below this is a waste of money (ASHRAE)**

**An upgrade** can expose dangerous differences between theory and practice in an old facility, he warns: "The biggest danger of outages when upgrading a live data center is the lack of documentation. Something you think is not connected may be connected, or is connected in a way which is non-obvious."

For example, a rack may appear to have an A and a B feed, but in reality they both go to the same source - or one is not connected at all: "They may be labelled wrong, or connected incorrectly."

Like a heart surgeon, a data center modernizer has to be ready for a crisis. When adding a new chiller to a Verizon facility, McCann had difficulties cutting the chilled water pipe. It's normal practice to freeze the pipe, then cut through it, but this pipe was too big to freeze all the way through.

"We had to do a lot of research to find a tool that could cut a hole in a pipe and insert a valve without it leaking," he says. Even after finding such a tool, the trouble wasn't over: "There's a danger of shavings getting into the water or the cut-out getting washed down the line and breaking the cooling system."

The situation arose because this was an old facility. The upgrade had never been planned, and the data center was built without a shut-off or a bypass for its chilled water pipe. "New builds are much easier," he says.

"One thing that gets overlooked in retrofits to older buildings is the people," he says. Building a data center, you have the site to yourself, but when working on a live facility, you need to work alongside facilities staff. "How can people park, and get in and out for lunch?" he asks. "How can they get day-to-day work done with all that noise?"

Changes in IT architectures can paradoxically make his job harder, he says (see box) - as virtualization allows workloads to be consolidated, hardware is driven harder and pushed to its limits. "It now requires more cooling, and failover processes need to work better. As things get more software-

defined, there is more reliance on hardware.

Verizon has a long heritage, which can sometimes be a burden but is currently proving very useful. It has hundreds of telco rooms, with space and power, but it has taken a while to properly turn them into data centers, with features like cold aisle containment. This is an upgrade which fits into the current evolution of infrastructure: these will become edge facilities.

Built to hold racks of old telecoms switching equipment, they now have plenty of space as the telco footprint consolidates. "We are not running into space issues," McCann says. "Now it's power and cooling."

IT equipment is now rated to run at higher temperatures, which ought to reduce the burden on cooling systems, but the increased density may well negate this benefit. And, in any case, operators are still reluctant to run their equipment hotter, if it is critical to their operations: "Equipment can go hotter and hotter, but if you let it go hotter, it might die sooner," McCann notes. "It's a balancing act."

He agrees that, thanks to modular technologies, future data centers will be easier to upgrade than the first facilities which are now being retrofitted: "We thought this would be all, and we would never outgrow it. We realize that there will be changes in future."

## When modernization meets consolidation

Consolidation begins with a desire to make one's data center estate more efficient. First of all, the IT load in individual facilities is made more efficient. Then data centers are combined and closed. But if the facilities themselves need upgrading, this can block consolidation or make it more complex.

