White Paper

Building a Data Center for Cloud Computing

Transform Your Storage Environment to Cut Costs and Increase Efficiency

Hamish McGovern and Rob Pollock, NetApp
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EXECUTIVE SUMMARY

This paper discusses the steps required to have your data center make the transition to a cloud infrastructure. It describes the elements of the NetApp® dynamic data center, including technology and best practices, and the know-how to make the solution a reality. The NetApp approach offers considerable advantages for those wishing to implement new service-based business models and delivers significant reductions in cost, complexity, and risk.

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INTRODUCTION

Data centers are at a crossroad. Massive data growth, tough economic conditions, and physical data center limitations (power, heat, space) are exerting extreme pressure on traditional IT infrastructures. Additionally, many companies seek to deploy IT architectures that support new, service-based business models. Finding ways to take cost, complexity, and associated business risk out of the data center without sacrificing service levels and while maximizing the potential of virtualization has become a major objective for almost every enterprise.

From an IT standpoint, cloud computing promises to deliver elastic scalability, pay-as-you-grow efficiency, and a predictable cost structure. On the business side, these capabilities can help turn capital expenses into operating expenses and increase productivity and innovation. Technological maturity is making workable cloud solutions both possible and affordable. You may already be considering ways to make your data center more "cloud-like" to boost efficiency, cut capital costs, and provide the elastic scaling you need to adapt to rapidly changing business requirements.

In theory, a cloud infrastructure makes it possible to change the way data centers are architected, built, and managed. But how do you begin making the transition while avoiding disruptions and without adding costs to ongoing operations? Those who have embarked on the journey to the next-generation data center have done so leveraging a dynamic computing model, centralized resource management, and rapid, flexible resource allocation to support the delivery of IT as a service (ITaaS). NetApp has worked with companies across the globe to create highly efficient data centers that reduce capital and management costs by 40% or more[1].

The NetApp dynamic data center solution delivers cost-efficient, virtualized, dynamic storage services for customers around the world and across all industries. The solution is based on a proven project delivery methodology that eases your transition to cloud computing. It includes a comprehensive management framework to rapidly commission and decommission applications, provision (and reprovision) required resources, and nondisruptively migrate applications and data across resources to meet changing service-level requirements. The NetApp solution allows you to seamlessly expand your underlying infrastructure and/or retire older components while maintaining continuous operations.

This white paper discusses the key challenges of data center transformation and explains how NetApp technology has been optimized to efficiently solve these challenges. It describes in detail the elements of the NetApp dynamic data center solution, including a service-oriented infrastructure (SOI) that utilizes standardized configurations. It also describes a service management framework that clearly defines all necessary management processes and enables a catalog of services that you can offer to your customers or application owners. In addition it explains a well-defined project delivery methodology that will take risk and complexity out of your transition.

1 BUSINESS NEEDS DRIVE CHANGE

A desire to reduce the cost, complexity, and risk associated with traditional data center infrastructures has become a driving force behind the changes that are sweeping through IT:

- Costs include not only the acquisition cost, but also ongoing management costs that are highly dependent on the operational efficiency of your storage environment.
- Compound annual growth rates (CAGRs) for storage ranging from 50 to 100% have a huge impact on IT budgets and create a constant management challenge.
- Unnecessarily complex infrastructure drives management costs up and business flexibility down.
- Complicated processes for data protection and disaster recovery increase business risks.

[1] Sensis Case Study, Oliver Wyman, July 2007. http://media.netapp.com/documents/sensis-case-study.pdf

These difficulties have led forward-thinking IT organizations to articulate a number of specific business needs:

- Pay as you go
- Data security and privacy
- Self-service
- Instant delivery and capacity elasticity

The NetApp dynamic data center solution addresses these needs by standardizing your storage infrastructure and storage practices, reducing complexity, and rationalizing procurement and deployment so you can deliver better results at less cost with less risk. Integrated data protection enables backup/recovery and disaster recovery processes to be the same regardless of the application.

The NetApp dynamic data center solution is uniquely designed to satisfy the requirements of cloud storage by delivering:

- Secure multi-tenancy
- Data mobility
- Integrated data protection
- Service automation and management
- Storage efficiency

These requirements and the capabilities that address them are described in detail in a NetApp white paper entitled “Storage Infrastructure for Cloud Computing: NetApp Is the Technology Partner of Choice.” This paper focuses on the details of deploying the NetApp dynamic data center solution.

