



**Building a business case:
The role of server consolidation in
IBM's transformation to an e-business**

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The Results

- A 15 to 1 reduction in the number of mail servers
- Reduction from 155 to 12 major datacenters worldwide
- Significant savings in capital, networking and administrative costs
- Improved efficiency in server administration
- Increased ability to respond to new application needs

The Strategy

Consolidate and simplify IBM's worldwide e-mail infrastructure – its Global Notes Architecture – to meet IBM's business objectives.

The Company

With 2001 revenues of more than \$85.9 billion, and more than 300,000 employees worldwide, IBM is the world's largest information technology company. The company's employees use IBM Lotus® Notes® as their client interface for e-mail, applications and databases, supported by IBM Lotus Domino™ running on IBM @server platforms.

Highlights

The ongoing goal is to create an infrastructure that is aligned with IBM's business objectives and able to provide the responsiveness necessary to meet emerging business requirements.

Throughout its business transformation process, IBM has been rigorously self-observant — documenting processes, results and lessons learned.

Executive Summary

Over the past decade, IBM has led the e-business transformation as one of the first companies to recognize and embrace the advantages of the e-business environment. IBM has reinvented itself, re-engineering many business and management processes, streamlining operations and simplifying its structure — all part of a collective effort to create a single, global IBM organization.

To support this mission, IBM has taken aggressive steps to reinvent its Information Technology (IT) infrastructure, making it more efficient and more cost effective. The ongoing goal is to create an infrastructure that is aligned with IBM's business objectives and able to provide the responsiveness necessary to meet emerging business requirements.

Among the many company-wide initiatives that have contributed to IBM's business transformation is the consolidation of its worldwide Global Notes Architecture (GNA), which today supports more than 320,000 mail users and the applications and databases that support them. Since the early '90s, IBM has reduced its 155 data centers around the globe down to 12 major centers worldwide. The entire user community in this unified global network runs the same version of Lotus Notes. Through this centralization and standardization, IBM has realized dramatic improvements in the scalability and manageability of its infrastructure.

Another significant benefit of IBM's transformation has been the ability to apply its own lessons learned — as well as those learned from numerous customer engagements — to other businesses. IBM has always been an early adopter of innovative technologies and has leveraged this as a benchmark for other companies.

This paper examines one important area of IBM's business transformation: how the IBM Business Transformation & CIO Organization used the discipline of server consolidation to simplify IBM's messaging and collaboration infrastructure, specifically its North American e-mail infrastructure. It describes IBM's Global Notes Architecture — a critical component of e-business that is used by every worldwide IBM employee, contractor, Business Partner and supplier — and how IBM has taken advantage of the versatility and flexibility of IBM @server platforms.

Highlights

IBM developed an overall blueprint to bring its IT infrastructure into alignment with business needs and established the Business Transformation & CIO office.

Setting the stage for transformation

In 1991, IBM operated more than 20 separate business units with 155 data centers worldwide, 128 Chief Information Officers (CIOs), 31 private and separate networks, approximately 16,000 applications, and hundreds of different PC desktop configurations. Each business unit presented a different – and incomplete – image of IBM to customers.

The rising networked economy, however, was changing customer perceptions and expectations. Being responsive now required a more collaborative approach and the ability to integrate across organizational boundaries to deliver customized, end-to-end solutions. IBM's highly decentralized environment made this extremely difficult.

In response, IBM's management began to transform the company: simplifying and integrating processes to present a single, consistent face to the customer. The company became more efficient, more flexible and more responsive as a result of these often difficult changes.

IBM at a Crossroads

IBM developed an overall blueprint to bring its IT infrastructure into alignment with business needs and established the Business Transformation & CIO office (BT/CIO). The BT/CIO office was responsible for the architecture of IBM's worldwide IT infrastructure and for the development and delivery of the company's IT strategy. At that time, its mission was to implement, support and exploit technology to meet both internal IT requirements and external business objectives. This explicit alignment of IT requirements with business objectives within the mission of a unified BT/CIO organization represented a dramatic break from past practices.