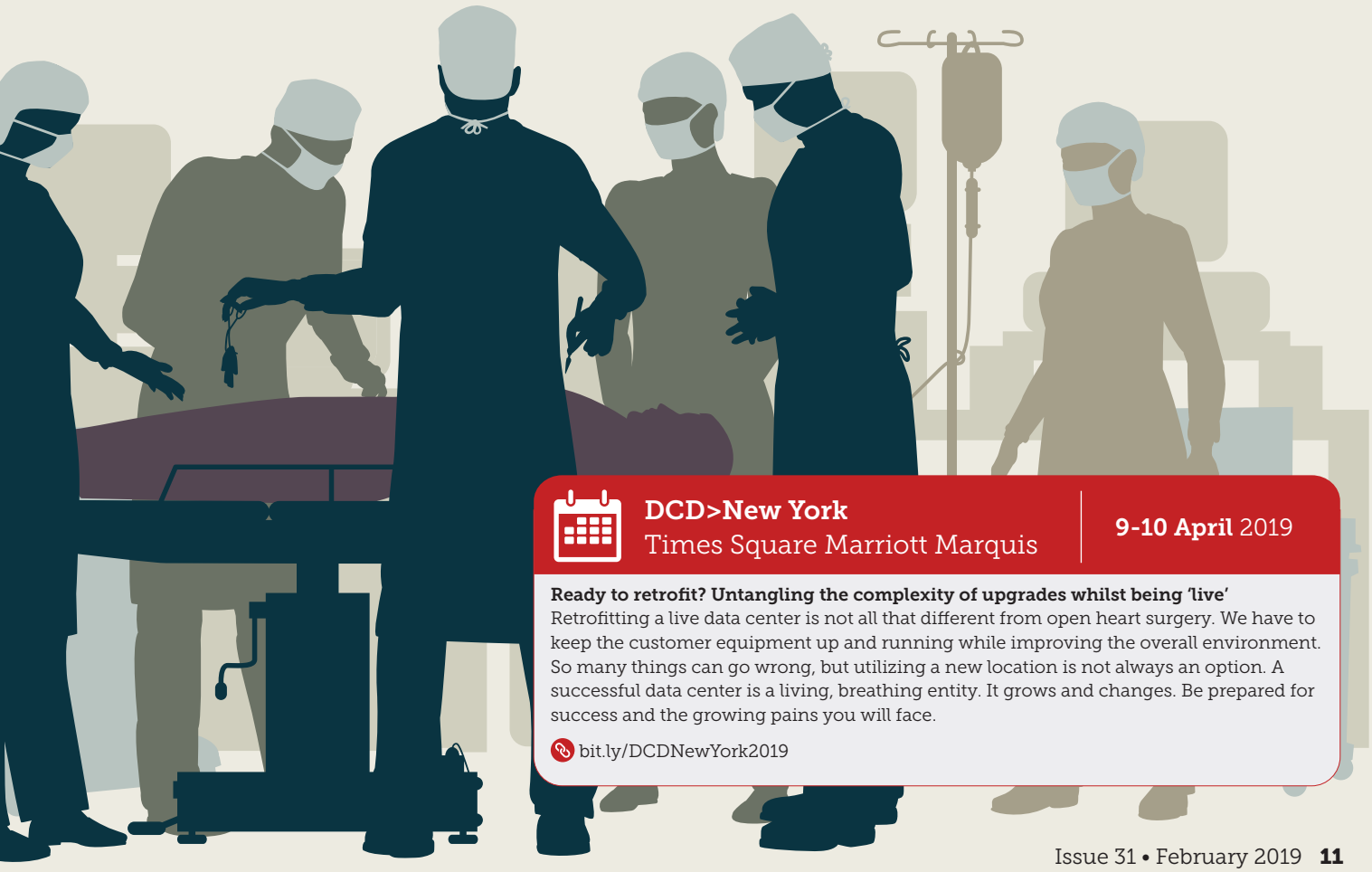
When virtualization first began its march across the IT world, servers were utilized at a rate of about 10 percent, and each application had its own server. The first steps were simple; put applications onto virtual machines, and combine those machines on physical servers, increasing utilization.

The drive to consolidate has progressed now, as centralized cloud services provide a greater aggregation and concentration of resources, with improved efficiencies. Large organizations often set goals of not opening any new data centers, presuming that any new capacity shall be bought from cloud service providers, rather than created in on-premises or in-house data centers.

The US government is a prime example of this: the 2014 Federal Information Technology Acquisition Reform Act (FITARA) mandated closure and consolidation, and is believed to have saved the administration around $1 billion. It's one of the policies that the Trump administration has left more-or-less unchanged.

The strategy is applied everywhere: according to the Data Centre Alliance, 62 percent of data centers are going through consolidation efforts at any one time. But let's think about what that means. It involves integrating physical DC locations, as well as optimizing hardware platforms hosting software.

In other words, any consolidation effort clearly implies modernization of the facilities which will remain. But that modernization effort will be as unique as the data centers that are being consolidated, says John Leppard of Future Facilities: "The process for consolidation is both complex and unique to each organization and its goals."



# Thriving during a Greek tragedy

**What happens when international fiber fails to light up, and your country hits a depression? Lamda Hellix's CEO tells *Peter Judge* about data center life in Greece**

**Peter Judge**
*Global Editor*

There is no one-size-fits-all data center business. What your company does will ultimately depend on what the business opportunities are in your location, and in your market sector - and this may create data center providers that are very different to each other.

