Upgrading Department PACS with Entry-Level Vendor Neutral Archive Components

A Smart Alternative to continuing the Proprietary PACS Archive Paradigm

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Message

Organizations that appreciate the benefits that the Vendor Neutral Archive (VNA) will bring to the organization, sometimes find it difficult to finance the complete VNA solution in a single budget cycle. It is most unfortunate if the decision comes down to deploying none of the solution, due to a lack of funding for all of the solution. In my opinion, continued investment in a proprietary Picture Archiving and Communications System (PACS) archive and the continued accumulation of proprietary data is a flawed strategy. The purpose of this paper is to propose an alternative to the full VNA deployment, and discuss an affordable entry-level phase to a multi-phase VNA deployment strategy.

Any IT initiative that is focused on an upgrade to a department PACS storage solution, a refresh of the existing storage solution or a replacement of the disaster recovery (DR) storage solution initiated by an end of life letter, is an opportunity to carefully consider the value to the organization in continuing the proprietary PACS archive paradigm. Migrating the image data from the PACS to a properly configured entry-level VNA is the organization's opportunity to once and for all normalize its image data and end the cycle of expensive and time-consuming data migrations that are required with every PACS replacement project. The hardware agnostic, entry-level VNA gives the organization the opportunity to apply advanced storage technology to all of its data management applications. All of these benefits can be realized at a fraction of the cost of a fully configured VNA, and in many instances for a price very close to that being quoted for the proprietary PACS solution.

A key component of the entry-level VNA configuration is the storage solution, and a key consideration for that storage solution is how hardware platforms such as IBM® Storwize® V7000 Unified and IBM SONAS provide significant value for not only VNA applications but other healthcare applications as well.

Background

Vendor Neutral Archive (VNA) now seems to be the accepted term for the concept of consolidating all of the long-term management of medical image data across the healthcare enterprise in a single data repository. The term itself still tends to generate debate, as some will point out that as long as a vendor is involved, a specific VNA solution cannot be neutral. Even the concept tends to be confusing, possibly because the label is frequently misapplied to some PACS archives by over-zealous marketing types and probably because the concept continues to

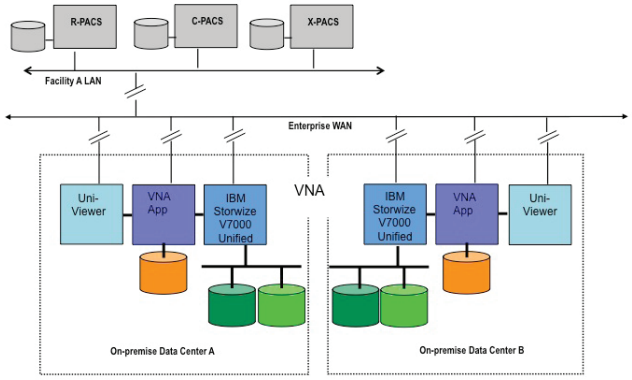
morph, accumulating new features and functions. For the purpose of this paper, I'd like to suggest a simple definition of the term VNA that has proven to be both simple and accurate.

The Vendor Neutral Archive is an enterprise-class data management system that consolidates primarily medical image data, but also related clinical content, from multiple departments into a "neutral" long-term archive system comprised of a master directory (database management component) and its associated consolidated storage system such as the IBM Storwize family of products or IBM SONAS (Scale Out Network Attached Storage), which will be discussed in greater detail later in this document. The single VNA thus replaces the individual long-term archive subsystems associated with departmental PACS. By virtue of consolidating all of the enterprise clinical content, the VNA can also function as the unified image data repository for the Electronic Medical Record (EMR) system.

The word "Neutral" in the name refers to the most important aspect of the concept…the ability of the VNA to manipulate PACS-specific Digital Imaging and Communications in Medicine (DICOM) header elements in such a way as to make the image data exchangeable between disparate PACS. This dynamic and bi-directional DICOM header "tag morphing" is the key determinant of the Vendor Neutral Archive. Admittedly some of the pretenders are capable of bi-directional tag morphing, but the real litmus test for a true VNA is the ability to execute all of the necessary tag morphing required to guarantee full compatibility of image data files between any PACS.

The illustration on the next page reflects the fact that nearly all VNA deployments in the US market are configured as a mirrored set of compute and storage subsystems that have been fully tested for interoperability to ensure ease of deployment such as IBM technology products including IBM Storwize family and IBM SONAS storage systems.

