White Paper

Delivering Excellence in Patient Care with Ready Access to Clinical Data

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Abstract

Agility is central to delivering excellence in patient care. However, healthcare organizations have entered a new era of scale in which the amount of data captured, processed, and stored is breaking down every architectural construct in the storage industry. NetApp delivers innovative technologies and capabilities for an agile data infrastructure that address the challenges of big data scale, enabling healthcare providers to gain insight into massive datasets, move data quickly, and store important content for long periods of time without increasing operational complexity.

TABLE OF CONTENTS

LIST OF FIGURES

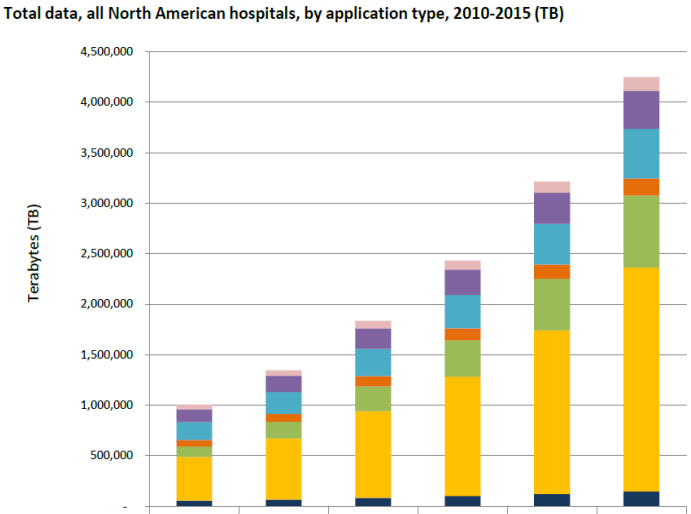
1 Healthcare's New Era of Big Scale

Medical imaging has transformed the healthcare industry. Specific aspects of the human body can now be examined and diagnosed without the need for invasive surgical procedures. In addition, teleradiology and telemedicine are now possible with ready access to digital images, coupled with the increased adoption of electronic medical records (EMRs) and electronic health records (EHRs). Remote diagnosis and second opinions can be easily obtained via remote access to medical files for real-time discussions and analysis. But this transformation of the medical industry does not come without challenges. One of the major obstacles is the storage capacity and retrieval times due to the growing size of medical images.

1.1 Where Is Big Data Coming From?

We have entered the era of big scale, in which the number of images and the amount of data being captured, processed, and stored by healthcare organizations are breaking down every architectural construct in the storage industry today. As a result, IT teams are trying to convert existing systems of record built in the 1990s and 2000s into "systems of engagement": systems that can efficiently deliver the necessary information to the right people, in real time, to enable them to perform more sophisticated diagnoses and deliver optimal clinical care. To accommodate this exponential data growth, storage solutions that scale both in capacity and bandwidth have become a necessity.

Figure 1) Total data, all North American hospitals, by application type, 2010–2015 (TB).



	2010	2011	2012	2013	2014	2015
Research Data	45,007	56,536	72,331	89,876	110,893	137,035
Non-Clinical Imaging	128,307	159,959	202,576	249,808	306,774	375,566
General Unstructured Data/File Services	175,039	216,070	270,544	330,523	402,430	490,478
E-Mail	66,391	80,533	99,176	119,009	142,244	170,060
Electronic Health Records	105,464	163,065	247,852	358,524	508,706	713,673
Clinical Imaging	431,306	603,824	857,499	1,182,290	1,620,810	2,215,525
Administrative Applications	54,518	66,826	82,998	100,388	121,164	146,097

Source: Enterprise Strategy Group, 2011.

1.2 Continuity of Care Requires Access to Real-Time Information

In medicine, there is no room for error. Immediate access to patient records and other medical data is a necessity for clinicians to ensure both patient safety and overall patient satisfaction. With access to an extensive set of data points (such as results from tests, procedures, and physical examinations as well as research results), physicians have the ability to quickly identify the correct course of treatment, resulting in improved quality of care.