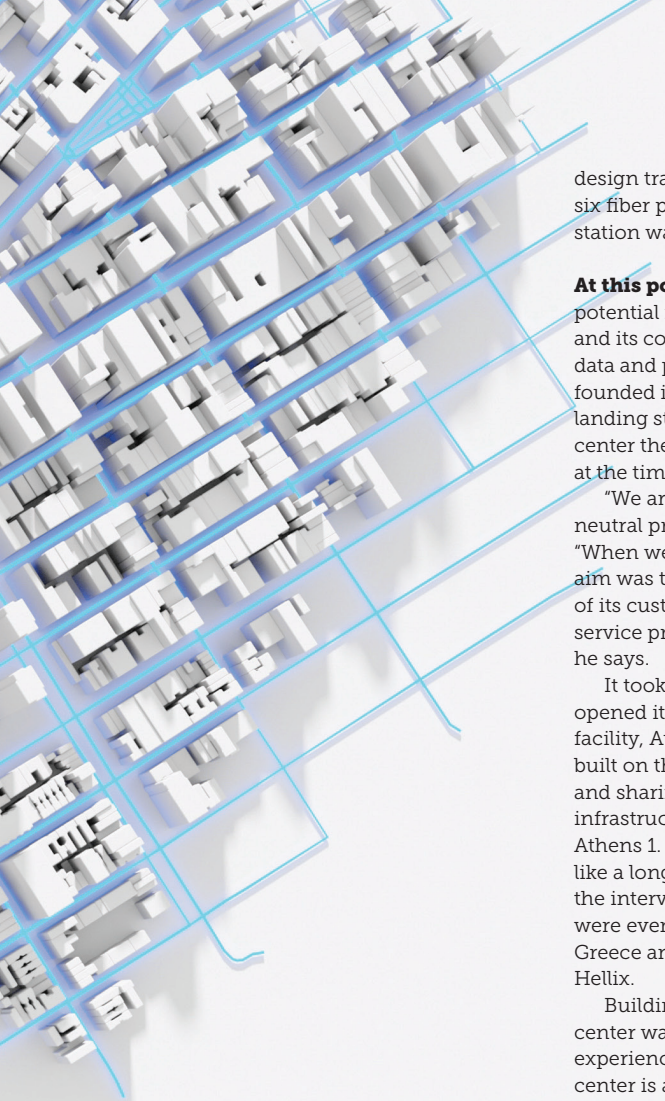
Greece's Lamda Hellix is a case in point. Created from the fall-out of the telecoms crash of 2001, it has had to think fast, and keep refocusing to handle changes in the tech world, the Greek business climate and the regional digital ecosystem.

This year, the company expanded its Athens 2 data center with an extra 1MW, and announced it had passed the Uptime Tier III reliability certification, while the company celebrated fifteen years in the business.

Founder Apostolos Kakkos has worked to develop an international tech business in Greece, and also made time to co-found the European Data Centre Association. We met him in his Athens-2 flagship data center, joining the reception to celebrate Lamda Hellix's anniversary.

**He unfolded a fascinating** tale of flexibility and a drive to make Greece a significant tech center for South West Europe, with or without the help of major international fiber links.

The company's Athens 1 facility, close to Athens airport, was not originally built as a data center. It was originally planned in the late 1990s by Tyco Global Networks, as a cable landing station for a major international cable which, Kakkos says, would have turned Greece into a major communications hub.



But then the telecoms crash happened. Tyco Global Networks - along with other neutral international networks - was a good idea, Kakkos says, but it was ahead of its time: "At that point, all the existing cables were constructions between telco players who had monopolies in their countries. Tyco was producing fiber and selling it to telecoms operators. So why not run the cables and get the return that BT and the rest were getting?"

The idea was disruptive, but there was a problem: "At the time, there were no over-the-top services. The Facebooks, and the Netflixes did not exist." These nascent international cable operators couldn't make a profit, and in 2001 the network roll-out stalled, leaving redundant capacity on some routes, and other planned links unbuilt.

Athens now relies on the Telecom Italia's MedNautilus network, a fiber ring with a total design transmission capacity of 3.84Tbps on six fiber pairs, and Tyco's planned landing station was put on the market cheaply.

**At this point**, Kakkos stepped in, seeing the potential for a building with this location and its connections into Greece's existing data and power networks. Lamda Hellix was founded in 2002, quickly bought the Tyco landing station and in 2003 opened a data center there - a pioneering move in Greece at the time.

"We are the first and only 100 percent neutral provider in Greece," says Kakkos. "When we started in September 2003, our aim was to address the local market." A lot of its customers are international firms and service providers with a presence in Greece, he says.

It took 12 years before the company opened its second facility, Athens 2, built on the same site, and sharing a lot of infrastructure with Athens 1. That sounds like a long time, but the intervening years were eventful - both for Greece and for Lamda Hellix.