Highlights

The BT/CIO office analyzed IBM's environment to determine what factors were inhibiting business transformation and what steps were necessary to allow the company to take advantage of new technology, quickly and affordably.

Identifying key issues

To begin, the BT/CIO office analyzed IBM's IT environment in light of identified business problems rather than technical function. The group sought to determine what factors were inhibiting a more aggressive business transformation. They also needed to identify the steps necessary to permit IBM to take more rapid advantage of new technology, and to do so more affordably.

An in-depth examination of the environment revealed the major issues:

- **Decentralization and redundancy on a massive scale**

IBM had 155 data and control centers around the world and 99 “central” Service Delivery Centers (SDCs) in support of major IT initiatives. Each of these sites contained a mix of different environments – in many cases, hundreds of systems.

- **Lack of consistency across the infrastructure**

Different groups used different applications for the same services. In other cases, multiple generations of hardware were running different levels of the same software – sometimes in a single data center. Some of this was driven by the realities of operating major centers in a variety of countries around the world: differences in depreciation rules dictated upgrade schedules; export/import regulations sometimes limited what equipment could be used.

- **Difficulty in deploying new technology or applications**

With so many different systems, data centers, and levels of software, new deployments and upgrades were extremely difficult. This complexity and inconsistency of the infrastructure made it nearly impossible to quickly and equally incorporate new technology throughout the enterprise.

- **Not end-user friendly**

The complexity and lack of consistency made the systems difficult for users to navigate. Each system presented a different look and feel to its users. Additionally, the diversity of systems and software made it impossible for support staff to take advantage of best-of-breed management practices.

Highlights

- **Increased costs and staffing issues**

This large, diverse infrastructure brought with it many costs: IBM had significant capital investments in older technology. Many smaller centers couldn't take advantage of the cost benefits of larger systems. The highest costs were driven by staffing: inefficiencies and duplication of effort because of the number of data centers and inconsistent service levels due to variations in skill and experience.

With these facts in hand, the BT/CIO office worked with IBM Global Services (IGS) to build a business case for change. They identified potential targets for consolidation with these goals in mind:

- To gain control of costs and reduce complexity
- To provide equal levels of service on a worldwide basis
- To position IBM for continued business transformation

Consolidation provided a disciplined approach to optimizing and simplifying IBM's IT infrastructure from end to end: including servers, storage, data, applications, networks, resources and the systems management tools that bring it all together.

Recommending consolidation

Consolidation, of course, is a lot more than simply replacing small servers with larger ones. It is about finding ways to better align and manage an existing IT infrastructure with the current business model, while establishing a flexible foundation to handle future requirements.

The BT/CIO office recommended a consolidation strategy because it provided a disciplined approach to optimizing and simplifying IBM's IT infrastructure from end to end: including servers, storage, data, applications, networks, resources and the systems management tools that bring it all together. The immediate benefits to be gained were cost savings and improvements in efficiency, availability and productivity. But the longer term benefit was the most important: IBM needed to ensure a stable foundation for the rapid deployment of new solutions to meet continually changing business needs.

For this server consolidation effort, the BT/CIO office turned to IBM Global Services (IGS) for their expertise based on numerous customer engagements. IGS defines four key approaches to consolidation: centralization, physical consolidation, data integration and application integration.

Highlights

Four key approaches to consolidation: centralization, physical consolidation, data integration, and application integration.

The BT/CIO office recommended a combination of consolidation approaches to create the proper solution.

- **Centralization** involves relocating existing servers to fewer sites. Centralization is often the initial step a company takes toward controlling costs through consolidation.
- **Physical consolidation** is the process of reducing the actual number of servers by replacing many small systems with fewer larger ones. Generally, this takes place within the same architecture. The flexibility of the IBM @server line of products, however, makes it possible to achieve physical consolidation across architectural “boundaries.”
- **Data integration** enables the combination of data from different sources – across same or disparate data types and architectures – into a central resource base.
- **Application integration** involves the migration of an application and data to a new platform in order to co-locate applications and data, including combining different application workload types within a single server/system. It allows the running of mixed, multiple workloads within a single architecture, as well as multiple architectures.