1.3 Transform IT to Enable Improved Patient Care

The current departmental approach to picture archiving and communication system (PACS), cardiovascular, oncology, and pathology systems emphasizes the problems of both access and scale. Because of this, decision makers (CXOs, chief medical information officers, IT directors, storage and application administrators, and so on) are beginning to recognize the benefits of a consolidated IT infrastructure. By transforming IT through consolidation and integration of medical systems, substantial efficiencies can be achieved that position IT to deliver significant results. These include:

- Increased physician referrals due to improved workflow
- Higher nursing satisfaction with fast, easy access to information
- Superior quality of care and patient safety with nondisruptive operations
- Improved reimbursements with increased HCAHPS scores due to increased patient satisfaction

2 Big Data Putting Big Pressure on Storage Demands

Digitized images, managed by PACS systems, enable doctors to immediately retrieve images online while treating the patient. By removing the time constraint of having to wait for films to be delivered, doctors are able to make time-sensitive, critical decisions that can impact the outcome of the patient's treatment. Decisions regarding future storage solutions need to address:

- Capability to scale existing PACS solutions to accommodate growing demand within radiology as well as other departments
- Effective management across diagnostic imaging and EMR and EHR systems to get an accurate picture of patient health
- Ability to provide a secure data environment for use by the internal staff and consulting physicians
- Capacity to provide secure, interactive connectivity with remote affiliated medical care facilities and imaging centers within a network or an integrated health exchange
- Effective failover and disaster recovery procedures so that no data is lost

2.1 Growing File Sizes

Think about the last time you got an x-ray. For every image captured, 0.5MB of data was generated; the average exam produces approximately 30MB of data. Now, think about more advanced procedures. Mammograms generate 120MB of data, and 3D MRIs produce more than 150MB. And 3D CT scans create more than 1GB of data per exam.

In addition, cardiology images incorporate procedures such as electrophysiology and vascular processes with the already popular digitized catheterization. And CT image storage is being added as the use of ultrafast 64-slice CTs becomes adopted as a precertification procedure to the invasive cath procedure. Outpatient nuclear and echocardiology diagnostic procedures are also adding PACS capabilities as the equipment becomes DICOM compliant.

According to Enterprise Strategy Group, by 2015 the average hospital will manage more than 665TB of data. Some will have more. To top it off, these records often have patient lifetime retention requirements, further compounding the challenge of storage in the healthcare space.

This explosive growth in both the volume and size of images being sent to PACS solutions is taxing the ability to capture, store, and retrieve data across the infrastructure, which is no longer radiology centric. As digital imaging quickly branches out to encompass the richer, denser cardiovascular angiography and, in some cases, digitized oncology and pathology images, storage systems are being pushed to the limit.

2.2 Offline Storage Is No Longer Viable

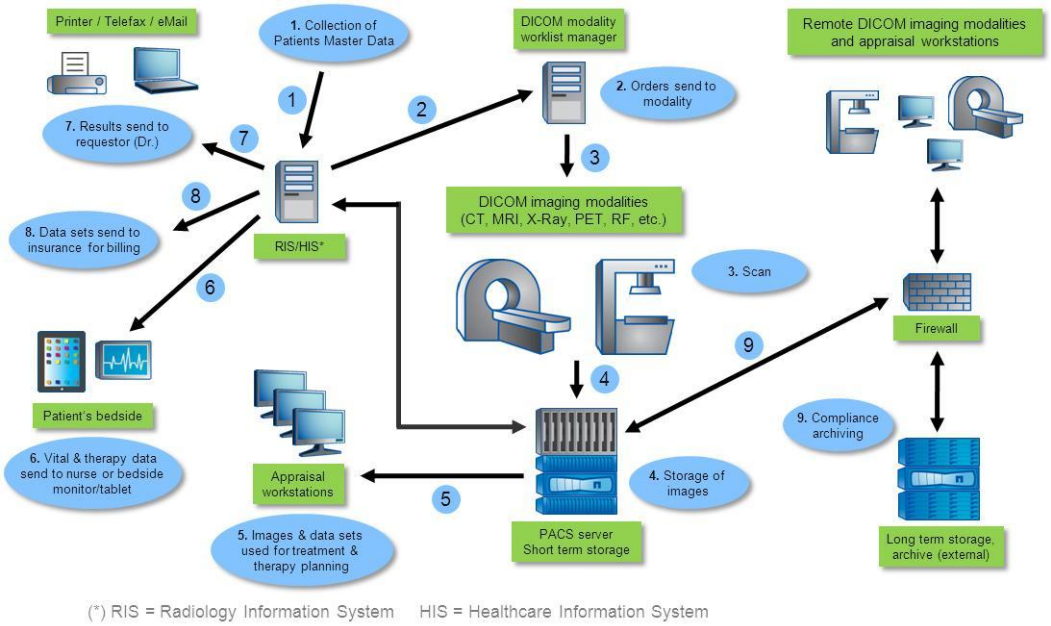
Traditional, tiered infrastructure solutions cannot provide the timely access to medical records required by medical professionals at an affordable cost. To meet the demands of today's clinicians, IT must create a shared IT infrastructure that allows rapid, affordable access to all information, including both current patient records as well as archived data.

