



EMC DURHAM CLOUD DATA CENTER

Powering EMC IT's cloud vision

EMC® IT was hard at work reducing operational costs, increasing IT agility, and preparing for a dynamic future in the cloud when it faced the necessity, as well as the opportunity, to relocate its corporate data center. EMC decided to build a new 20,000 sq.ft. energy-efficient and 100-percent virtual data center in Durham, North Carolina.

EMC's new 450,000 square foot facility will also house the company's first U. S.-based Center of Excellence (COE). The Durham COE will consolidate regional EMC research, development, and proof-of-concept labs, and offer a wide range of consulting and technical services, customer executive briefings, and a live showcase of EMC and partner solutions.

To maximize return on its multi-year, multimillion-dollar investment, EMC IT has made flexibility—the ability to adapt to new technologies with minimal disruption over the next 20 years—its priority. As a result, energy efficiency, modularity, and low-impact construction have been primary design decision drivers.

While its existing data center is already 75-percent virtualized, migration to Durham will accelerate EMC's transition to a 100-percent virtual data center. All applications will run on a single version of the VMware® vSphere™ operating system within an x86 enterprise hosting architecture.

About 350 applications and six petabytes (PB) of data will be migrated in a series of database grid-centered move events scheduled to take place from Spring 2011 to Fall 2012, with a deadline of decommissioning and vacating the Westborough data center space by end of 2012.



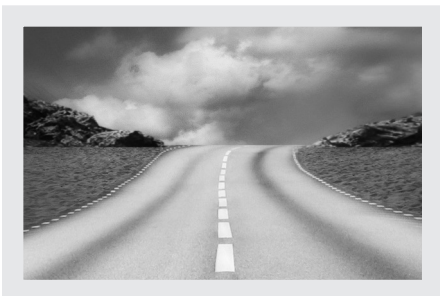
WHY A NEW DATA CENTER?

With high energy costs and business continuity limitations resulting from both its enterprise data centers being located in Massachusetts, EMC constructed a business case for a data center relocation. After evaluating multiple options, EMC decided to build a new, energy-efficient virtual data center in Durham, North Carolina.

Lower utility and property costs, an educated workforce, and reduced environmental impact through re-use of the existing building were primary reasons for selecting the Durham site.

The North Carolina location will also extend the distance between EMC's primary U. S. data center and its secondary DR site in Hopkinton, Massachusetts, geographically separating the corporate data centers by more than 600 miles, thereby increasing resiliency in the event of a regional disaster.

No hardware is being relocated from the existing data center. Instead, applications and data are being migrated to the new virtual infrastructure in Durham across a redundant 10-gigabit fibre optic Ethernet link, using a combination of EMC and VMware data replication and virtual site recovery technologies.



ACCELERATING THE JOURNEY TO THE CLOUD

Many organizations use the necessity for relocation to a new data center as an opportunity for transformation, and EMC IT is leveraging its new data center to accelerate its transition to cloud computing.

To reduce costs, improve services, and enable business innovation and competitive advantage, EMC IT has been on a multi-year Journey to the Cloud—moving from a physical to a virtualized IT infrastructure and more automated processes that will enable IT to be delivered as a service.

The design of the new Durham facility gives EMC a virtual data center foundation required for cloud computing.

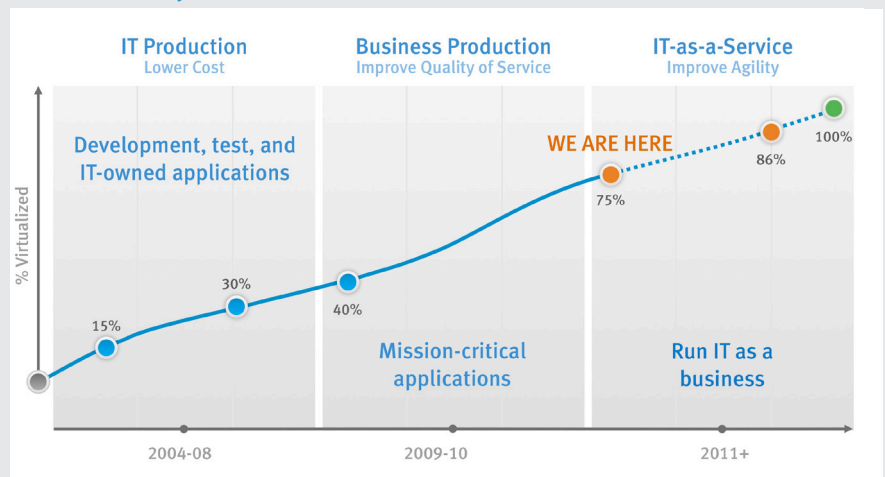
At the same time, the progress made to-date on Journey to the Cloud initiatives to rationalize, consolidate, and virtualize EMC's existing IT environment will ease the data center migration effort—and dramatically reduce ongoing power, cooling, space, equipment, and maintenance costs in the new data center.