Note: The same storage can also be configured for additional applications within the enterprise. There are two instances of each significant application, one in each of two geographically separate data centers. The two separate VNA subsystems represent a true disaster recovery configuration. Notice that in this illustration there are also two separate instances of a universal viewer component, one in each data center. The UniViewer (my term) is a multi-modality medical



Despite the fact that the concept of VNA has now been around since 2007, questions about its intended purpose still pop up in blogs and forums. In the most basic terms, the purpose of the VNA is to address nearly all of the problems associated with today's department PACS. In an article published by Health Imaging and IT, the author names the top 10 problems with today's PACS. It is easy to explain how the VNA solves 7 of those problems.

- Integration…The VNA enables image sharing between department PACS, in the same organization as well as between department PACS in different organizations
- Downtime…The VNA can provide a true business continuity solution that most PACS configurations cannot provide.
- Hanging Protocols…The VNA can dynamically modify DICOM headers in such a way as to guarantee that images from disparate PACS will be compatible with each other's hanging protocols.

- Interoperability…The VNA will consolidate and standardize the servers and storage solutions required to manage all of the enterprise image data for its life cycle.
- Out with the Old…The VNA will significantly reduce the complexity and cost of future DICOM data migrations, as only a small fraction of the historical data needs to be migrated to a replacement PACS
- Whose PACS?…The VNA takes responsibility for long-term management of the image data as well as image-enabling the EMR. Removing these responsibilities from the PACS makes the PACS solely responsible for supporting operations that are confined to the imaging department. The choice of PACS that best meets those requirements shifts back to the imaging department.
- Disaster Recovery…The VNA provides for a very robust disaster recovery solution, and the storage solution must be able to provide application-consistent disaster recovery options for any additional applications that may be connected as well.

A properly configured VNA consolidates all of the individual PACS long-term storage solutions into a single, enterprise class, long-term storage solution…effectively taking the long-term "Archive" out of the individual department PACS.

Itemizing all of the significant features and functions, and technology requirements of the true VNA along with a detailed explanation of each is beyond the scope of this paper. Yet it is important to appreciate what separates the true VNA from the many pretenders that have suddenly entered the market. Hopefully the following succinct list will not only clarify the issue, but help the reader appreciate why the VNA is rapidly gaining status in the IT community.

- Dynamic DICOM Tag Morphing – On-the-fly conversion/mapping of data elements in a DICOM header in support of data exchange between disparate PACS
- Flexible Architecture – Server and storage hardware-agnostic, mirrored subsystems with automated failover and reconciliation, supports virtual server and virtual IP
- DICOM and IHE – Full conformance, with latest DICOM Service Object Pair (SOP) classes, no exceptions
- Non-DICOM - Methodology for accepting and managing non-DICOM data objects.
- Data Compression - Capable of negotiating any DICOM supported compression syntax
- PACS Synchronization – Capable of staying in sync with the PACS database via Health Level 7 (HL7) monitoring and custom messaging protocols
- ILM Methodology - Intelligent Information Lifecycle Management (ILM) – data movements internal and external to the system based on meta data associated with the study data. Automated, user-defined data purge mechanism with manual supervision. Node-specific retention flags that would over-ride a purge operation. The storage solution itself should also allow for ILM data movements to and from different tiered-levels of disk, as well as tape. Ideally this is done seamlessly and transparently to the application(s).
- Storage Reclamation - Ability to reclaim storage space following media migration or data purge.
- Transaction Logging - Health Insurance Portability and Accountability Act (HIPAA) compliant logging and reporting by Organizational Node
- Pre-fetching / Auto-routing - HL7 assisted Pre-fetching of relevant prior data being managed by the VNA and Auto-routing of that data to the appropriate department PACS.
- Data Migration Engine – Built in data migration capabilities that the customer may use for any necessary future migrations.
- UniViewer – An interfaced or integrated general purpose viewing application that can be accessed directly or through the EMR as the means of accessing and viewing any of the

[1] Top 10 PACS Problems…Health Imaging & IT, July 19, 2011

clinical content being managed by the VNA.

So What's the Problem?

Clearly the VNA is more than a big archive, and the properly configured VNA is going to be more expensive than the archive component of the organization's biggest PACS, since it will be managing all of the image data from all of the department PACS in two mirrored archive subsystems. Therefore the properly configured VNA is big enough and expensive enough to possibly require multiple years and multiple budgets…a scenario very reminiscent of first generation Radiology PACS deployments. Even as late as the mid '90's, first generation Radiology PACS required large investments. As a consequence, early PACS deployment strategies focused on solving more manageable, smaller problems with entry-level products that were modestly priced.

