From the data center floor to the rooftop, eBay drives down transaction costs with Dell Data Center Solutions

Customer profile

Company   eBay
Industry   Technology
Country   United States
Employees 27,771
Web site ebay.com

Challenge

eBay® needed an efficient, scalable data center to keep pace with growth and reduce costs.

Solution

Dell™ Data Center Solutions custom designed servers for their data center, and custom designed an ultra-efficient, highly scalable Modular Data Center for the roof that relies heavily on fresh air cooling.

Benefits

- Gain free-air cooling year-round
- Increase density with up to 30 kilowatts in a rack
- Scale out easily with modular infrastructure
- Deploy thousands of servers in minutes
- Industry leading PUE in harsh environmental conditions

Application areas

- Data center facilities
- Modular data centers

"Our results—you can't contest them. We've never been this efficient."

Dean Nelson, Vice President, Global Foundation Services, eBay

When it comes to online marketplaces, there is none bigger than eBay. The company has more than 102 million active users and drives $69 billion in transactions —more than $2,000 every second. But numbers alone don't tell the story of eBay. At its heart, eBay is a company driven by innovation—from its groundbreaking approach to e-commerce to its leading-edge data centers that allow buyers and sellers to find each other with the click of a mouse.

While buyers and sellers never see this side of the business, the eBay focus on innovation is nowhere more apparent than in the company's data centers. That's the case in Phoenix, Arizona where the company has launched one of the world's most efficient data centers. Among other achievements, this extremely dense data center uses dry desert air year round to cool thousands of servers—and to help drive down the cost of doing business on eBay.

When IT is the business

For eBay, rapid growth is a constant challenge. On an annual basis, the company is adding millions of active users and listings for sale on its site. To keep pace with this upward spiral, and to continue to deliver a first-class customer experience, eBay must continually scale out its IT infrastructure and push for greater efficiency in its data centers.

"IT is our business," notes Dean Nelson, Vice President of Global Foundation Services (GFS) for eBay. "That's because our 100+ million active users depend on our site 24 by seven by forever. More than $69 billion worth of goods are transacted through our site every year. That works out to be about $2,000 a second. Having the right infrastructure to allow buyers and sellers to complete those transactions is extremely important. Without it we die."

For Nelson and his team, keeping IT in step with the demands of the business is a never-ending quest. The company's back-end infrastructure must continually scale out to accommodate ever-larger numbers of buyers and sellers who connect with one another through an eBay data center.

"Keeping up with the demand is one of the biggest challenges, because our business is continuing to grow," Nelson says. "Lately, we have been spending a

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lot of time watching the behaviors of our buyers. Usually people would go to the store, find something they want and they would buy it. Now people are on mobile devices using eBay applications like Red Laser and the eBay mobile app, looking for what they want, when they want it, how they want to buy it, for the price they want to pay. We are making those activities extremely easy for our customers. Keep in mind that all transactions go through our network, into our data center, and complete on our IT equipment.

The rise of a next-generation data center
eBay has a very unique organizational structure. Facilities and IT are both under the same executive, with the same budget and goals. In contrast to many enterprises, the team reports up through the CTO, not the CFO or the CIO. Global Foundation Services (GFS) is responsible for data centers, networking and supply chain. This organization is on the revenue side of the business, so balancing cost and overall system performance is paramount. This balance can directly impact margins.

In 2010, faced with rapid growth and a need to drive down operational costs, eBay launched a data center expansion effort dubbed Project Mercury in Phoenix Arizona. Under this banner, the GFS organization set out to build one of the world's most efficient and flexible data centers.

The GFS team made the decision to use modular data centers in Phoenix, the location of one of eBay's three primary data centers—the company's two other primary sites are in California and Nevada. The data centers are strategically located to minimize latency between sites, so things happen faster for buyers and sellers doing business on eBay.

"Latency is our biggest driver," Nelson says. "That's how fast a transaction needs to be done between the sites. The reason we're here is first and foremost to ensure that we can quickly deliver results for those users doing those queries."

In 2010, eBay took a novel approach to drive data center innovation. They put out a public request for proposal (RFP) for the design of its Project Mercury data center. It issued a list of challenges to vendors to cast their preconceived notions out the window and rethink how to design the next generation data center. This list made it clear that the company wanted vendors to step outside the box and think in terms of innovation and target scale, flexibility and "uber-efficiency," according to Nelson.

"In Project Mercury, it's all about efficiency," he says. "My team pays the power bill. Our data centers represent over half the power consumption for the company. So every watt we can reduce, wherever it's reduced, lowers our actual costs. This directly increases our margins. And that's very, very important because we're on the revenue side of the business. Every time we can reduce the costs, it gives us opportunities to reinvest in our portfolio, lower costs for our buyers and sellers, and reach more people around the globe."