With today's SATA drive technology, IT now has access to cost-effective, secure online storage solutions for long-term retention of patient records. This provides the flexibility to store current patient data on high-performance primary storage for immediate access to current images and then archive to SATA for secondary storage (replacing tape), enabling compliance with retention regulations. Physicians can then easily retrieve the historical data they need to assist in a patient's diagnosis or treatment plan.

2.3 The Necessity for Workflow Efficiencies

To get an accurate view of a patient's health, physicians require immediate access to all image modalities (regardless of department) as well as EMR and EHR systems to determine the proper treatment. These different modalities are increasingly being architected into a unified PACS infrastructure to deliver the workflow efficiencies across these systems in a time frame that meets doctors' demanding schedules.

Figure 2) Healthcare IT imaging workflow.



(*) RIS = Radiology Information System HIS = Healthcare Information System

By adding order processing, scheduling, analytics, and built-in reporting tools for modality-specific procedures and streamlined interfaces to billing, entry delays and billing errors can also be reduced. With the next generation of PACS solutions, radiologists and cardiologists can now read, create, and sign off on a report, attach it to the bill, and initiate electronic transfer of the bill to health insurers to improve cash flow.

3 Healthcare Content Challenges

We have entered an era in which agility is central to delivering excellence in patient care. But while healthcare organizations struggle to manage monumental data growth in the face of constrained budgets, IT is under pressure to drastically reduce access time to patient records. To support these challenges, big content needs an underlying infrastructure that accommodates storing, managing, and retrieving the large datasets generated by imaging modalities.

3.1 Federal Mandates

Conformance requirements for federal mandates mean healthcare organizations need to keep an ever-growing amount of patient data. At some point it will break the budget. Eventually it will be necessary to think differently and to evaluate ways to keep more data while spending less.

Cost of Compliance

With the growing reliance on information technology in the healthcare industry, the privacy of medical records is not just a civil right, but also a government regulation. The advances in EMR/EHR systems, collaboration in diagnosis and research, and integrated billing systems all require that the healthcare industry demonstrate compliance with both the Health Insurance Portability and Accountability Act (HIPAA)[1] and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO).[2] Storage systems must show proof that they meet these requirements to safeguard against data loss and access by unauthorized individuals.

And as hospitals gear up to meet the Health Information Technology for Economic and Clinical Health (HITECH)[3] Act (the mandate for all patients to have electronic patient records by 2014), information systems
officers must also contend with participation in regional and national health information exchanges and networks as well as the implications regarding data growth, availability, and portability of patient data in a secure environment. Although many of the large integrated delivery networks already have a secure electronic communication platform in place, no one single standard or set of standards has been agreed upon to match a region of patients with a discrete record locator and handle the management.

3.2 Effective Long-Term Retention for Compliance and Retrieval

Although it is not yet required across the entire United States, several states now require hospitals to retain patient data, in particular, obstetrics data, for upward of 20 to 30 years. As the amount of stored data grows, the retention of that data becomes more complex, not only in terms of volume, but also in terms of compliance with federal and organizational policies concerning how long to store data, when to delete it, and where to store it. Increasingly, organizations are challenged to store data for decades or forever, and they need to make sure that the data is not compromised as the storage infrastructure evolves during that time.

The next challenge is to be able to quickly find and retrieve relevant content from that long-term repository as the amount of data and the complexity of the storage infrastructure increase. Not only is it critical for organizations to provide fast access, but it has to be easy for doctors and nurses to retrieve all medical images and patient files to enable them to perform their jobs effectively.

Leveraging Historical Data for Research

Increasingly, healthcare organizations are finding that research activities are able to leverage tremendous value from the historical patient data in their archives. This data can lead to the discovery of the root cause of diseases, and often results in the development of new medical procedures or drugs that can accelerate a patient's recovery.

- **Data analytics**. Using a clinical decision support system and data from EHRs, Southeast Texas Medical Associates were able to develop and deploy a diabetes prevention program to identify at-risk patients.[4]
- **Data mining.** Florida Hospital used data mining to launch a clinical best practices initiative with the goal of developing a standard path of care across campuses, clinicians, and patient admissions.[5]

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[1] Health Insurance Portability and Accountability Act of 1996 establishes national standards for secure electronic transactions between and among healthcare participants, including care providers, health insurers, pharmacies, and employers.

[2] Joint Commission on Accreditation of Healthcare Organizations performs accreditation and related services to support quality care in a hospital setting.

[3] Health Information Technology for Economic and Clinical Health 2009 addresses the privacy and security concerns associated with the electronic transmission of health information.