The typical Radiology PACS deployments in the mid-90's were phased over several years and several budgets. The complete PACS configuration would frequently be broken up into smaller mini-PACS subsystems. For example in phase I the organization would deploy a mini-PACS configuration for CT, next phase deploy one for MR, then one for Ultrasound, and follow-up with one for Nuclear Medicine. Each of these mini-PACS was an entry-level configuration that could ultimately be stitched together to create the full-blown Radiology PACS. Like the early days of PACS, there should be several affordable subsets of the Vendor Neutral Archive that can solve simple, but aggravating problems caused by today's PACS.

As healthcare institutions plan for their next generation of clinical IT applications, transitional solutions are needed to facilitate the deployment and simplify the decision making process. This strategy should be applied to the VNA. An entry-level VNA configuration can serve as a bridge between those individual PACS archives and an integrated clinical repository platform. Consider the entry-level VNA as both a product concept and a strategy.

The VNA software suite is comprised of numerous "subsystems" focused on the applications listed above, for example: DICOM Routing, HL7 integration, pre-fetching/auto-routing, Information Lifecycle Management, tag mapping, PACS synchronization, etc. Any strategy that attempts to divide up the VNA according to the required features/functions would be overly complicated to explain, and present significant challenges to the system integrator. What is needed is a far simpler approach to the component "packaging" that will define the ideal entry-level VNA.

We can arrive at the most logical entry-level VNA configuration by looking at some of the most recognizable problems faced by many healthcare organizations… problems that would be better solved by deploying an entry-level configuration of the VNA rather than trying to "fix" the existing PACS.

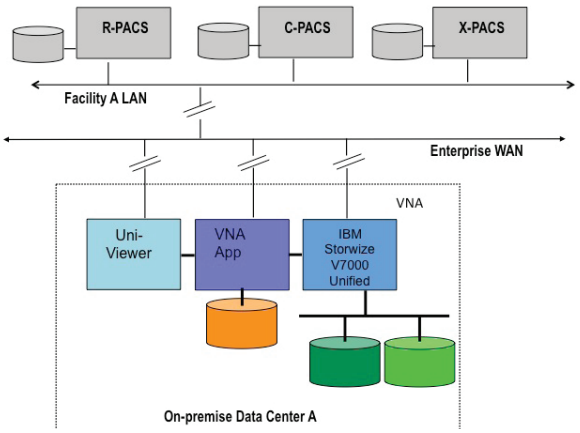
Some of the common problems associated with department PACS that healthcare organizations face today are listed below:

- Aging DR Solutions (storage solutions that require a refresh or actually face end-of-life)
- Individual DR solutions for each PACS
- Inability to exchange data between disparate PACS
- Poor performance of clinical viewers over low bandwidth connections
- Non-existent business continuity solutions
- Expensive and time-consuming data migrations when PACS are replaced

The Solution…Logical Entry-level Configuration

Using the above list as a guideline, the simplest approach to creating an entry-level

VNA configuration is to divide the VNA in two (somewhat) equal halves. The traditional VNA configuration consists of two mirrored subsystems, a Primary and a Secondary, each located in geographically separate data centers. Therefore the entry-level VNA would simply consist of the Primary VNA subsystem…a single instance of the entire VNA application suite and whatever hardware infrastructure is required to meet the customer's needs.



These single instance systems, such as the one suggested in the above graphic, must be capable of all of the following:

- Ensuring inherent high availability and fault tolerance,
- Ability to work with multiple instances leveraging state of the art global namespace technologies for easy and non-disruptive scalability (example: IBM SONAS and IBM Storwize V7000 Unified),
- Integrated ILM,
- Embedded support for data protection features such as anti-virus and Network Data Management Protocol (NDMP) backup,
- Delivering highest performance and throughput in a highly scalable configuration

In addition, these storage systems should also provide

- Ease of migration,
- Co-existence of both PACS (SAN or DAS) and VNA (usually NAS) data in a single unified storage system,
- Support for traditional campus-based users as well as secure/authenticated remote users using mobile devices (via remote file sync/share features)

The full software license is applicable regardless how many of the VNA functions are actually utilized. The Secondary VNA subsystem is then deployed in the second data center in a subsequent year and budget cycle.