The new business challenge

Each of these approaches has benefits and challenges, and they can be used alone or, as the BT/CIO office ultimately recommended for IBM, in some combination to create the proper solution.

The BT/CIO office recommended:

- **Centralization:** consolidating into as few data centers as possible. BT/CIO proposed moving from 99 to 12 major SDCs worldwide by the end of 2002.
- **Physical consolidation:** BT/CIO would seek to deploy the minimum number of the most current systems required to support the business.
- **Application integration:** BT/CIO would use the fewest number of applications or application images running on these updated systems.

Highlights

A detailed business case was created for each phase of the overall project, accounting for factors such as capitalization, leases and the taxes for existing systems while also remaining focused on the defined business needs.

Having created the overall business case, it was then necessary to create a business case for each phase of the project to be accomplished under the plan. These individual cases were considerably more detailed, taking into account such factors as capitalization, leases and taxes for existing systems while remaining focused on defined business needs. Each case had to fit into IBM's planning and budgetary cycle, as well.

For each individual project within the master plan, BT/CIO created a Request for Service (RFS), which was forwarded to IBM Global Services (IGS), who would function as the systems integrator for the effort. IGS used the RFS to create a statement of work and a project plan that defined the actual effort.

IBM's efforts to consolidate its Global Notes Architecture (GNA) in North America provide an excellent example of this process in action.

Taking notes

IBM Lotus Domino and IBM Lotus Notes are two of the key components of the IBM business transformation because they enable one of the most critical functions of e-business, namely e-mail. The company's employees around the globe send and receive e-mail through Lotus Domino and use Lotus Notes as the client interface to e-mail, applications and databases.

However, IBM's GNA in 1997 still reflected IBM's pre-transformation IT infrastructure in microcosm:

- 57 different GNA host sites scattered across four continents
- 10 sites in North America alone, serving employees in Canada, the US and Mexico
- More than 1,250 mail servers and 1,000 application servers
- IBM RS/6000® SP™ systems installed in most, but not all, of these sites, with Domino running on multiprocessor nodes

Highlights

“Our analysis indicated that we could reduce the overall cost of our e-mail server infrastructure through consolidation. The question was what we would consolidate to, and how.”

— Johnny Barnes, IBM VP of Global IT Solutions & Standards

The total cost of running and managing these hundreds of nodes is estimated in the hundreds of thousands of dollars per year, according to Johnny Barnes, IBM Vice President of Global IT Solutions & Standards. “Our analysis indicated that we could reduce the overall cost of our e-mail server infrastructure through consolidation,” added Barnes. “The question was what we would consolidate to, and how.”

North America GNA consolidation: IBM’s approach

In building the business case for consolidating the North American Global Notes Architecture, the BT/CIO office recommended using all four consolidation approaches concurrently in order to achieve optimal results:

- Centralizing from 10 host sites to three, two major and one minor. This represented the fastest, easiest way to achieve results. **Centralization** offers costs savings through environmental reductions and trimming duplicate staff, and, to a lesser extent, by eliminating some duplicate software image reduction.
- Within each data center, the BT/CIO group recommended **physical consolidation**, replacing older, smaller servers with larger systems and newer technology to achieve these benefits:
 - Greatly simplified systems management
 - Reductions in staffing and environmental costs
 - The possibility of lower software licensing costs due to their ability to handle more users with fewer processors
- The BT/CIO group proposed migration from direct attached SSA storage to IBM’s Enterprise Storage Server™ arrays via a Storage Area Network (SAN) for **data consolidation**. Consolidating on a SAN provided these benefits:
 - Increased flexibility in deploying applications
 - Reductions in floor space and administrative resources dedicated to storage
 - Enhanced system availability because SANs simplify and speed up the backup and recovery process

Highlights

The BT/CIO office recommended that each data center consolidate on a different server platform. This would allow IBM to leverage existing skills while gaining valuable knowledge and “best practices” to feed back to its product development teams and customers.