Table 1) Data center challenges that the NetApp dynamic data center solution helps address.

Data Center Challenge	How the NetApp Solution Helps
High costs	Consolidates infrastructure and centralizes control. Provisioning and activation are on demand. Maximizes storage utilization, minimizing total raw capacity and reducing associated costs for space, power, and cooling.
Time to market	Eliminates labor-intensive tasks. Rapid and reliable services through a single management framework with well-defined processes and a consistent methodology.
Operational risk	Data protection is fully integrated. Backup and recovery are designed in and consistent across multiple classes of data.
New technology deployment risk	Proven end-to-end delivery approach takes the guesswork out of moving to an IT-as-a-service model.

2 MAKING THE JOURNEY TO IT AS A SERVICE

Because not everyone’s requirements and timelines are the same, NetApp works closely with you to understand your needs. You may be building a new data center that needs to incorporate some or all elements of the NetApp dynamic data center solution. You may be evolving your existing data center with an eye toward preserving your existing investments. Or you may only be interested in a small pilot project. No matter what your objectives, we can facilitate your journey by adapting this solution to your requirements and timeline.

Making the transition to the NetApp dynamic data center solution is a five-phase process. Each step is taken with the big picture in mind to generate significant benefits. Completion of all five phases effectively bridges the gap from traditional IT to service-oriented infrastructure to enterprise cloud services.

The phases are:

- **Centralize management** to gain visibility of costs, take control of your IT infrastructure, gain economies of scale, and begin the journey to service-oriented infrastructure.
- **Standardize your offering** based on key business requirements. Attempting to support point solutions for each application is costly and slows provisioning. Standardization with repeatable processes is key

to improving provisioning times and reducing support cost and risk. Standardization is a prerequisite for successful consolidation, automation, and cloud deployment.

- **Virtualize and consolidate** your physical infrastructure. Drive up asset utilization and take full advantage of NetApp storage efficiency. Virtualization happens at each level of the infrastructure stack, increasing asset utilization and simplifying management by facilitating the easy movement of both applications and data. Shared services and multi-tenancy—meeting the needs of multiple applications or customers with the same physical infrastructure—deliver much faster time to market and a lower overall cost structure.
- **Automate**. Once the offering and processes are standardized and infrastructure virtualized, automation becomes possible. Automation tools provide simple controls for overall workflow management.
- **Self-service** and APIs for delegated control. Handing over control is the crowning achievement. Allowing your internal or external customers the flexibility to scale on demand, being able to choose different levels of performance and data protection, and automating recovery from application errors are possible through application integration and self-service capabilities.

Figure 1) Conceptual view of the journey to IT as a service and cloud infrastructure.

3 NETAPP SOLUTION ELEMENTS

The NetApp dynamic data center solution takes the complexity and cost out of your transition to a cloud infrastructure. The solution consists of three components:

- A **service-oriented infrastructure** replaces or supplements an ad hoc server, network, and storage infrastructure with a well-defined, standardized solution.
- A **service management framework** defines all the processes required to manage the solution. Storage is made available via a service catalog of capabilities you offer your internal or external customers.
- A **well-defined delivery methodology** takes the risk out of making the transition from where you are today.

The combination of an SOI and a well-defined management framework takes the guesswork out of provisioning and management.

SERVICE-ORIENTED INFRASTRUCTURE

The NetApp service-oriented infrastructure delivers consistency. A standardized architecture allows you to consume and deploy resources in a repeatable manner. The ability to duplicate results provides rapid

provisioning and overall operational efficiency. Figure 2 shows a logical overview of the NetApp dynamic data center solution.