> *We are the first and only 100 percent neutral provider in Greece*

Building the data center was a learning experience as a data center is actually quite different from a cable landing station, so Lamda Hellix gained a lot of skills on which it could capitalize: "We had to invent the data center business in Greece, and we didn't have a lot of potential partners so we had to create our experience and know-how."

The building was not designed for raised floors, so these had to be installed - with a step up and a well by each of the doors. Power and cooling systems had to be sited the whole set-up gained an enviable efficiency rating.

"We wanted to have our own center of excellence, in order to construct and design facilities as good as Equinix or Interxion, without spending so much money," he says. The company had some of the earliest Uptime-accredited engineers in Europe.

Of necessity, their expertise is somewhat specialized: "Our expertise is 10 to 15MW data centers, not 50 to 100MW. We aren't in Northern Virginia - we are in Greece." The facility began to offer colocation for large Greek enterprises, and multinationals with business located there. The site also offers disaster recovery, with desks equipped with PCs, ready for displaced office staff.

But as customers moved in, they also started to create business elsewhere for Lamda Hellix. Disaster recovery customers began to ask about problems with their on-premises data centers.

One customer had a data center which was over-heating. Its cooling supplier suggested using more CRACs to keep the temperature down, but the customer did not trust this suggestion.

Lamda Hellix's engineers visited and put their building expertise to good use. They spotted that the facility's raised floor was too low, restricting air circulation. "We went, not as a paid service, but as friends," says Kakkos, "but they asked if we could fix it, and one thing drove the other."

Lamda Hellix moved the whole data center out of the building, raised the floors and put it all back. From this project, the company launched Lamda Hellix Data Center Integration and Consulting Services, which has carried out projects in ten countries, including Ukraine, Malta, Cyprus, Abu Dhabi and the United Arab Emirates.

"The next step was a client for whom we designed and constructed a facility," says Kakkos. "Now we are running 162 facilities for third parties, from 30-40 rack sites up to a couple of MW."

Meanwhile, the company added services in its own data centers: it now has a multi-homing IP service, hardware as a service and hybrid cloud: "We are quite diversified in different services. So far it's gone well."

All this kept Lamda Hellix growing through the Greek Depression, which began in 2009, in the aftermath of the global financial crisis of 2007-2008. Indeed, some aspects of the crisis enabled Lamda Hellix to help Greek businesses who wanted to export services but found it difficult to use cloud providers hosted abroad, such as Amazon Web Services (AWS) and Microsoft Azure, because of government restrictions on currency movement.

**Hosting at a Greek** data center allowed Greek companies to access world markets, while paying a local provider in Euros. Some Greek companies actually moved services back from abroad into Lamda Hellix.

During this period, awareness of privacy also encouraged companies to keep Greek citizens' data within Greece: "We see a steady and growing acceleration for people using our facilities, including global financial companies and organizations who have to keep data in Greece."

International business - both in ▶

consulting and in hosting foreign organizations - has been important, says Kakkos: "The Greek economy is small compared to other countries. It's bigger than Bulgaria and Romania, but it is smaller than the Turkish economy."

Greece never became a transit country, after the collapse of Tyco's ambitions, but Kakkos still has hopes: "We are trying to help that."

Finally, in 2014, the 3MW Athens 1 was full, and it was time to start a new facility. The project for Athens 2 got under way. But once again, the economy threw in some surprises.

**By 2014, it seemed** Greece had stabilized, and the company went ahead and built, arranging a launch party for June 2015.

"It was a Tuesday," Kakkos remembers. "I thought there would be not many people. We invited lots of people from politics because this was international. It was infrastructure for Greece, for South West Europe." Kakkos invited everyone including people from the Chinese embassy - but he didn't expect many to show up for a data center opening.

*It wasn't the optimum time for the opening of a data center*

There had been a snap election in January 2015, and the EU bailout was extended. The Tsipras government was expected to agree new payment terms, but the EU rejected their proposals twice.

Just before the Lamda Hellix launch, talks broke down, and the government announced a referendum on the EU proposal. On Monday, the day before the launch, the banks closed for a month.

"It wasn't the optimum time for the opening of a data center," says Kakkos, with a grin. But in those circumstances, the launch was well attended, the opening went ahead, and Athens 2 is now filling up and expanding according to plan.