As a result of fail-over clustering, Rochester has never missed a Service Level Agreement due to server failure.

- **Application consolidation** on fewer software images is the longest and most challenging phase and is still in progress. This is critical to giving IBM the agility it needs to respond to a changing business environment.

As the BT/CIO office developed the business cases for these efforts, it made one more rather surprising recommendation: within each data center, consolidation would take place on a different server platform. This recommendation represented a strategic blending of cost considerations and alignment with IBM business goals:

- The one-time and ongoing costs of the server consolidation project would be reduced by fully leveraging the existing skills in each data center rather than having to go through time consuming and costly retraining or hiring of new staff.
- By deploying multiple IBM @server platforms, IBM gained valuable knowledge about performance, tuning, administration, and “best practices” to feed back to the development organizations and to share with customers. In addition, IBM could showcase its own success across the IBM @server platforms as a valuable proof-point to assist customers in their evaluation process.

Rolling out the Plan

IBM used three sites for Domino servers to roll out its server consolidation plan in North America: major sites in Boulder, Colorado, Poughkeepsie, New York, and a smaller site in Rochester, Minnesota.

Rochester, MN

The Rochester site serves approximately 10,000 users from the IBM @server iSeries™ (formerly AS/400®) development laboratory in Rochester and from IBM Software Group. Taking advantage of AS/400 scalability for Domino and available skills base in 1998, they began by moving Domino server images from 50 small UNIX servers to two larger AS/400 systems. Over time, they consolidated the users into fewer, larger Domino instances to reduce the costs of administration, without disruption to the end users.

Highlights

Poughkeepsie successfully leveraged cross-platform flexibility and has been able to run multiple workloads in one systems image.

As the smallest consolidation site, Rochester also has the flexibility to serve as a leading edge “test bed” for Domino on iSeries software enhancements. They were the first site in IBM to fully implement fail-over clustering. Rochester’s current configuration for 10,000 users is two iSeries 840 servers, each running at approximately 45-55 percent of capacity, leaving plenty of room for further growth or additional applications.

Rochester’s only server outage in two years gave them the opportunity to put their high availability strategy to the test: with the combination of Domino fail-over to the clustered servers and dynamic logical partitioning (LPAR) to re-balance system resources, the end-users experienced no loss in service.

Poughkeepsie, NY

The Poughkeepsie site will support approximately 100,000 users with IBM @server zSeries™ and S/390™ servers. The Poughkeepsie project combines centralization (moving systems from Southbury, Connecticut, and Toronto, Canada, to the existing Poughkeepsie site) and physical consolidation (reducing the number of systems). This project has focused on moving to the fewest number of servers and systems needed to support their user community while meeting IBM’s demanding Service Level Agreements (SLAs). IBM had been supporting approximately 20,000 users on RS/6000 SP nodes in the company’s Southbury, Connecticut, location and another 18,000 users in Toronto, Canada. Those users were consolidated into the Poughkeepsie data center, and migrated to Domino running on zSeries servers. Exploiting zSeries architecture has allowed for mail, applications, and database to run concurrently in one z/OS™ image. For the users, this has been completely transparent. For IBM, it has provided even greater economies of scale and simplified systems management.

The deployment in Pougkeepsie consists of running 12,000 users in a single system image (one LPAR). The 12,000 users are divided among three Domino server instances.

Highlights

Boulder realized a 700 percent increase in the number of users per system image while supporting daily traffic volumes as high as 4.8 million transactions.

Boulder, CO

The Boulder site serves approximately 100,000 users on IBM @server pSeries™ and IBM RS/6000 servers. The Boulder staff tackled a complex task in both centralization and physical consolidation. They relocated existing RS/6000 SP nodes from many locations into a single location. At the same time, they began the transition to newer servers, moving users as financial considerations such as lease termination and depreciation permitted SP nodes to be taken out of service.