EXAMPLES INCLUDE:

- **Application Portfolio Rationalization**—Over the past two years, EMC has been able to reduce the number of business applications in its data centers from 653 to 389, for an estimated \$3.7 million in savings. The initiative greatly reduced the number of applications in the Westborough facility that needed to be virtualized and migrated.
- **Database Consolidation**—EMC IT was also able to reduce the number of database servers in its Westborough data center from 51 to 6—and its Oracle data bases from 55 to 4.
- **Server Virtualization**—By virtualizing new applications and “sweeping the floor” to decommission or virtualize existing applications, EMC has achieved 75 percent virtualization in its existing data center, which reduces complexity and much of the effort involved in moving to its new 100-percent virtual data center.
- **Storage Optimization**—Tiering and the integration of next-generation data deduplication, data and file system archiving, and automation technologies have resulted in a 75 percent gain in storage utilization and a 170 percent improvement in storage administration productivity. Through effective tiering and archiving, EMC managed to reduce storage growth by 1.5PB that would otherwise need to be protected and migrated from Westborough to Durham.
- **IT Organizational Change**—EMC IT has been transitioning its IT organizational structure from traditional silos of domain-based IT management teams (e.g., network, servers, storage, and security) to a unified organization focused on the optimization of an integrated, pooled, and shared virtual environment. IT infrastructure operations and support staff are co-located in a central Command Center, with opportunities for cross-domain training to become certified “Cloud Architects” with the skills to manage virtual environments.

So far in its Journey to the Cloud, EMC has saved \$104.5 million through CapEx avoidance, lower energy costs, and space efficiencies. It has also reduced energy consumption by 34 percent and shrunk its carbon footprint by nearly 100 million pounds of CO₂.

EMC IT: THE JOURNEY TO THE CLOUD



EMC Global IT supports more than 48,000 users; across 400 corporate offices; in more than 80 countries; spanning five data centers; hosting 500 applications and 8 petabytes (PB) of data.

To reduce costs, improve services, and enable business innovation and competitive advantage, EMC IT embarked on a Journey to the Cloud to move from a physical to a virtualized IT infrastructure with more automated processes to deliver IT as a service (ITaaS).

EMC's vision is to offer the entire IT stack as a service through on-demand self-service provisioning with metered usage for chargeback. As such, ITaaS capability spans server, storage, and network infrastructure; enterprise applications; databases; security services; virtual desktop services; and more—with the ability to draw infrastructure- and software-as-a-service from a shared pool of virtual resources in EMC data centers and/or partner data centers across the globe.

To share its hands-on experience, knowledge, and lessons learned, EMC introduced the EMC IT Proven program to chronicle its Journey to the Cloud.



DURHAM DATA CENTER AT-A-GLANCE

The Durham data center has been designed to operate as a Tier III data center with N+1 redundancy and redundant pathways for 99.982 percent availability.

EMC Facilities and EMC IT worked together with external design and construction partners to collaborate, coordinate parallel efforts to maximize modular, low-impact build practices to reduce project timeframes.

Ground was broken on the project in January 2010 and the data center portion of the facility was commissioned on October 1, 2010. As construction neared completion, EMC IT began staging IT infrastructure at the site so that build could begin immediately.

The new data center went live on March 1, 2011, with all connectivity, seed infrastructure, foundation applications, security, monitoring, and backup capabilities in place to begin receiving production applications.

The new data center is the same size—20,000 square feet of raised floor—as the old data center, but is 100 percent “white space” dedicated to IT infrastructure, with all power and mechanical units (e.g., HVAC, PDUs, and UPS), as well as office space, located elsewhere in the building. This approach, along with dramatically reduced power and space requirements due to rationalization, consolidation, and virtualization, provides the flexibility, capacity, and energy to meet EMC data center requirements for years.