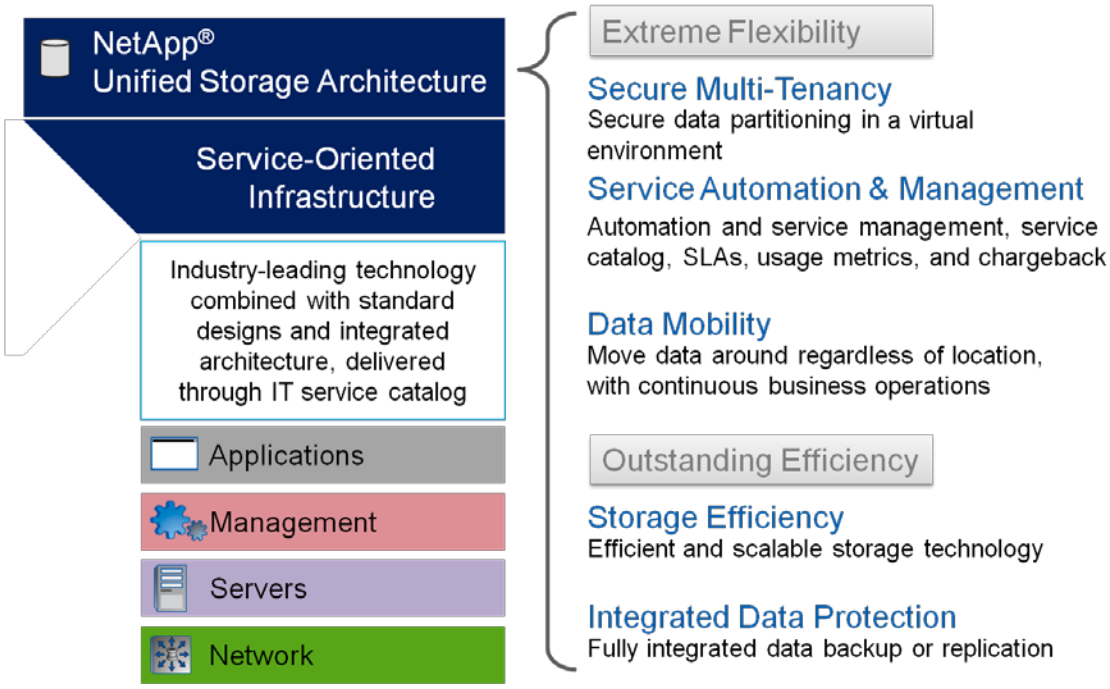

Figure 2) Logical overview of the NetApp service-oriented infrastructure.

The technology stack of the NetApp dynamic data center solution consists of four primary layers. The goal is to drive compliance when you want to either scale out the physical storage pool (provisioning) or consume storage from the pool (activate applications).

- The **application layer** includes a number of application and OS standards that we call activation guides. These guides detail how you will consume storage to achieve real process efficiency.
- The **server layer** can include both physical and virtual servers. The goal is to provision, activate, protect, and recover your data quickly and cost effectively.
- The **network layer** design goal is to build a single solution that can simultaneously meet the needs of both Ethernet and Fibre Channel storage traffic. This provides the ability to deliver a consistent set of features and performance.
- The **storage and data protection layer** consists of an agile and dynamic infrastructure that can change as business demands change. The NetApp unified storage architecture gives you the flexibility to choose not only the right protocol but also the right performance, and to accommodate your storage growth rates in the most cost-effective way. (The NetApp unified storage architecture is described in detail in a white paper entitled "Unified Storage Architecture: Enabling Today's Dynamic Data Center."[2]) This service-oriented solution integrates a broad range of products and capabilities.

Collectively, these layers provide (1) high data center efficiency through thin provisioning, zero space cloning, multiple classes of service, and efficient data protection; (2) application-aware data protection for both system and site failures to minimize operational risk; and (3) dynamic infrastructure through rapid backup and recovery, instantaneous cloning for development, QA, data mining, and image cloning.

[2] NetApp WP-7054-1008. http://media.netapp.com/documents/wp-7054.pdf

	Typical	Possible with NetApp
Management	250TB per FTE	Up to 2PB per FTE
TCO	10% off the top	Reduce up to 47%
Provisioning	Weeks	Minutes
Application Deployment	Months	Weeks
Utilization	30%-40%	Data: 100%-2000% Storage: 75% or greater
Storage Efficiency	35%	Guaranteed 50% less Up to 85% less for VI
Backup and Recovery	Hours	Minutes
Clones	Hours	Minutes
Power	10% reduction	20%-50% reduction

Source: 2007 Oliver Wyman: Sensis Case Study

Figure 3) Cost savings and efficiency gains that result from the NetApp SOI and service management framework.

New capabilities can be made available to all applications within the environment very quickly. The dynamic nature of the solution meets the changing demands of a wide range of applications with flexibility to choose not only the right protocol but the right performance, and to meet the most aggressive storage growth in the most cost-effective way. In summary, this SOI lets you scale out and consume storage with minimum management overhead for maximum efficiency; it is a prerequisite for achieving automation.