[4] http://www.himss.org/content/files/quality101/phase2/25_Quality_101_PhaseII_DiabetesPreventionProgram11-16-2010.pdf

[5] http://www.himss.org/content/files/jhim/19-2/datamining.pdf

- **Genomics.** Ongoing work by Duke Institute for Genome Sciences & Policy has tracked the physical and mental health and lifestyles of individuals from young children through adulthood, uncovering links between specific genetic mutations along with maltreatment during childhood and elevated rates of depression, antisocial behavior, and health problems such as elevated inflammation and heart disease.[6]

3.3 Secure Transmission of Patient Data

Securing vital and sensitive patient information is an ongoing concern for any healthcare organization. The simplicity of sharing data across networks (data in motion) has brought efficiencies to healthcare providers, making it easy for attending physicians to consult with specialists in remote locations. However, concerns about patient data integrity and security must be addressed.

In addition, due to data's sensitive nature, guarding data at rest is of equal concern. In order to protect patient data, security measures must also be in place to prevent unauthorized access to archived data, data that is not accessed or changed frequently, files stored on hard drives, files stored on backup tape and disks, and files stored off site or on a storage area network (SAN).

Protecting Both Data at Rest and Data in Motion

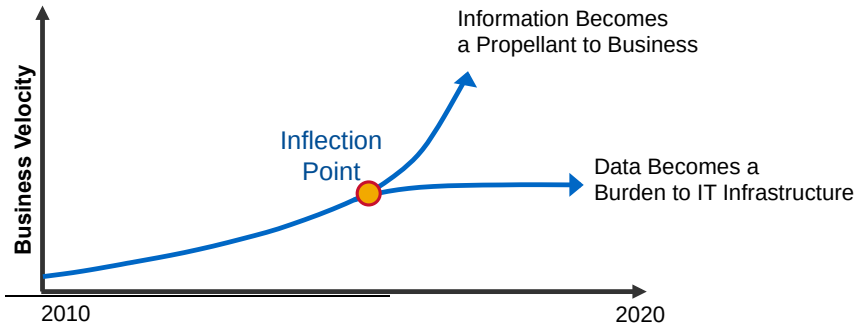
Federal mandates have established national standards for secure electronic transmissions, transactions, and archiving using encryption, firewalls, and virtual private networks to protect the integrity of an electronic transmission. Data encryption prevents visibility of data in the event of theft or unauthorized access. This form of security is used extensively to protect data in motion, and it is becoming recognized as an excellent method for protecting data at rest as well. Now, data storage administrators must create information access to records that capture passcodes, access identification, and enable time stamping to demonstrate the same protection with respect to retrieved files.

4 The Shift to an Agile Data Infrastructure

Why is an agile data infrastructure important? Two reasons: monumental data growth and the opportunities to deliver excellence in patient care. Data has been growing steadily for the past 50 years, but the orders of magnitude today are simply staggering. The creation, transmittal, processing, and storage of data have reached epic proportions. Assuming a 50% annual growth rate, this equates to a 58x data growth factor within this decade. This new abundance of data provides the healthcare industry with new ways to diagnose and treat patients.

It is becoming clear that we are reaching a collective inflection point at which data growth either becomes an overwhelming burden to IT or fuel to propel superior patient care. Successfully moving beyond the inflection point requires a new way of thinking and a new data infrastructure that supports historic growth levels while containing costs and avoiding complexity.

Figure 3) **Data growth impact on healthcare.**



[6] http://www.genome.duke.edu/research/psychology/

NetApp Agile Data Infrastructure

The NetApp® agile data infrastructure changes the way that healthcare IT can architect its data infrastructure to drive efficiencies across a shared environment. Much like a network, storage will be a lasting infrastructure that can grow and change while maintaining stability and predictability of services. This enables much higher levels of agility at a much lower cost than ever before, allowing healthcare organizations to optimize staff productivity, enhance physician satisfaction, and improve the overall quality of care.

The NetApp agile data infrastructure is centered on three pillars: the Intelligent, Immortal, and Infinite pillars. Specific technologies form the basis of an infrastructure that easily adapts to healthcare's IT needs.

- **The Intelligent pillar** helps deliver more impact faster with automatic data management and efficiency.
- **The Immortal pillar** enables nondisruptive operations with continuous data access even during system maintenance and upgrades.
- **The Infinite pillar** enables growth without limits to performance, capacity, and operational scalability.