The entry-level VNA configuration would draw upon the full compliment of VNA applications to solve all of the problems listed above. In every case, an argument can be made for the entry-level VNA being the better approach to solving each of those PACS problems.

Organizations facing a storage solution refresh or an end of life notice for a disaster recovery solution associated with a PACS should question going through the time and expense of migrating the image data from one proprietary DR solution to another proprietary DR solution, when they could begin the "normalization" of their image data by migrating it from the PACS DR solution to the VNA-fronted DR solution. Furthermore, the hardware agnostic nature of the VNA would allow the organization to choose whatever storage solution made the most sense, rather being limited to those storage solutions supported by the PACS vendor.

Organizations considering a storage upgrade should question upgrading an existing storage solution or replacing older storage media on one PACS, when they could begin the consolidation of PACS storage and the normalization of that data by purchasing a larger, new storage solution fronted by the entry-level configuration of the VNA. An added benefit is being able to use this system to replace the older storage on several PACS.

Organizations that have disparate department PACS and are frustrated with the inability to exchange relevant prior imaging studies between these PACS, or between their PACS and those of outside referral organizations should consider deploying an entry-level VNA with a entry-level storage solution that can easily scale to facilitate image exchange between those PACS.

Organizations considering an upgrade to their PACS clinical viewing software should remember the poor performance of the typical PACS clinical viewer over low bandwidth connections. The entry-level VNA with UniViewer option will more efficiently image-enable their EMR with a viewing application that delivers exceptional performance over low-bandwidth networks due to it zero client server-side rendering technology.

Organizations have long been challenged with creating a workable back-up plan to cover both scheduled and unscheduled downtime for their PACS. Very few (if any) department PACS can be configured with a real, easy-to-use business continuity solution. The entry-level VNA with UniViewer option can function as the business continuity solution for any of the department PACS, once the organization has migrated the most recent 18 to 24 months of priors into the VNA.

Organizations that are at least half way through the life expectancy of an existing department PACS, know by now that they are facing an expensive and time-consuming data migration when that PACS is eventually replaced. There is no better time to question the migration of all of the data from the old PACS to the new PACS, knowing that it will be necessary to migrate an even larger volume of data, when that new replacement PACS is eventually replaced. It's time to break this senseless cycle. In my opinion, a pro-active migration of all of the organization's image data to an entry-level VNA is the logical decision. Furthermore beginning this project in the middle of the PACS lifecycle not only reduces the volume of image data to migrate, it also reduces the eventual cost.

Organizational Profile

Having defined the logical entry-level VNA configuration and listed a few ideal applications for this configuration, let's look at the organizational or circumstantial characteristics that would be indicators for the entry-level VNA.

Organizational Characteristics - Organizations exhibiting all of the following characteristics should investigate the entry-level VNA strategy.

- The organization has an understanding of the VNA concept and the advantages of this approach to image data management. Deploying their VNA is simply a matter of time and budget approval.
- The organization recognizes the liabilities, in terms of time and costs, associated with either an immediate or pending data migration. That data migration may be from either an old DR solution to a new DR solution, or an old PACS to a replacement PACS.
- The organization is unable to secure the required capital, or operational funds to deploy the full, mirrored, dual-sited configuration of the VNA.

Circumstantial Characteristics – Organizations exhibiting any one of the following characteristics should investigate the entry-level VNA strategy

- The organization is facing a storage solution refresh or an end of life notice for a Disaster Recovery solution for any of its department PACS.
- The organization is considering a storage upgrade for any of its department PACS.
- The organization needs to facilitate image exchange between its own department PACS, or between its internal PACS and an external PACS.
- The organization needs to image-enable its

EMR with a single universal viewer that can more efficiently access image data from a centralized image data repository.
- The organization cannot afford to halt imaging operations when a department PACS undergoes scheduled or unscheduled downtime, and therefore requires a realistic and workable business continuity solution.
- The organization is considering, or actively planning to replace an existing PACS, or a PACS vendor.

The following circumstances might also prompt the organization to consider a pro-active migration to an entry-level VNA, even if PACS replacement is thought to be some time downstream.

- The organization does not have the staff or funding available to support the outgoing PACS as well as the new PACS, during the typically lengthy data migration process.
- The organization desires to utilize the new PACS as soon as possible and not be delayed by the migration process that cannot begin until the new PACS is on site.