Given the market dynamics, Lamda Hellix is bringing capacity on stream in phases, starting with 500kW and scaling up to a present capacity of around 3MW, with a full capacity of 6MW planned for a couple of years' time.

Both Athens 1 and 2 are two-story facilities, and Kakkos points to some specific enhancements. Lamda Hellix uses two fire suppression systems, with the Inergen inert gas system backed up by a water mist system designed for deployment in a real emergency. The water mist is designed to minimize problems with the technology, but its priority is to keep the people in the facility safe.

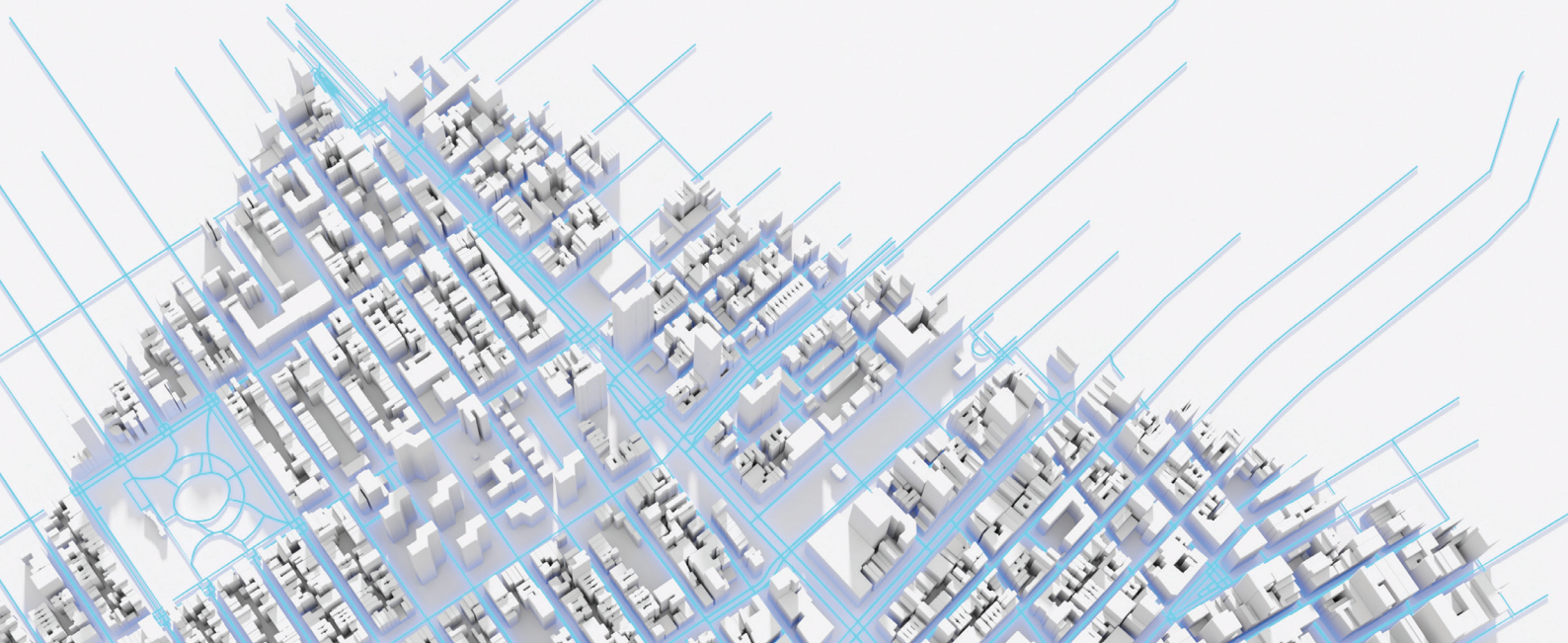
Kakkos is proud of the DCD Award Lamda Hellix won in the Service Provider category in 2015. It also won an award in 2012 for "best workplace in Greece."

**Its work for** other clients also gets noticed. He mentions a few names, including Khazna of the United Arab Emirates, and a modular build for Greek research network GRnet that also won an award.

In future, Kakkos hopes that the relaxation of capital controls by the Greek government will enable greater growth in the country's economy.

"We have growth around two percent. The two largest parties are quarreling about whether it could go to four percent. I'm a creator and an entrepreneur, I say how can we get six percent?"

If that happens, Kakkos already has plans for Athens 3.