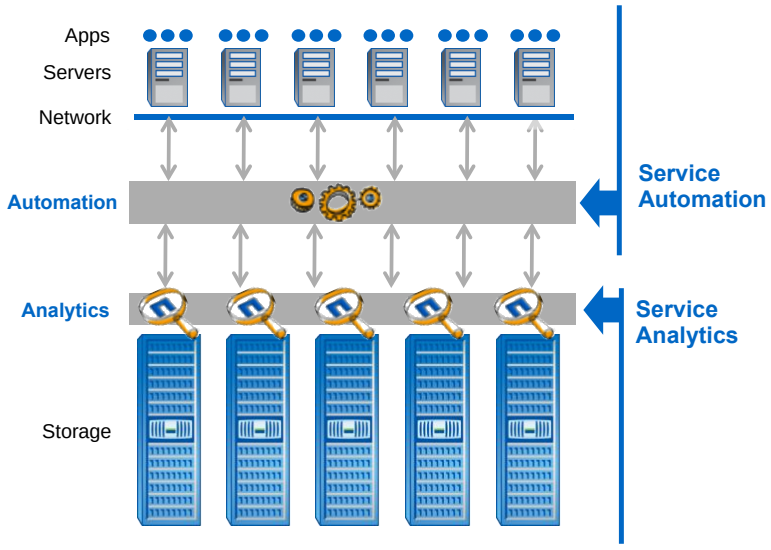
4.1 Intelligent Data Management

The cornerstone of an agile data infrastructure is intelligent data management. By automating the ability to deploy, adjust, and control data storage attributes, healthcare IT can now respond with the agility needed to accommodate growing volumes of patient data and provide the time-sensitive access to patient records demanded by doctors and nurses.

Service Automation and Analytics

NetApp simplifies the complexity of managing patient data with policy-based management. Routine operations such as creating a LUN, establishing a replication pair, and monitoring performance bottlenecks become increasingly easier when multiplied by hundreds or thousands of instances, and they eliminate the need for manual intervention unless an out-of-policy condition exists. Healthcare IT can now easily support terabytes to petabytes of patient files while reducing the time it takes to perform routine administrative tasks. And with improved policies and processes, IT is positioned to manage more terabytes per full-time employee with the push of a button.

Figure 4) Self-managed storage scales capacity, not people.



Storage Efficiency

NetApp storage efficiency technologies and techniques are designed to reduce unchecked storage growth while lowering costs, enabling healthcare IT to maximize investments in storage technology. In use by thousands of customers in a broad range of environments, NetApp storage can help lower the cost structure by reducing overall data storage costs by 50% or more while offering an infrastructure that enables clinicians to provide quality of care. We employ a variety of data reduction techniques, including primary-level deduplication, compression, and more. The variety of data reduction techniques reduces the amount of data on the disk and traveling over the network.

Flexible Online Tiering Options for Primary and Archived Storage

NetApp storage solutions are designed to handle the growing volume of data generated by medical imaging, streamlining the footprint for long-term archiving. NetApp provides flexible solutions that enable healthcare organizations to consolidate tiers and that result in a cost-effective and efficient storage solution with fewer controllers. Consolidating multiple terabytes of PACS data and additional hospital records on NetApp storage can considerably reduce the number of servers and storage devices that your IT team must manage, maximizing your return on IT investment. This helps simplify data management, increase storage utilization and availability, and enhance backup, recovery, and archiving processes.

4.2 Immortal Data Operations

Not much patient data is deleted these days. There are some valid reasons for this, such as the healthcare mandates that require long-term data retention. And, over time, it's been proven that it's more cost effective to keep all data rather than spend the time to analyze what should be deleted. This means that the majority of your data will eventually outlive your equipment several times over.

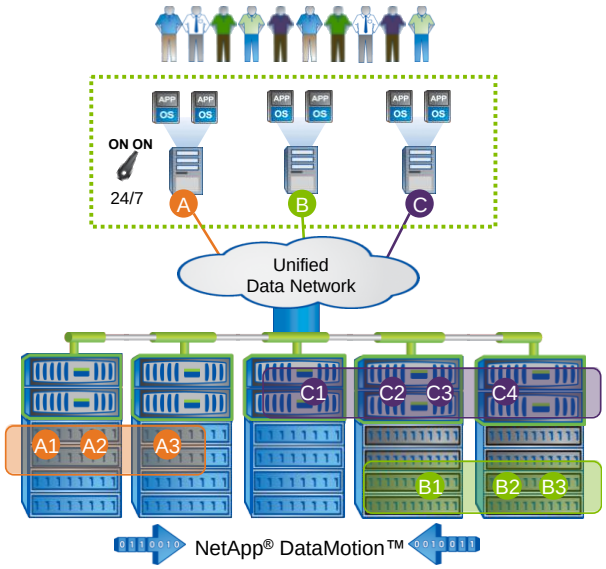
Nondisruptive Operations and Continuous Access

Patient safety is a top priority for healthcare organizations. Nondisruptive operations allow nurses to readily access medical records so that the correct patient gets the right treatment at the right time. And with nurses' fast, easy access to information, increased satisfaction across the nursing staff translates to improved quality of care.