One of the challenges in the RFP called for vendors to design a data center that would make primary use of free air for cooling severs and other data center equipment, year round.

"The first challenge was, 'You will design a data center for us that is going to give us free cooling year-round in Phoenix," Nelson says. "That opened it up. We didn't say, 'Here's how you're going to design it and how you're going to do it.' We gave it to the engineers and we basically leveraged the minds in the industry. And it was a competitive RFP. We allowed anyone who was qualified to submit a proposal. That innovation cycle was incredible."

Video »
The eBay team talks about "uber-efficiency" with PUE at 1.043 at 2-3x the density

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>
> *Dean Nelson, Vice President, Global Foundation Services, eBay*

So how do you design a data center in a desert climate for free cooling? The answer begins with knowledge of the environment. Nelson and his team knew that because of the dry air in Phoenix, the modular data center could utilize direct evaporative cooling. Even with outdoor ambient temperatures frequently above 100 degrees Farenheit (F), the servers see air temperatures of 87 degrees F, or less off the evaporative units.

"It can be 120 degrees outside, but because it's dry, and there's less humidity in the air, you only have to cool the equivalent of 87 Fahrenheit—on the worst day of the year," Nelson says. "And you can do this with containers on the roof directly exposed to the sun and achieve incredible efficiencies out of these units."

The key is to achieve a balance between the outside air temperature and the temperature of the processors in thousands of servers. Having a completely vertically integrated solution allows for a balanced ecosystem between the facility and the servers, which drives the ultimate efficiencies. "The servers and chips can handle much higher temperatures than people think. 87 Fahrenheit, for four hours a day, two weeks of the year, which is the worst-case scenario, is still cold for that processor, says Nelson. All of the other times of the year, the temperatures are colder. We designed for that worst case annual temperature to be the starting point for cooling. After that, everything else is easy. Everybody babies these servers. They have a much wider thermal envelope and can operate at higher temperatures without sacrificing performance."

To achieve the potential of free air cooling, IT and facilities staff must work together to optimize the data center environment.

"If you start tuning IT equipment and facilities together, you can have that balanced ecosystem," Nelson says. "The majority of data center inefficiencies are directly tied to the facilities and IT teams not working together."

The second public RFP for the Project Mercury initiative covered the computing equipment for the new data center. "We clearly articulated how the vendors could win," Nelson says. "We add the unit costs to the cost associated with the wattage consumed per server with our workload over its useful life. That's really, really important, because now we know exactly what it is going to cost us to operate that device for the three years they are in production. We leveled the playing field and focused everyone on the ultimate efficiency and a holistic TCO."

In the RFP process, Nelson and his team made their wishes clear to vendors: "We want to be able to get the maximum compute power, for the lowest wattage possible, for the best TCO—these are the main business drivers. Can you give us that?"

Dell met that request, according to Nelson. "That's what we deployed in Phoenix: highly efficient equipment, at the right price point, that is operating incredibly well."

Bringing Project Mercury online

The 14,000-square-foot Project Mercury data center came online in 2011 with four megawatts of IT power, with immediate expansion capabilities to six megawatts, and the infrastructure to support eventual expansion to 12 megawatts.

The ground floor of the data center is designed for "rack 'n' roll deployments," where fully loaded and cabled server racks can be rolled into the center, dropped into a row of racks, plugged in, and put into service. The roof of the facility is built to accommodate data center containers that arrive fully loaded, ready for service.

"We found our triggers. Fully integrated rack solutions are great for less than 1,000 server orders. When we are ordering more than 1,000 servers at a time, container modules are the most cost effective. We have them built at the vendor, validated, shipped on a flatbed, craned onto the roof in a few hours; plugged in with water, power, and data; and lit up," Nelson says. "We can deploy thousands of servers in a matter of hours. We had cranes lifting more than 1,500 servers at a time onto the roof in 22 minutes. That's the speed of business. We want to enable the business to go as fast as they want to go."

Equipment that went into the multi-vendor Project Mercury data center included Dell™ rack servers on the ground floor and a Dell Modular Data Center on the facility's roof. The Modular Data Center holds 1,920-servers in a 20-rack configuration. This configuration draws up to 560 kilowatts under full load.

By the standards of today's enterprise data centers, the 14,000-square-foot Project Mercury data center isn't particularly big, but don't let the size fool you. The data center is ultra-dense and ultra-efficient.