The Entry-Level VNA Product Description

All VNA software application suites are architected differently, based on the history of their key components, when they were developed, the tools available at that time, etc. This differentiation doesn't necessarily make one VNA better than the others it just makes them different. Nevertheless all true VNAs provide similar functions, whether the software applications are packaged in a collective suite or exist as a series of independent modules that work in unison. The software architecture in turn dictates the hosting hardware (server) architecture. The purpose of this section is to offer a high level and generalized overview of the entry-level VNA configuration from the perspective of its software, hardware, and the associated professional services.

Software Components – The VNA software components would consist of the following major elements. Typically the full software suite is provided under a perpetual software license based on the total volume of new studies that will be ingested per year.

1. The directory Data Base Management (DBM) subsystem. There may be one centralized directory or a series of federated directories deployed in each of the major facilities.
2. The VNA application Suite.
   a. Image data ingestion
   b. DICOM Modality Work List (MWL)
   c. Comprehensive bi-directional tag mapping engine and reference tag library
   d. Pre-fetching and auto-routing triggered by an HL7 feed and based on a user-defined relevant prior algorithm.
   e. Reconciliation against an order of all new studies coming directly from a modality (not a PACS)
   f. Content-based routing. (Meets complex image routing and retrieval requirements)
   g. XDS-I (Cross Document Sharing for Imaging) service components
   h. Clinical functions
   i. Comprehensive auditing and reporting package
   j. Image access
   k. PACS-VNA synchronization applications including both HL7 and customized PACS-VNA messaging
3. The HL7 interface engine
4. The workflow subsystem
5. The content management subsystem
   a. Aggregation application
   b. Interoperability functions
   c. Sharing and querying functions
6. The storage management subsystem
   a. Virtualization
   b. Data protection functions
   c. Information Lifecycle Management (ILM) functions including a purge function driven by a user-defined retention policy

d. Replication function
e. Application interfaces to the variety of supported storage and system networking solutions (unified storage systems capable of supporting SAN and NAS architectures)
f. Application Programmer Interfaces (API) to storage grids, CAS, etc.

7. DICOM data migration engine
8. Support for central management of a multi-site VNA configuration, if required
9. Desktop as well mobile device access to the VNA
10. Remote VNA system monitoring application
11. VNA test system

Hardware Components – The number of servers required to host the software applications and the actual Bill Of Materials (BOM) that specifies the individual server requirements is very dependent on the architecture of the application suite and the actual software modules that will be utilized. The system integrator will play a key role in creating the most efficient server configuration and selecting the most appropriate storage solution, as the long-term view requires careful hardware design.

1. Servers (a series of virtual servers for those software components that can be virtualized and dedicated servers for those that cannot be virtualized)
2. Tier 1 storage
3. Tier 2 storage (if the application requires this architecture)
4. Load balancing switching
5. Test server(s)
6. Migration servers. Some VNA configurations depend on the use of separate servers dedicated to the data migration. These servers are frequently leased to the customer for use during the migration and then removed after migration has been completed. Ideally, these migration features should be provided by the storage systems to allow for phased migrations to suit an organization's deployment needs.

To ensure that all these hardware components work well with each other and with the VNA software applications, it is important that the hardware and software components are tested together, as well as validated for ease of installation/deployment, optimized for ease of operation and certified to meet the expected throughput/performance.

Professional Services – A key part of the VNA configuration is the professional services package that should include all of the following components.

1. Project management
2. System installation
3. PACS interfacing
4. HL7 interfacing
5. System set-up (custom programming of all of the applications, rules, etc.)
6. Set-up, execution, and monitoring of the data migration(s)
7. Set-up of the remote system monitoring application
8. System administrator training

Options to the Basic Package – In addition to the above standard components of the entry-level VNA there are a number of important options worth listing.

1. UniViewer. Several of the true VNA product packages now include an integrated universal viewer display application. This zero client viewing application based on server-side rendering is the ideal methodology for image-enabling the EMR, accessing the images directly from the VNA. This is a software application that may or may not require its own dedicated servers.
   a. URL interface to the EMR. The UniViewer package comes with a URL-based interface to the EMR.
2. Non-PACS DICOM data ingestion. This optional software package allows the VNA to ingest DICOM image data directly from imaging

modalities. The package includes a menu-driven QA/QC toolkit and a reconciliation feature that matches the study images to an order.
3. Non-DICOM data ingestion. This optional package includes the software and interface hardware required to allow the VNA to acquire and manage non-DICOM image data.