SERVICE MANAGEMENT FRAMEWORK

The NetApp service management framework is closely aligned to the Information Technology Infrastructure Library (ITIL), which has been designed to increase the rigor of best practices used within the IT industry. A key goal of ITIL is to help IT teams better understand costs and reduce fixed costs wherever possible.

This service management framework defines all of the services necessary to operate a storage infrastructure and includes seven services:

- **Lifecycle management** covers both configuration and asset management.
- **Capacity planning** defines how you determine what storage you need in order to have enough capacity available on demand.
- The **solution architecture** service defines how you add new feature sets to enhance the capabilities of your storage environment. You might choose to add such features as compliance, encryption, thin provisioning, deduplication, and so on.
- **Procurement** is the act of buying storage to scale out your environment. The procurement service makes sure that you always buy the correct storage and deploy it in the proper way. The combination of a standardized architecture and this procurement service enables the right purchasing decision to be made every time.

- **Storage design and activation** define the way you deploy storage, and include the design documents that describe the environment as well as the methods for storage activation.
- **Change management** integrates your storage environment into your change management processes, allowing you to effectively assess the risk of any changes that are made.
- **Maintenance and support** define the maintenance and support services that protect the health and availability of your storage environment.

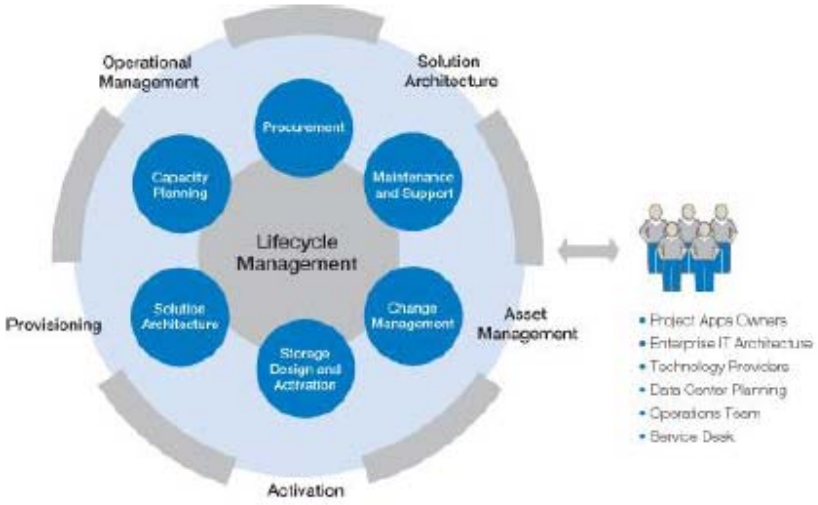

Figure 4) Service management framework.

Five processes overlie the seven services. These five processes are all that are required to run your data center.

- **Provisioning Physical Capacity.** The purpose of the provisioning process is to assess requirements and make sure that sufficient capacity is installed into the pool ready for activation as required. The process is primarily concerned with capacity planning and the deployment of physical resources in accordance with defined design standards.

  A well-formed provisioning process reduces the labor required to deploy new storage by using standard configurations and designs to remove the “white space” in the provisioning process.

- **Activation.** The activation process uses virtualization to present storage and data protection capabilities to applications. Applications consume the preprovisioned storage in accordance with the activation standards. The process is primarily concerned with consumers of the storage and the configuration control of the deployed solutions.

  A strong activation process can dramatically reduce the time needed to activate resources in support of new customers or new business initiatives by using standard activation guides. Consistent activation processes also reduce the labor required, as activation is template driven. This removes the variability in the activation of technology and can drive efficiency through the technology stack in the data center.

- **Solution Architecture.** The purpose of the solution architecture process is to evolve the architecture in a controlled manner. This evolution may include software version upgrades, hardware models, or the introduction of new functionality.

  The solution architecture process, by facilitating careful decision making that takes into account the overall design, assists in reducing support costs and eliminating outages.

- **Asset Management**. The purpose of the asset management process is to manage the deployed assets. This includes leasing of hardware, software licenses, and versions. It also includes the replacement of aging assets.

  Asset management provides efficient use of assets to maximize return on investment.

- **Operational Management**. The purpose of the operational management process is to maintain the deployed infrastructure. This process is the key to operational stability with interfaces to your problem management processes and the automated functionality provided by NetApp toolsets.