This higher quality of care requires that healthcare IT personnel deploy storage solutions that can both store and manage large amounts of data while retaining the ability to quickly retrieve content when patient files or historical content is required to aid a diagnosis or treatment plan. NetApp's agile data infrastructure recognizes that if data is Immortal, then the infrastructure should be too. Because data can be accessed while it's being moved, operations such as workload balancing, technology refreshes, and adding capacity can all be done without scheduling a system outage or disrupting continual access to patient data.

To help avoid unplanned downtime, NetApp combines the proven reliability of its base hardware with innovative solutions to continue operations in the face of hardware failures or disasters that affect a site or region. Based on data from over 15,000 customer systems (the data has been audited and validated by IDC), NetApp storage systems in active-active controller configurations deliver uptime greater than 99.999% on average. This translates to less than five minutes of downtime per year, making scheduled downtime a relic of the past, which is increasingly important in delivering continuity of patient care.

Figure 5) Zero downtime for routine upgrades and replacements.



Embedded Data Security

Patient satisfaction increases when an accurate diagnosis is received. And with today's ability to confer online with specialists at remote facilities, physicians can accelerate the time to get treatments underway. However, sensitive patient information must be shared securely as mandated by HIPAA, and that information spans both data in motion and data at rest. A range of NetApp embedded data security technologies helps healthcare organizations comply with the regulatory requirement to protect stored patient data while enabling physicians to effectively treat their patients.

NetApp Storage Encryption provides full disk encryption using self-encrypting drives from leading vendors. This allows healthcare organizations to secure confidential patient data, comply with government regulations, and preserve the reputation of healthcare organizations by avoiding a publicized data security breach—all without compromising storage efficiency.

NetApp Storage Encryption supports the entire suite of storage efficiency technologies from NetApp, including deduplication and compression, providing you with the efficiency savings you see with unencrypted volumes. Array-based antivirus (AV) scanning is also supported.

- Implements full disk encryption at the hardware level
- Prevents access to data until the drive is unlocked by an authorized administrator
- Supports storage efficiency: FAS deduplication and storage compression
- Supports integrated data protection: Backup/recovery and SnapMirror®, SnapProtect™, and SnapVault® technologies
- Is file system and network independent

Integrated Data Protection

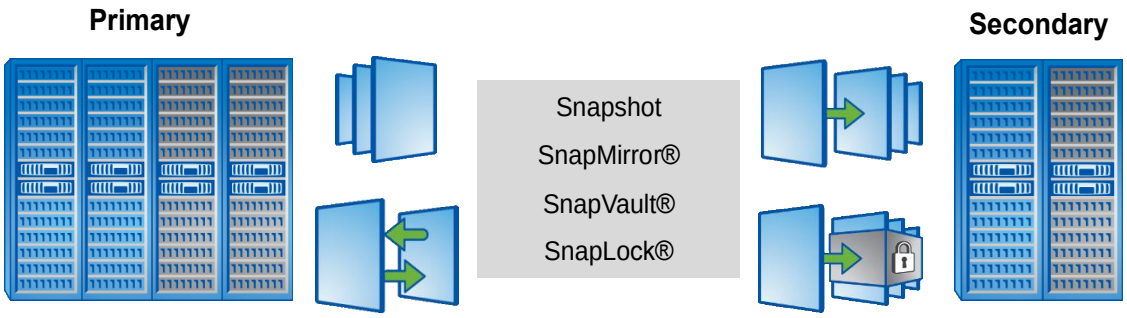
JCAHO accreditation requires hospitals to create effective failover procedures on site to protect stored patient images and other medical records. In addition to maintaining a data recovery backup system in the event of an unexpected equipment failure for online and near-line storage, HIPAA mandates now require medical information management executives to establish remote long-term data caches as part of a comprehensive disaster recovery plan.

Data protection needs to become as "set it and forget it" as possible. This principle holds whether the process is application integration to provide local availability, providing network-efficient and storage-efficient disk for backup and disaster recovery, or using exactly the same formats for long-term retention.

NetApp delivers automation of routine operational tasks, providing efficiencies that eliminate time-consuming, error-prone activities so patient data is not compromised. The ability to automate at this level is becoming more and more critical in order to deal with storage environments that need to constantly expand and change to support growing patient files.

- **Enable continuous availability.** Built-in high-availability features in the Data ONTAP® 8 operating system protect against hardware and disk failures, as well as operational downtime due to system upgrades or routine management tasks.
- **Provide integrated data protection.** Data ONTAP 8 provides integrated data protection—including Snapshot™ copies, SnapMirror replication, and integration with data protection software partners—so that data is protected, even across multiple data centers.

Figure 6) "Set it and forget it" data protection removes human error.