Phase II Upgrade

The entry-level VNA configuration is essentially the Primary VNA subsystem, or half of the typical dual-sited, mirrored VNA configuration. The entry-level VNA may initially be interfaced to only one department PACS, or several department PACS in only one of the organization's hospitals. In this case there are several possibilities for expansion of the entry-level VNA.

1. Interface to additional department PACS in the same facility, and a corresponding increase in the size of the storage solution.
2. Interface to all department PACS in the one or more of the other facilities in the health care system, and a corresponding increase in the size of the storage solution.
3. Interface to non-PACS modalities and /or interface to non-DICOM image sources in one or more facilities
4. Addition of the UniViewer.

I tend to think of the above "next steps" as simple extensions of Phase I, primarily because the VNA is still only managing the secondary copy of the image data…the disaster recovery or business continuity copy of the data. With the exception of that data being managed by the standalone imaging devices and the non-DICOM data sources, the primary copy of a majority of the organization's image data is still being managed by each of the department PACS.

In my opinion, Phase II would represent the completion of the paradigm shift from managing image data in isolated department PACS to managing all of the enterprise image data in a single, consolidated enterprise VNA. Therefore, in the context of this paper, Phase II would involve the deployment of the Secondary VNA subsystem. For the most part, this involves purchasing and installing the required hardware infrastructure…a second set of servers, storage solution(s) and load balancing switches. There is an upgrade to the VNA software license to manage this secondary copy of the data, but it is typically a reasonable fraction of the cost of the license associated with the Primary subsystem deployed in Phase I.

Once the VNA itself is managing both copies of the enterprise image data, and the VNA is thus capable of providing for its own disaster recovery and business continuity solutions, the organization can begin decommissioning a large percentage of the long-term storage on each of the department PACS, retaining only a modest volume of working storage on each PACS. At this point, the organization has in place a fully mirrored, dial-sited VNA. It is important to note that Phase II would also include the secondary instance of the UniViewer, assuming of course that the UniViewer was deployed in Phase I. The only major subset of the Phase I configuration that would not have to be duplicated in Phase II would be the VNA test system.

Applying IBM Smarter Storage for Smarter Computing for VNA and Other Healthcare Applications

A key component of the entry-level VNA configuration is the storage solution, and a key consideration for that storage solution is how hardware platforms such as IBM Storwize V7000 Unified and IBM SONAS provide significant value for not only VNA applications but other healthcare applications as well. IBM has tested and certified VNA solutions with leading providers to ensure interoperability and investment protection.

This section provides an overview of the IBM storage systems and the associated feature/

function sets that make them ideal candidates for the storage component of both the Phase I (entry-level) and Phase II VNA configurations. Many of these features make these IBM storage systems ideally suited for additional applications within the enterprise.

IBM Smarter Storage, the strategic IBM approach to storage design and deployment, can help healthcare institutions focus on the value of information in their core systems in order to gain timely insights to benefit patient treatment and care. Smarter Storage solutions leverage innovative IBM research on intelligent algorithms, automation, virtualization and information-sharing along with best practices to help manage costs and control the rate of storage growth. The IBM approach focuses on technologies and capabilities that drive the development of solutions that manage cost and capacity without compromising performance and service. The IBM Storwize family and IBM Scale Out Network Attached Storage (SONAS) are examples of IBM storage systems that embody the tenets of Smarter Storage and can help address immediate information infrastructure needs and prepare for future healthcare environments.

The IBM Storwize family includes entry to enterprise level storage systems that are designed to support growing business requirements while controlling costs, making it ideal for storing and accessing healthcare data and related digital information. Key Smarter Storage capabilities include storage virtualization, built-in solid state drive (SSD) optimization, thin-provisioning, clustering, high availability, real-time data compression, replication services, multi-protocol support and a common, advanced administration interface. The Storwize family offerings are optimized for rapidly growing workloads and can help healthcare organizations flexibly and economically keep pace with new clinical and business requirements.

The inline data compression capability of the Storwize V7000 Unified can boost storage efficiency for both block and file data. Specific to this discussion around VNA solutions, data compression is more applicable to non-image data. This is because of the VNA's charter to store lossless image data.