  The service-oriented infrastructure makes the support process efficient. Standard configurations reduce outages and ultimately reduce the support costs in the event an outage does occur because the configuration is well known and fully documented.

The NetApp dynamic data center solution represents a paradigm shift. New technology requirements are no longer handled on an ad-hoc basis. The NetApp solution allows your internal or external customers to choose from a service catalog of standard configurations and capabilities that you have defined up front. This service catalog—part of the SOI—is implemented and managed as part of the service management framework.

A service catalog is tailored to satisfy 90% of business needs from a defined set of offerings that can be provisioned and integrated rapidly. A typical service catalog provides:

- Storage tiers so that applications can be matched with their capacity and performance needs
- Different levels of data protection to meet varying RPO and RTO requirements
- Support for a standard set of physical and virtual operating systems and server types
- Activation guides to provide standards for application connectivity and data layout that have been tested for throughput and latency
- A long-term retention option for archive or compliance needs

WELL-DEFINED PROJECT DELIVERY METHODOLOGY

The prospect of transforming your data center to a cloud infrastructure by implementing the NetApp dynamic data center solution might seem daunting, but NetApp has helped customers worldwide make the transition. Our dedicated Professional Services team and Authorized Professional Service Partners have the expertise to assess your situation, provide valuable insights, and create and execute a plan that will help you achieve your goals with the least cost, minimum risk, and the least disruption to your ongoing operations.

Our project delivery methodology is designed to mitigate the risks associated with the transition. We use a well-defined work breakdown structure; clear project management methodology; and a clear division of labor between NetApp, NetApp partners, and your IT team. Our phased approach allows us to rapidly deploy services in a predictable and repeatable fashion.

We recognize that everyone's needs are different and that not everyone is inclined or able to undertake a full data center transformation at one time. That's why we offer the Fast-Start Workshop to help illuminate the path to complete data center transformation, in a prescribed format that addresses your unique business needs.

The NetApp Fast-Start Workshop is a two to four-day program designed to:

- Identify application and infrastructure targets based on capacity, performance, and service-level needs.
- Assess impacts on cost savings, efficiency gains, and performance improvements.
- Identify the top five process improvements in cost and efficiency, agility and timeliness, and progress toward IT as a service.

You choose the granularity of transformation that makes sense for your needs, from incremental steps to a single large effort. If you proceed in a stepwise fashion, all planning is done with the end goal in mind, so no effort is wasted. The savings that result from each step can help to fund the next step.

4 BENEFITS OF THE NETAPP SOLUTION

The NetApp dynamic data center solution drives down total cost of ownership and reduces complexity. It also decreases the time it takes to install provisions for a new customer or application (time to market) and mitigates both deployment and business risk.

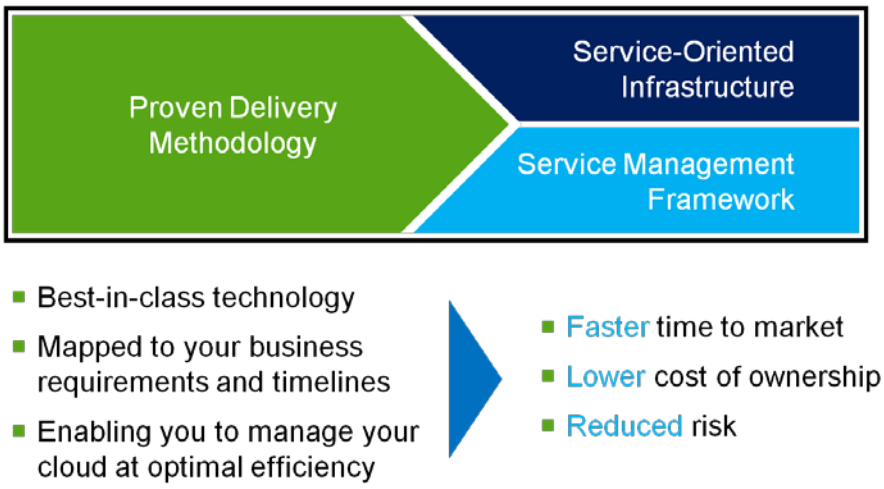

Figure 5) The NetApp dynamic data center decreases cost, risk, and time to market.