For consolidation, the Boulder site has installed one pSeries 690 server and two RS/6000 S80 servers thus far. With each of these servers, the Boulder staff has employed different consolidation techniques, evaluating them from several perspectives before they develop the final architecture for their 100,000+ user community.

- With one of the S80 servers, IBM has essentially duplicated a cluster of nine SP nodes by creating six Domino partitions, each supporting 1,700 users. While this approach reduces costs associated with both the hardware and AIX® operating system, it still requires licensing and staff for six instances of Domino. This has not proven to be the most effective solution and will soon be displaced.
- The second S80 server has a very different configuration. Taking advantage of the greater scalability of the latest Domino releases, this system runs two Domino images, each handling over 5,000 users. In this configuration, software costs are reduced, since only one operating system license and two Domino licenses are required.
- For the pSeries 690 server, IBM has taken another approach. The server is configured with two logical partitions (LPARs), using technology originally developed for IBM's mainframes. One LPAR is set up as a production server: it runs two instances of Domino 5.10, serving a total of 7,500 users. The second partition is used for testing and development, with three separate Domino images. There are 4,000 users testing the Beta version of Domino 6.0. Another 1,000 research users are exploiting some of the advanced features of Domino 6.0, including iNotes™ and iMap, and 1,000 developers are using the third Domino 6.0 image for their work. The system has plenty of additional capacity for handling other application and development tasks.

Highlights

Through consolidation, IBM has a much more efficient, effective infrastructure. In addition to reduced costs, IBM is better positioned to respond quickly to further business changes and new requirements.

Essentially, the staff at all locations are seeking to build an optimal model (physical servers and users per Domino partition) for each of the platforms that meets IBM's Service Level Agreements at the lowest total cost of ownership. And this is true for all of IBM's consolidation efforts worldwide. The ultimate goal is to deploy the minimal number of the most current systems using the least number of operating systems images and application instances.

Getting measurable results

Through consolidation, IBM has a much more efficient, effective infrastructure. At the Boulder site, for example, IBM was able to achieve a 700 percent increase in the number of users per system image while supporting daily traffic volumes as high as 4.8 million transactions. By maintaining fewer servers, the company will reduce capital expenditures as well as software upgrades and administrative costs. And where it operates fewer data centers, fewer replications will be required between servers, saving IBM facility management costs, network fees and network bandwidth.

In addition, incorporating new technology positions IBM to respond quickly to further business changes. IBM @server products are scalable, able to handle growing transaction volumes and easily support new e-business applications. New features of the upcoming Lotus Domino 6 already being tested in Boulder, will facilitate easier management of the GNA and the business-critical e-mail environment.

Consolidation has paid off on the bottom line. The Notes consolidation efforts are occurring simultaneously with other consolidations in IBM's IT infrastructure, including "backoffice" applications that run on VM and MVS™, SAP enterprise applications, IBM's Global Web Architecture and more. All of these efforts have contributed to IBM's successful transformation to an e-business, but the consolidation of its GNA, specifically, has contributed several benefits. For example, the current consolidated e-mail deployment requires 57 fewer full-time equivalents than previously. Add in reductions in floor space, the number of servers and software fees, and the savings are obviously substantial. IBM expects on a worldwide basis to achieve a 5 to 1 reduction in the number of servers and to reduce the number of delivery sites by more than half.

Highlights

“A reliable and secure IT infrastructure is an enabler for new e-business opportunities. We have to be responsive, cost effective and flexible. As a result of consolidation, IBM is now well positioned to execute.”
— Bernard L. Kreppel, IBM CIO Office, Server and Data Center Architecture

Lessons Learned

Business transformation and IT transformation are a continuous process – and the goal of IBM’s BT/CIO office is to continually evaluate the company’s business objectives and align the IT infrastructure to support these objectives. This paper has examined IBM’s North American e-mail infrastructure as one example of how consolidation contributed to IBM’s business transformation. Following are some of the key lessons learned thus far.

Lesson One: Server consolidation can have measurable bottom-line benefits.