For large deployments, IBM SONAS (Scale-Out Network Attached Storage) provides an enterprise-class, modular, scalable, network-attached storage (NAS) solution that can support billions of files in a single global file system to easily address current and future storage requirements. Delivering seamless scalability for the high performance and massive storage capacity that large or rapidly growing healthcare providers require, SONAS leverages innovative Smarter Storage technologies including a distributed architecture to reduce management complexity and eliminate any single point of failure that would impede data availability.

Creating efficiency to manage cost and capacity growth

The growth of medical data demands a constant pursuit of increased storage efficiency. But widespread use of efficient storage technology has been hampered by complex deployments, inconsistencies across products, tradeoffs in performance and other drawbacks. Efficient storage should have advanced features pre-installed and ready to deploy to help shrink capacity needs and improve productivity.

IBM Storwize family

Smarter Storage technologies that are built into the Storwize family offerings to deliver effortless efficiency for medical imaging and related applications include:

- IBM Real-time Compression™: Integrated into the Storwize family, Real-time Compression is designed to improve efficiency by storing up to five times as much active primary data

in the same physical disk space. Real-time Compression operates immediately as data is written to disk, so no space is wasted storing uncompressed data awaiting post-processing. (As noted: this feature is only applicable to managing non-image data.)
- Thin provisioning: Using thin provisioning, medical imaging applications consume only the space they are actually using, not the total space that has been allocated to them. Designed to keep business overhead low, thin provisioning optimizes efficiency by allocating disk storage space in a flexible manner among multiple users, based on the minimum space required by each user at any given time.
- Common, easy-to-use interface: The Storwize family includes a powerful management interface that gives administrators intuitive control of the system and offers the ability to manage both block and file storage requirements from the same graphical user interface.

IBM SONAS

In demanding healthcare environments, including medical imaging, SONAS leverages innovative technologies including:

- Modular clustering: This capability helps ensure data availability by eliminating single points of failure and enhances productivity by improving performance.
- Replication services: File system and fileset-level snapshots and asynchronous replication help preserve business data and processes and protect against both major and minor disasters.
- Global namespace: Access to data is through a single global namespace, providing location-independent file services over multiple heterogeneous, distributed file systems.
- NDMP high-performance backup support: SONAS supports backing data up simultaneously in existing storage systems using—and preserving investments in—third-party data management software, including Symantec NetBackup, EMC NetWorker and CommVault Simpana.
- IBM Tivoli® Storage Manager (TSM) integration: This tight affinity with TSM enables very efficient and extremely fast backup and restore processes, and policy-driven migration of files to IBM premium Linear Tape-Open (LTO) Tape Libraries or any TSM Server-supported tape or tape data de-duplication device. Additionally Tivoli Storage Manager provides full support of IBM tape-encryption technology products.
- Self-optimizing enhancing performance and productivity for healthcare applications

IBM Storwize family

The Storwize family uses built-in self-optimizing technology to analyze data-access patterns and automatically adapt to balance performance and cost. IBM System Storage® Easy Tier® automatically and dynamically moves appropriate data—such as data that is frequently accessed—to fast, high-performing SSDs based on ongoing performance monitoring. Imaging data that does not require such high performance remains on lower-cost hard disk drives (HDDs). Healthcare organizations can also gain these benefits without spending administrative time to manually create and manage storage tier policies.

IBM SONAS

SONAS can consolidate existing storage into a single pool and also provide extreme scale-out performance and massive capacity to support billions of files. The enterprise-level system is based on a modular, building-block architecture that reaches far beyond the clustering capabilities of conventional NAS systems.

With the ability to make changes to the storage infrastructure and to provision storage nearly instantaneously, SONAS enables easy dynamic growth without sacrificing performance. In addition, SONAS is designed to non-disruptively

upgrade and scale, supporting continuous operations for today's demanding business environments, including healthcare organizations.

High-density, high-performance SONAS can help an organization facing huge data growth to consolidate and manage its data affordably, relieve crowded floor space and reduce management expenses associated with administering an excessive number of disparate storage systems. Capabilities such as full and incremental backup and restore, along with central deployment and management of automated tiered storage, help increase the efficiency of protecting files.

Cloud agile: Increase information access

Cloud deployment models enable anytime, anywhere access to clinical information which will support collaborative partner-ships and dynamic care delivery. SONAS and the Storwize family incorporate IBM Active Cloud Engine™, a suite of capabilities specifically designed to manage files in an automated, scalable manner for distributed data centers and/or cloud-based environments. Active Cloud Engine creates the appearance of a single, very fast system despite geographic, media or other discrepancies that may exist in the physical reality. These capabilities enable users not only to search huge amounts of data and very quickly find what they're looking for, but also to rapidly store, delete, distribute and share that data. Active Cloud Engine gives healthcare organizations the ability to manage large numbers of files efficiently, locate the data of interest rapidly and get that data to where it is needed easily.