ENTERPRISE APPLICATION INFRASTRUCTURE

The EMC IT team has leveraged the design of the new Durham data center and its virtual infrastructure architecture to build out a fully configured data center, with the seed infrastructure to support about 150 virtual machines and 45 foundational applications to begin receiving the first production applications in less than 150 days.

Overhead cable management trays for power, fiber, copper, end-of-row racks with network and fiber patch management, and integrated Vblock infrastructure all play a role in improving IT agility.

The degree of agility gained became evident recently when EMC IT set up the Vblock infrastructure for its new SAP ERP (v6) enterprise application. It took less than a week to rack, stack, wire, label, and document the new Vblock Type 2 infrastructure, which will be used initially for development and testing of the new application. The new Vblock infrastructure includes a Cisco Unified Computing System (UCS) chassis with 18 server blades and 652 GHz of processing; 4.6 terabytes (TB) of RAM; an EMC Symmetrix® VMAX™ array with 246 terabytes of storage capacity; a Cisco Nexus 7000 and 5000 series LAN; and a Cisco MDS 9513 SAN director.

In contrast, a project of this size would take at least a quarter to build out in the existing data center.

In addition, the compute and storage currently loaded on the Vblock is only around 25 percent of capacity. Administrators can easily scale the infrastructure by adding more server blades and/or disk—without the need for any further cabling.



ENERGY-EFFICIENT DESIGN AND CONSTRUCTION

- EMC kept the exterior of the 450,000 square foot building and is using a three-phased, modular, “box within a box” approach to complete the facility—150,000 square feet at a time.
- Cooling and power are implemented independently with each module.
- Cooling and air-handling units are built offsite to very tight tolerances and then placed in the building.
- Cold aisle containment is provided for rack rows of higher load density (12k/rack)—and hot aisle/cold aisle rack row arrangements are used to increase cooling control and efficiency.
- Efficiency design innovations include a rooftop water collection system, free air-cooling for much of the year, and UPS flywheel technology that eliminates the need for batteries.
- The project is on track for meeting a stringent power usage effectiveness (PUE) objective of 1.3 PUE (or better, depending on load) and obtaining LEED™ Silver certification.

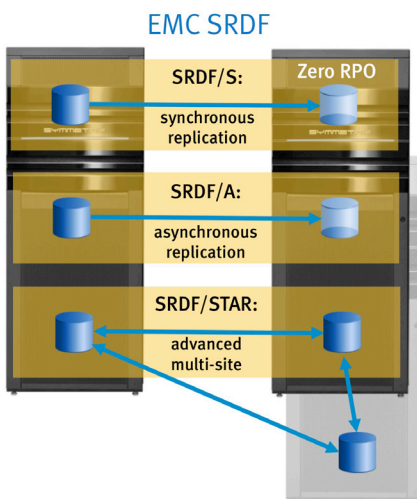
100 PERCENT VIRTUAL



- EMC has selected the Virtual Computing Environment (VCE) Vblock reference architecture—which integrates VMware software, EMC storage, and Cisco UCS blade server and network technologies for unified VM provisioning and simplified workload management—as its virtual data center enterprise hosting platform.
- Durham will be the first EMC data center to host all applications on top of a single “virtual data center operating system”—VMware vSphere.
- With this standardized virtual infrastructure and operating environment in place, EMC IT will be able to locate and move workloads easily and transparently anywhere within the Durham data center for maximum efficiency, performance, and utilization.
- EMC IT leverages separate Vblock Type 1 and 2 configurations in its new data center to host general-purpose Tier 1 and Tier 2 applications.
- Separate Vblock infrastructure packages are dedicated and “tuned” to deliver specific enterprise applications, such as the company’s new SAP ERP v6 system.
- Virtual infrastructure is managed using the latest EMC and VMware management tools.