- IBM today is running fewer servers, which has reduced capital expenditures as well as software upgrade and administrative costs.
- IBM operates fewer data centers, saving facility management costs, network fees and network bandwidth.
- IBM has reduced duplication of effort, permitting more efficient use of staff skills.
- IBM has significantly improved the total cost of ownership of its infrastructure, taking its costs from higher than the industry average to lower than the industry average, with more savings accruing as consolidation continues.

Lesson Two: Server consolidation can help position a company for the future.

- As a result of its transformation, IBM has become more efficient and better equipped to be a leader in the emerging information economy. “A reliable and secure IT infrastructure is an enabler for new e-business opportunities. We have to be responsive, cost effective and flexible. As a result of consolidation, IBM is now well positioned to execute,” according to Bernard L. Kreppel, IBM CIO Office, Server and Data Center Architecture. For example, IBM’s consolidated infrastructure enables the company to effectively respond to the IT changes associated with business acquisitions and divestitures.

Highlights

The single most important success factor in IBM's consolidation efforts has been building a business case that accurately defines business needs, and then developing the technology solution that is most cost-effective in meeting those needs.

Lesson Three: Success requires a disciplined, results-oriented approach and a methodology

- To achieve results, IBM had to reinvent its approach to technology projects. The single most important success factor in the company's consolidation efforts has been building a business case that accurately defines the business needs and then developing the technology solution that provides the most cost-effective solution to those needs.
- IBM has developed a new methodology – a series of logical, consistent steps that help model the complex relationship between IT resources and business processes. The methodology helps to profile the entire infrastructure in some unique and insightful ways. This insight is then used to make recommendations on how to optimize the infrastructure based on specified business goals.
- This methodology can help to determine present and future IT needs and how to deliver higher levels of service at lower total cost. It encompasses a suite of tools and best practices that provide the foundation for delivering best-of-breed, end-to-end consolidation solutions for all key architectures. In addition to applying this methodology to its own business, IBM is able to share its expertise and its own experiences with its customers.

Lesson Four: Keep at it

- IBM's experience has also led to the important realization that consolidation is not a one-shot solution. In today's constantly changing, constantly accelerating business climate, ensuring that a company's infrastructure continues to enable the company's business model requires continued effort.
- The BT/CIO organization constantly evaluates and re-evaluates IBM's infrastructure in light of changing business requirements and needs. And these efforts continue to be the laboratory for developing new approaches to technology that can benefit businesses of all shapes and sizes, in any industry.

Highlights

Simplifying an IT infrastructure is fundamental to becoming and remaining competitive in today's world.

Server Consolidation: The bottom line

Of the many lessons that IBM has learned throughout its transformation to an e-business, one of the most important lessons is this: Simplifying an IT infrastructure is fundamental to becoming and remaining competitive in today's world. Here is a list of some of the key benefits of server consolidation, based on IBM's own experience, plus numerous customer engagements:

- **Simpler, More Efficient Environment:** Many machines are more difficult to manage than a few.
- **IT Optimization:** Provides enhanced corporate communications; centralized current information enables improved company-wide data access.
- **Better Ability to Adhere to Corporate Standards:** Business processes such as security, backup, and software standards can be more easily maintained.
- **More Accurate Business Planning Becomes Achievable:** IT forecasts are easier with optimized servers and budget projections can be made more accurately.
- **Superior Change Management:** Optimized servers can equate to a more flexible IT environment for future application requirements.
- **Better User and Customer Service Levels:** Centralized processing power is more easily utilized and redirected.
- **Continuous Availability (24 x 7) Becomes Feasible:** High availability and disaster recovery solutions are more achievable with fewer points of potential failure and less complex networks.
- **More Manageable Technology Updates:** It is easier to maintain currency with future technology innovations.
- **Faster Application Deployment:** Implementing new applications can be done more quickly when optimized servers are involved.
- **Reduced Operational Costs:** It costs less to run two systems than 100 systems.



For More Information

Please visit the IBM @server Server
Consolidation Web site at
ibm.com/eserver/sconcio/casestudy

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Route 100
Somers, NY 10589

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