"This data center was half the capital costs to build compared to our previous data centers, -and- has four times the rack density," Nelson says. "It still amazes me that at this density, it is only half the cost to operate. By lowering our overall cost per megawatt, we are ultimately lowering the cost per transaction on eBay. When facilities and IT come together, and are able to come up with that ecosystem that balances itself automatically and as a result, our buyers and sellers win."

Putting the Modular Data Center to the test
In a test of the Modular Data Center conducted in August 2011, Nelson and his team saw first hand what they had accomplished from a cooling standpoint. They tested the Modular Data Center, and its 1,920 servers, under maximum-load conditions on a sweltering day in the desert sun.

"It was 115 Fahrenheit, measured outside—115 Fahrenheit—on the roof, exposed to the sun, in the desert. We were sustaining 26 kilowatts per cabinet, and we were getting free cooling," Nelson says. "Let that sink in for a second: We were getting free cooling at 115 Fahrenheit in the desert."

Along with free cooling, the eBay team realized a Power Usage Effectiveness (PUE) number that would be the envy of virtually any data center, anywhere. The PUE is a measurement of the amount of power used by computing equipment in relation to the amount of power that goes into the data center facility.

"The PUE on that day in August, measured with the Green Grid standards, was 1.043," Nelson says. "That means for every watt of compute, there was only 0.043 watts to run it. This incredible efficiency is achieved at densities that are two to three times greater than the majority of the data centers out there, in an extremely harsh environment. We measured again on a cooler day in February and the PUE was 1.018."

In addition to achieving extremely good power efficiency, the new eBay data center is built to enable the flexible provisioning of resources. The Modular Data Center, for example, uses just two standardized SKUs, or server configurations. One delivers high-performance processing and the other delivers a large amount of local storage. Any application can be provisioned to a SKU, including search, front end, cloud, and other compute functions.

"This is the cloud concept," Nelson notes. "You decouple your equipment from the actual applications. That's what we have been able to achieve. This equipment can now be multi-purposed, whenever we need it, to any kind of function. Today we're using it for search, but as things shift and change, we can repurpose that equipment to anything we need over its useful life."

Bringing innovation to the table
In designing the data center solutions, including server configurations and the Modular Data Center, engineers from the Dell Data Center Solutions (DCS) group worked side-by-side with engineers from eBay, according to Jeremy Rodriguez, a distinguished engineer for the eBay GFS group. He notes that eBay's engineers had direct access to the Dell engineers who designed the solutions.

"The Dell team brought some great innovation to the table," Rodriguez says. "There was a lot of transparency in how they created and engineered their solutions. It was really easy to work with the back-end engineers who designed the Modular Data Center solution, in addition to the server components."

Compared with other vendors, the DCS group asked different questions, Rodriguez says. "They were really asking, 'What do you want to see? What is the problem you're trying to solve?' That's a little bit different than other industry players who had solutions that were already pre-made and said, 'How can we modify this for your business requirements?' DCS took it a level further. They said, 'Let's design something together. Let's create a solution that is exactly what you want.'"

The Dell DCS engineers who responded to the RFPs helped design the Dell solutions and assisted with their implementation, Rodriguez says. "It was the same group of people, and it was clear they were fundamentally invested in what they were doing for eBay. They were here, onsite, working with our engineers when the delivery was happening. They were here to oversee every piece of it, to make sure it was perfect."

Nelson echoes these sentiments. "We're vendor-agnostic," he says. "What we care about is having the best solution to solve our business problem. By putting that public RFP out there, the competition starts. And the reason Dell is in here is they fought, and they won. Dell did a really good job understanding our problems, translating that into a solution that we ultimately have deployed, that is giving us the ultra-efficiency that they actually said they would guarantee. This one exceeded our expectations. The efficiencies were really, really impressive."

Results you can't contest

When asked to summarize the results of the Project Mercury initiative, Nelson's list includes free cooling year-round in Arizona, cabinet densities up to 30 kilowatts, highly scalable infrastructure, and the ability to physically deploy thousands of servers in a matter of hours and provision them in a matter of minutes.

"This is a multi-tier data center," he says. "It's modular. And it's extremely dense. At 12 megawatts of potential IT power and only 14,000 square feet of usable space, I believe that it is one of the densest data centers in the world. The space utilization, power densities, and overall power and cooling efficiencies are just staggering to me. I also believe this is one of the world's most energy efficient data centers. The PUEs that we are putting out are going to raise a few eyebrows."

Nelson hopes other data center operators will push forward to try to drive efficiencies to an even higher level in their own data centers.

"Our results—you can't contest them," he says. "The Green Grid has validated our numbers through their industry standard measurement of PUE. We've never been this efficient."

Video »
The eBay team launches Project Mercury with a Tron theme

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