# Inside Intel: From silicon fabrication, to energy-efficient data center

**We all know Intel for its chips, but perhaps we should be paying more attention to its data centers, *Sebastian Moss* reports**

**Sebastian Moss**
*Senior Reporter*

*It was our first experiment, and when we were successful at getting 30kW per rack with 24-inch racks, then we said 'ok now let's go and break the barriers'*

Shesha Krishnapura is beaming. Of the many data center tours I have been on, Krishnapura's is clearly the one with the most excited of guides. "Welcome to the world's best data center," he says with a chuckle.

We're in a huge, 690,000 square foot (64,100 sq m), five-story building right next to Intel's global headquarters in Santa Clara, California. "Where you are standing is an old Intel fab called D2. The last product that was made here was the first generation Atom in 2008. It was decommissioned by the end of 2008, so by 2009 it was available - just an empty space."

Krishnapura, the CTO and senior principal engineer for Intel IT, "made a proposal to use D2 to learn how to build megascale data centers with energy efficiency, cost efficiency, and so on, in mind."

"At the time, [then-chief administrative officer] Andy Bryant said 'OK, you guys can have this fab to build, but first go and experiment in the old S11 building.'" There, Krishnapura's team built a chimney cooling system, along with a traditional CRAC unit, to achieve a power usage effectiveness (PUE) of 1.18. "It was our first experiment, and when we were successful at getting 30kW per rack with 24-inch racks, then we said 'ok now let's go and break the barriers.'"

**The result, built out** over several years, is a data center with several unique elements, and an impressively low PUE.

"Today you're going to see around 150,000 servers," Krishnapura says as we head into D2P3, Intel's largest data center, which spans 30,000 square feet (2,800 sq m), with a power capacity of 31MW.

The facility uses close-coupled evaporative cooling that relies on recycled water, to help it to reach an annualized PUE of 1.06, significantly below the "worldwide average of about 1.7," Krishnapura says.

He explains: "The city, when they process all the wastewater from homes, like sewer water and all the kitchen waste, they typically throw it into the Bay for natural evaporation. But they also sell that water for industrial use, or landscaping or other stuff, at 50 percent lower cost. So we buy that to cool this data center."

Elsewhere in the old semi conductor fabrication plant are smaller data centers, ▶

including D2P4, which has 5MW of power capacity across 5,000 square feet (465 sq m). Thanks to free air cooling, it, too, has a PUE of 1.06 - "they have exactly the same PUE, but totally different techniques."

**The two facilities** have the lowest PUE of any of Intel's data centers. "We've closed lots of small, inefficient data centers, and are trying to reduce our average PUE across our data centers to near 1.06," Krishnapura says. Back in 2003, the company operated 152 data centers, by 2012 the number shrunk to 91. "Now we're at 56."

The reduction in data center footprint has conversely come as the company has faced more and more compute demand - with a rough increase in demand of 39 percent a year. To meet this challenge with fewer sites, Intel has relied on its old friend, Moore's Law (the observation that the number of transistors in a chip doubles every two years, proposed by Intel co-founder Gordon Moore).

"In 2002, we had 14,191 servers with single-core, two-socket CPUs, totaling 28,000 cores," Krishnapura says. "Now we have 240,000 servers, we have 1.7 million cores, more than 260 petabytes of storage and more than half a billion network ports within the data center."

While Krishnapura talks, I become aware of something unusual about the facility: "You're already sweating, because it's very hot," Krishnapura observes.

**When retrofitting D2**, Krishnapura read a paper from Google that revealed the search giant operates its facilities at 78°F (25.5°C), in the cold aisle. "We said 'why limit it at that? What's the maximum we can go to?'" All available IT equipment supported inlet temperatures of up to 95°F (35°C), so the company settled on a cold aisle target of 91°F (32.7°C).

"It ranges between around 78-91°F in the cold aisle, depending on the outside temperature. The hot aisle is usually 20-30°F hotter."

**242,000**
**Total number of servers across Intel data centers**

Looking up, Krishnapura says another difference is the height. "Industry-standard full IT racks are 42U, roughly 6ft. We are much taller, our racks are 60U, it's 9ft." They are also slimmer: instead of the standard 24-inch format, they are trimmed to 20 inches, allowing for a few more racks to be crammed in.

"In 50 linear feet, where you can put 25 standard racks, we can put 30 of them. And as they're taller, we can put a lot more servers: each rack supports all the way up to 280 servers, and each rack can support up to 43kW peak power load."