DRAMATICALLY REDUCED COSTS

The NetApp dynamic data center solution drives down acquisition costs by dramatically increasing storage efficiency. By eliminating point solutions and standardizing your storage architecture, you get the full benefit of storage consolidation. This is amplified by proven NetApp storage efficiency technologies, including unified storage with flexible volumes, space-efficient Snapshot™ copies and clones, thin provisioning, and deduplication.

These technologies significantly increase storage utilization, reducing the total amount of storage you need and cutting your requirements for floor space, power, and cooling. You can learn more about these technologies in a NetApp white paper entitled "Unified Storage Architecture: Enabling Today's Dynamic Data Center."

A second factor that reduces cost is operational efficiency—the number of people it takes to operate your storage environment. One dynamic data center customer grew storage by 10 times (from 1.6PB to 16PB) without adding additional staff. If you are experiencing the typical 50 to 100% annual growth rate for storage, the NetApp solution can enable you to scale out your environment without adding to your support team.

Customers who have implemented the NetApp dynamic data center solution already realize the full cost benefits:

- A major European telecom company saw a return on investment in just eight months across capital and operating expenses.
- A Pacific Rim telecom provider saw storage utilization rates double and can now manage more than 20 times more storage per full-time employee than before.
- Sensis, a leading Australian information services company, achieved a 47% reduction in total IT costs[3].
- Activision, a leading electronic game developer, saw a 50% decrease in storage required and slashed cloning times from days to hours[4].

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[3] Sensis Case Study, Oliver Wyman, July 2007. http://media.netapp.com/documents/sensis-case-study.pdf

[4] "Activision Protects Data and Transforms Development" http://media.netapp.com/documents/activision.pdf

FASTER PROVISIONING AND DEPLOYMENT

The NetApp dynamic data center solution takes the complexity out of provisioning, yielding a major reduction in the time it takes to deploy and activate storage. The traditional process of deploying a point storage solution includes:

- Determining what architecture to use
- Deciding on a storage system
- Finding the budget and procuring the hardware
- Installing the hardware
- Laying out the storage volumes

This is obviously time consuming, and the end results highly depend on the quality of the decisions made at each point. With the NetApp service management framework, all provisioning tasks are clearly defined in advance, so there are no delays, and the outcome is always predictable. Provisioning time goes from months to days—or hours if needed.

ENHANCED DEVELOPMENT AND TEST

Whether your infrastructure serves internal or external customers (or both), you need to be able to support development and test activities. NetApp cloning technology allows you to provision test environments very rapidly without making space-consuming copies. Because much less storage is required, you can support development and test environments much more cost effectively.

Rather than constantly provisioning storage, you simply set and enforce storage policies. NetApp cloning technology gives development and test teams the ability to freely clone all the test environments they need without consuming massive amounts of storage and without administrator assistance. The result is development and testing that go faster and achieve better quality.

REDUCED RISK

A storage environment made up of disparate storage systems and a variety of backup and DR solutions growing at 50% to 100% annually will quickly become unsustainable. Such an environment is simply too labor intensive and ultimately becomes impossible to scale further with reasonable resources. The NetApp dynamic data center solution utilizes integrated data protection to define a single set of standard practices that encompass your entire storage environment. All data is protected using consistent, well-defined methods, significantly reducing business risk.

Table 2) NetApp dynamic data center solution benefits

Area	Benefit
Infrastructure operations	• Manage up to 2PB per full-time administrator • Reduce provisioning from weeks to minutes • Increase utilization rates to 75% or higher • Cut raw storage requirements in half
Data center operations	• Reduce power consumption 20% to 50% • Save up to 50% in floor space
Application development	• Clone test data sets using only incremental storage • Test more and test more often
Database operations	• Cut backup windows from hours to minutes

5 CONCLUSION

Ever-increasing storage growth rates combined with uniquely challenging economic conditions are making traditional data center practices unsustainable. Forward-looking IT teams are evolving existing IT infrastructures to a more efficient cloud model. The NetApp dynamic data center solution meets the requirements of cloud infrastructures by reducing costs, mitigating risk, and helping IT teams succeed in the face of increasing budget constraints and business challenges.

The NetApp solution combines a standardized architecture that simplifies scaling and activation with a defined management framework that takes the guesswork out of managing cloud infrastructure for maximum operational efficiency. A fully defined project delivery methodology mapped to your requirements and timelines decreases the risks associated with making the transition to the NetApp solution.

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