IBM providing decades of healthcare solutions

IBM has decades of storage technology excellence, experience and expertise with the healthcare industry. IBM's knowledge and partnerships help organizations unlock the value of their data. IBM brings together comprehensive software and storage technologies to help you reduce the complexity and costs of your storage infrastructure and prepare for future healthcare environments. Taking advantage of these capabilities and applying leading practices can help you to grow the value of your data, increase service levels and reduce IT costs. IBM SONAS and Storwize V7000 Unified deliver a premium-level solution that meets the medical imaging archive requirements for healthcare organizations of all sizes. These tested and proven solution unlock trapped value of digital clinical assets to enable healthcare organizations to manage all DICOM and non-DICOM clinical content. The agile, flexible and scalable solution delivers performance, capacity and information lifecycle management capabilities that are built into SONAS and Storwize V7000 Unified systems making them a perfect fit for both Phase I and Phase II VNA deployments.

Conclusion

The Vendor Neutral Archive can solve many problems presented by today's PACS, but a properly configured VNA is a dual-sited mirrored configuration, and therefore a significant investment. A multi-phase deployment strategy, reminiscent of the early days of Radiology PACS, may be the right approach for many organizations. The healthcare organization should therefore investigate any IT projects to determine if they present an opportunity to deploy smaller, manageable subsystems of the full VNA configuration.

Many of the storage upgrades, refreshes, and conversions offer excellent opportunities for deploying an entry-level VNA configuration.

When it is time to replace the disaster recovery solution provided by your PACS vendor, or substantially add to the primary or secondary storage solution associated with any of your department PACS, a strategic alternative to continuing those proprietary storage solutions

provided by the PACS vendor would be to migrate the data into an entry-level VNA platform. By continuing with the PACS vendor's solution, your organization will spend precious capital in a short-lived system that simply propagates the PACS vendor's proprietary data formats, limiting the organization with data that cannot easily be accessed by or shared with disparate data repositories in the enterprise.

The PACS vendor frequently limits the choice of storage solutions that can be interfaced to their PACS to only those few solutions that they have chosen to validate. This list of options may not include the latest technology. The VNA software is generally hardware agnostic, allowing the organization to choose the storage solution that is best suited to meet all of the organization's storage needs.

It is also worth remembering that changing storage solutions almost always involves an expensive and time-consuming media migration…moving the DICOM image data from the old storage to the new storage. PACS vendors are known to charge significant professional services fees to perform this media migration. If the organization is required to pay for a data migration, why not migrate the data to a neutral storage solution through a migration engine that normalizes the image data in the process? Once the image data is migrated to a VNA, the organization will never have to pay for another expensive DICOM data migration.

The Entry-level VNA configuration that I have described in this white paper meets the criteria of a multi-phase deployment strategy that I have been describing in blogs and webcasts over the last two years. Deploying "half" of the typical VNA configuration and positioning it as a "neutral" DR solution is a smart alternative to the proprietary PACS DR. Adding the UniViewer component to this neutral DR solution creates an effective business continuity solution that is above and beyond what most PACS configurations can offer.

Phase II of the multi-phase VNA deployment strategy could focus on any number of small projects like adding additional PACS systems to the entry-level VNA, or adding images from non-PACS departments like Endoscopy. It could focus on adding non-DICOM images to the VNA.

In order to achieve the true purpose of the VNA… taking over long-term data management from the department PACS…the VNA will need to be configured with its own disaster recovery subsystem. Ultimately Phase II is simply the addition of the Secondary VNA subsystem in the organization's second data center.

The IBM storage platforms such as IBM Storwize V7000 Unified and IBM SONAS described in this paper are ideally suited for inclusion in the entry-level VNA configuration and beyond. As storage requirements continue to evolve in today's healthcare environment, advanced storage technologies become increasingly important. The IBM technology not only enhances the VNA application suite, it provides the same benefits to other data management applications that may be sharing the storage with the VNA.

Any IT project involving PACS storage is an opportunity to engage with IBM resources that are prepared to bring years of storage and data management experience to bear in designing a more attractive alternative than the continuation of the proprietary PACS archive paradigm.

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