These are used internally for many of the things one would expect from a large enterprise, from running SAP workloads, to hosting webservers, to running Intel's video conferencing tools.

They are also used to design the company's chips. "We use it for all the pathfinding to 7nm, to 5nm, some of the quantum physics algorithms - how the electrons scatter - all of that," Krishnapura says.

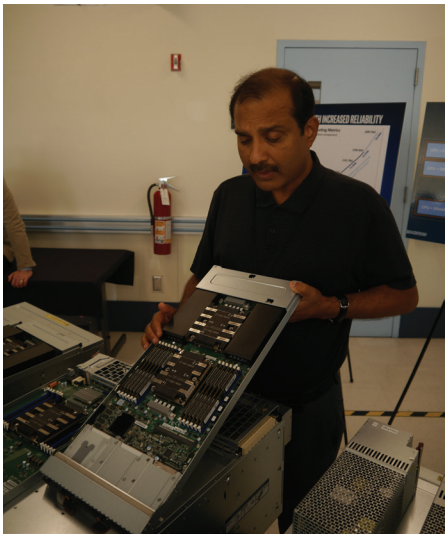
*If people want to 'rack it and stack it,' they just need to remove four screws - it takes 23 percent of the time [spent previously]. You save 77 percent of the technician's time*

By using Intel products in the company's facilities at scale, Krishnapura is additionally able to "give feedback back to the data center chip design business - we want to eat our own dogfood and learn from it."

This creates a "feedback loop into the data center business, about how do we innovate and what kind of chips we want to make," Krishnapura says. "It could be FPGAs from our Altera acquisition, or it could be the discrete graphics which we are working on, or it could be the other accelerators like Nervana."

**But perhaps**, for a business like Intel, one of the major benefits of using its own data centers is the obvious one - saving money: "The goal is to run the best data centers in the world and, from 2010 to 2017, we saved more than $2 billion, compared to having everything in the public cloud. So our cost is less than 50 percent of running in a public cloud."

Further cost savings are being realized as the company pushes for fewer, but larger, data centers. "For every 5MW, we are paying $1.91m less in utility bills, electricity bills, every year in Santa Clara," Krishnapura says. "For this particular data center, for example, when it is filled out, we will be paying a nearly $12m lower electricity bill for the 31MW."



That electricity is used to power servers from several different vendors - *DCD* spotted logos from HPE, Dell and others - but most of all, it's used to power Supermicro servers. That's because the company partnered with Intel on Krishnapura's brainchild: disaggregated servers.

"Green computing is not just energy-efficient computing, or using less natural resources like freshwater, there's also e-waste," Krishnapura says, describing how data center operators often rip out entire servers and replace them every five or so years - a huge financial cost, and a significant waste, when some equipment can be reused, as can the sheet metal. "There is no reason to change all of this."

**Disaggregated servers** "separate the CPU complex, the I/O complex and the accelerator complex," he says. "Whatever you need, you can independently upgrade easily."

Of course, companies can already upgrade aspects of their servers, but it is a difficult and laborious process. With disaggregated servers, "if people want to 'rack it and stack it,' they just need to remove four screws - it takes 23 percent of the time [spent previously]. You save 77 percent of the technician's time, that's a huge value."

**23**
**The number of sites Intel's 56 data centers are spread across**

However, with Krishnapura and Intel holding the patent, there is a downside: "It's our IP, obviously we don't want our competitor chip, graphics or other processor to get in."

**The servers are** currently only available from Supermicro: "In fact they were the last company that I pitched the idea to, I had pitched it to every other company... but Supermicro saw the value very quickly."

In June 2016, Krishnapura discussed the idea with Supermicro CEO Charles Liang, "and then six weeks later we had 10,000 servers deployed - it's never been done in the industry that fast. Now we have more than 80,000 disaggregated servers."

The idea, which aims to reduce the number of new servers companies need to buy, has not been immediately embraced by the industry: "It could be that their revenues are also lower," Krishnapura says. "But what they don't understand is that as [company] IT budgets are flat, you are now giving a reason for them to upgrade every two years, instead of every four."

This would mean that customers are likely to buy more CPUs - which will presumably come from Intel - but Krishnapura also insists this is a matter of ethics. "My whole purpose now is to use less material, less energy to deliver more compute and more aggressively bring value to the enterprises worldwide - not just to the cloud, but also for the private cloud, for HPC, and every segment."

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