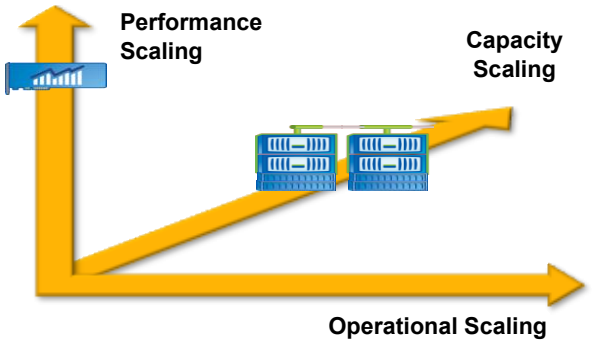
4.3 Infinite Data Scaling

NetApp has always offered the ability to efficiently scale up in modular increments, as compared to competitive solutions that typically require a forklift upgrade whenever a workload outgrows the architecture of their specialized (and non-unified) storage systems.

Scale-Out Architecture Accommodates Growing Content Repositories

With the introduction of Data ONTAP 8, NetApp offers the healthcare industry the ultimate in seamless scaling: the ability to scale out performance and capacity for both NAS and SAN environments to accommodate a range of medical applications. Petabytes of patient data and billions of files can now be stored across multiple sites in a single, location-independent namespace, with retention policies defining where and how long data should reside.

Figure 7) Scale applications without adding complexity.



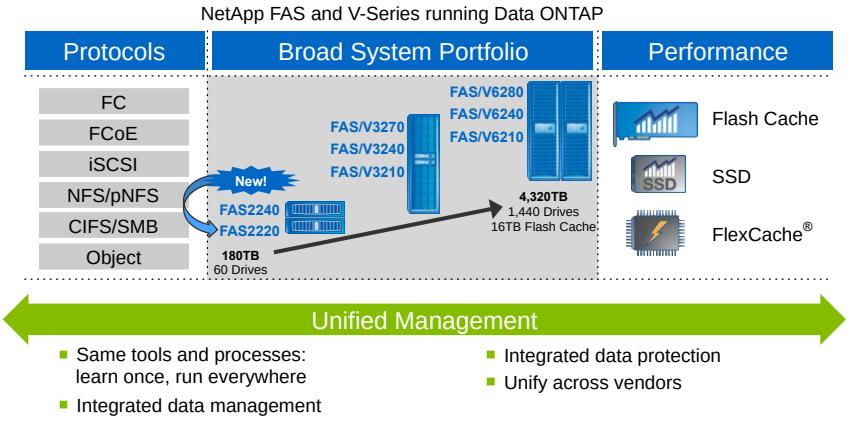
Unified Architecture

The NetApp Unified Storage Architecture and the NetApp Data ONTAP operating environment deliver a flexible architecture that supports a diverse set of medical and business applications, multiple protocols, diverse workloads, and changing requirements that confront healthcare organizations today.

The real benefits of unified storage are at the architecture level, not at the box level. A unified architecture means that you don't need to take a rip-and-replace approach when you need more I/O or a mix of I/O and cost profiles for different applications and storage needs. NetApp Data ONTAP 8 delivers superior capabilities for file services across file shares and virtual infrastructures supporting PACS, EMR, and EHR.

With Data ONTAP 8, healthcare organizations can consolidate file services workloads and business applications onto a dynamic storage cluster by adding nodes, disk technology, and caching as needed for a flexible, scalable file services infrastructure. The ability to handle multiple workloads and deploy multiple technology options across a single architecture gives you the flexibility to deal with change, because whatever storage requirements you have today, they will change again in the next 12 to 18 months.

Figure 8) One architecture for many diverse workloads.



Secure Multi-Tenancy

With NetApp software, you can share storage with maximum privacy and data security. In addition, NetApp with Cisco® and VMware® helps provide secure, end-to-end multi-tenancy across applications and data so you can reap all the benefits and business advantages of a shared IT infrastructure with virtualized computing.

The FlexPod® data center platform, jointly developed by NetApp and Cisco, provides a flexible infrastructure platform composed of presized storage, networking, and server components. Healthcare facilities have the agility to grow their data pools only as needed with the best available security for patient records and government compliance. With this massive data pool at their disposal, healthcare workers can more easily treat, diagnose, and provide customer service and billing information to patients, healthcare benefits providers, and government agencies. The FlexPod solution enhances the deployment of big datastores at a fraction of the cost and with much less complexity than purchasing, installing, and maintaining traditional data silos and storage arrays. This means you can accommodate more data, at less cost, and actually improve patient care and benefit coordination and compliance.