BUSINESS CONTINUITY

- The location of the new Durham data center—more than 600 miles from the Hopkinton, Massachusetts site—increases EMC’s resiliency in response to catastrophic events.
- EMC Consulting business continuity and disaster recovery (BC/DR) consultants were engaged to help assess BC/DR plans and conduct a Business Impact Analysis (BIA) to determine the financial and operational impacts of an outage on different business functions—not just in terms of revenue and productivity loss, but also in areas such as brand image and customer loyalty.
- After analysis, EMC consultants worked with IT to develop a Service Catalog of recovery options that businesses can choose from to meet the Recovery Time Objective (RTO) and Recovery Point Objective (RPOs) requirements for restoration of service and data.
- In addition to IT recovery services, businesses have been charged to develop preparation and contingency plans for actions they will take in the event of an epidemic, political crisis, or natural or man-made disaster—such as plans for moving staff to alternate facilities or alternate supplier sourcing strategies.
- Recovery plans are being documented and tested in coordination with migration planning because there is a considerable overlap (e.g., teams, vendors, and procedures for validation of function in a new location) and also to make sure recovery capabilities are in place to reduce risk during migration.



TIERED DATA REPLICATION

- EMC IT built out three separate and repeatable SAN-based tiers—Mission Critical, Business Critical, and Business Important—for data replication.
- These SAN data replication tiers are designed to meet Service Catalog-defined RTO and RPO service levels for application and data backup and restore, and enable a consistent model for consumption-based chargeback.
- The mission-critical tier uses EMC SRDF® synchronous and asynchronous replication technologies in a star-configured, cascading bunker approach to achieve instantaneous data replication and duplication of data for Zero Data Loss.
- Asynchronous replication is used by the SAN-based Business Critical and Business Important tiers—to limit maximum data loss to up to 15 minutes for Business Critical applications and up to 24 hours for Business Important applications.
- A new SAN-based backup infrastructure eliminates all tape, and uses bi-directional EMC Avamar® and EMC Data Domain® deduplication at the source and target to reduce online backup size and offsite archiving.

MIGRATION PLANNING AND EXECUTION

- Applications and data will be migrated to the new virtual infrastructure in the Durham data center across a redundant 10-gigabit fibre optic Ethernet link using EMC data replication and storage virtualization solutions as well as VMware virtual site recovery technologies.
- While the EMC IT organization has gained considerable experience integrating applications, infrastructure, and operations from EMC acquisitions into its data centers, it has not previously managed a migration on such a large scale. It has engaged EMC Consulting to leverage expertise, methodologies, and tools for program management, discovery, application alignment, bundling, and migration planning and execution that have been developed, proven, and refined in large, critical data center migrations for EMC customers.
- This real-world experience proved useful in helping EMC IT to realistically estimate the resources and timely decision-making commitments required from its organization for a successful migration.
- As in other IT organizations, virtualization has led to a certain amount of “virtual sprawl” in the Westborough data center, as configuration and change management processes and tools have not kept up with virtual infrastructure. EMC IT is working on reconciling and unifying its sources of record into a single configuration management database (CMDB) and rigorous change management process.
- A core principle of the EMC Consulting Data Center Migration Methodology is to “discover everything, before planning to move anything”. Consultants work with business application owners and use proprietary discovery and data management tools to discover: all existing applications; how they’re used by the business; their interdependencies with other applications, databases, and infrastructure; and service level requirements.
- While virtualization simplifies the actual migration, it makes meticulous migration planning more critical than ever because a virtual, consolidated, and shared environment, in which “almost everything is connected to everything” makes it more challenging to carve out logical move groups. EMC IT and EMC Consulting have decided that move groups will be database-centric, with database grids and the applications that rely on them moving together.
- The migration planning team is also learning how best to bring a virtual data center online (e.g., the right sequence of cold-starting physical infrastructure, cold-start applications, and foundational applications), which will also inform BC/DR planning.

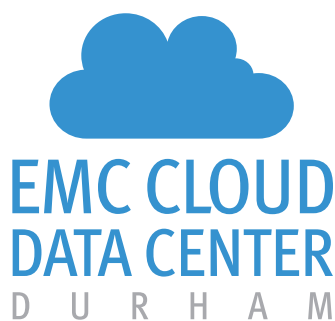
AUTOMATION AND MANAGEMENT

- The new data center will be “lights dim” with only a small staff onsite. It will be monitored and operated remotely from cross-domain EMC Command Centers in Southborough, Massachusetts and Bangalore, India.
- In addition to providing “follow the sun” operational support, the Bangalore Command Center, with its 12-hour business day and 24-hour coverage on weekends, will manage data center applications.

REFERENCES

The following documents provide additional, relevant information. You can access these documents at www.emc.com or by contacting an EMC representative:

- EMC IT’s Journey to the Private Cloud: A Practitioner’s Guide
- EMC IT web page at <http://www.EMC.com/ITProven>



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