Vendor-Neutral Storage Leverages Cost and Delivers Efficiency

As storage environments have evolved over the years, healthcare organization have made substantial investments in a wide range of storage solutions to support the specific needs of departmental applications. Yet, today's requirement to easily access and share information from remote locations is driving the need for a shared storage infrastructure to:

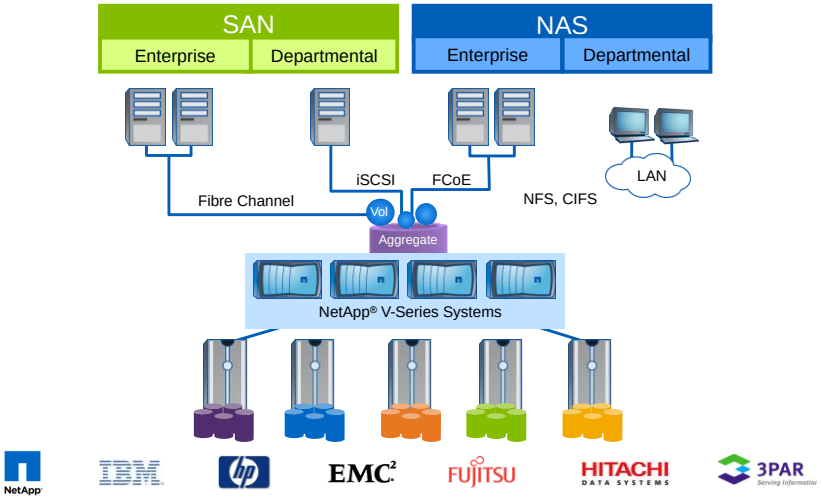
- Improve diagnosis and patient treatment by leveraging information across clinical applications.
- Drive staff productivity with efficiencies provided by a virtual desktop environment (VDI).

Many healthcare organizations have made significant investments in Fibre Channel (FC) storage area network (SAN) disk arrays, but this storage no longer meets the evolving needs for data protection, business continuity, cost reduction, and operational efficiency. However, replacing all existing storage is simply not in the budget. With vendor-neutral storage (VNS), healthcare organizations get the flexibility to leverage the cost and efficiency of new storage solutions while protecting their investment in existing storage systems.

Future-Proof Your Data Center

NetApp is the only vendor that offers a unified NAS and SAN gateway under one roof, enabling healthcare organizations to capitalize on the ability to do more with less. With NetApp V-Series open storage controllers, healthcare organizations can manage storage arrays from multiple storage vendors—including EMC, IBM, Hewlett-Packard, and Hitachi Data Systems—in a consistent way and with less effort.

Figure 9) V-Series architected to work in demanding heterogeneous environments.



NetApp V-Series can help make the storage you already own more efficient and flexible. Our advanced data protection, data management, efficiency features, and Virtual Storage Tier transform existing FC-SAN storage systems, enabling you to continue to use the capacity from your current investment while driving more value across your storage environment with streamlined backup and recovery, fast and easy disaster recovery, and improved storage efficiency. You get:

- **Choice.** Leverage current storage investments while attaining 30–40% savings with the NetApp Virtualization Guarantee Program.
- **Unprecedented levels of scalability and data storage flexibility.** Leverage the power of Data ONTAP to scale seamlessly across protocols using the same management tools and feature set.
- **Maximum efficiency.** Reclaim orphaned storage and achieve 100% or greater storage utilization with NetApp efficiency features.
- **Heterogeneous replication and nondisruptive operations.** Automate processes associated with backup and recovery in minutes.

5 Summary

Healthcare organizations that deliver agility and efficiencies through IT have the ability to respond immediately to change with improved clinical care in an unpredictable environment. And selecting the right storage solution is an important decision that can provide significant strategic advantages.

Collectively, the right storage solution can help improve overall patient care, lower infrastructure costs, simplify the management of data, and give you unmatched flexibility in responding to changes across IT environments. Doctors, nurses, and patients benefit from fast and highly available access to critical medical images and other patient records, while IT departments and hospital administrators get a cost-effective, easy-to-maintain storage solution that scales to hundreds of terabytes and controls operating costs.

NetApp provides a secure, boundless storage infrastructure that addresses the many challenges healthcare organizations face, including effectively managing large medical imaging files, addressing long-term retention policies, quickly finding and retrieving content from long-term repositories, and leveraging historical data to assist in medical research.

- **Improve patient care.** Medical images can be integrated with the patient's health information from various department systems to create a single integrated EHR.
- **Scalable storage that handles medical imaging growth.** Storage systems scale to over hundreds of terabytes each year and can be combined to handle petabytes of digital studies.
- **Reliable storage that protects compliance and access.** Highly available storage, robust data protection, strong security, and disaster recover features enable nondisruptive operations and compliance with regulations.

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