Skillful integration and dedicated back-end support key to Vendor Neutral Archiving

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Executive Summary

The original objectives of the Vendor Neutral Archive (VNA) concept were to eliminate multiple data silos and facilitate data interoperability between disparate departmental PACS. Unfortunately a much broader interpretation of the concept has since evolved and that has resulted in more confusion than clarity. If the VNA is a solution that can be configured in multiple ways using components from multiple solution partners, the organization is now faced with the inherent challenge of how to make a best-of-breed solution really work for them. The composition of an organization's "ideal" VNA, the specific configuration that best meets the initial and long-term requirements of the organization, will more likely be an assembly of best-of-breed components and subsystems from multiple vendors. Therein lies a well-known problem. An end-to-end solution based on technology choices from multiple vendors, will require experienced system integration and very sophisticated back-end support.

Is it possible for a single vendor to offer technology choices and multiple configurations, then actually build and support that custom solution? Can a site-specific, best-of-breed VNA meet the organization's expectations?

This paper will review the various components of a true VNA solution; one that includes both enterprise data management as well as enterprise-wide data distribution and display through an EMR portal. It will present various architecture and deployment considerations. It will summarize many of the options available to organizations looking for a partner to help in a VNA implementation, and suggest a profile of the ideal partner — one that has the software, hardware and services expertise to integrate, deploy and support multiple best-of-breed solutions.

Challenge of a Best of Breed VNA

This 60-minute Webcast by Michael Gray and Dan Trott describes how providers seeking a vendor neutral archiving solution can build a best-of-breed solution, while at the same time not get overwhelmed with the complexity of managing and integrating multiple partners, solutions and platforms.

Click here to access the webinar.

(URL: http://www.healthdatamanagement.com/web_seminars/-43488-1.html?st=Cust&s=dell)

Background

I started writing about the Vendor-Neutral Archive concept in 2007, when it was mostly referred to as a PACS-Neutral Archive. That was apparently too accurate a description, so someone in marketing soon changed "PACS-Neutral" to "Vendor-Neutral." Regrettably, that name allows for a much broader interpretation and therefore much more confusion. Today there are as many brands of Neutral Archive as there are opinions as to what constitutes the application. Even the PACS vendors, who are largely responsible for creating today's state of data incompatibility, are claiming that the core of their department PACS is actually a Neutral Archive.

The original PACS-Neutral Archive concept was focused on modest goals — solving the two most obvious problems with PACS:

- The proliferation of data silos
- The lack of data compatibility between disparate PACS.

As other imaging departments began to follow Radiology's example and deploy their own PACS, many organizations began to recognize the problems they were going to have supporting multiple storage solutions. The second problem was less obvious. As long as there was only one PACS in Radiology and it did not have to exchange data with any other PACS in the organization, no one fully understood the proprietary aspects of their image data until the time came to migrate that data to a different PACS.

As is usually the case with concepts that start out with modest goals, one problem illuminated another, and one solution required five more. By the time the name had been changed to Vendor-Neutral, the re-invention of enterprise data management and distribution was in full bloom.

This white paper is going to focus on the many choices involved in the configuration of a Vendor-Neutral Enterprise Archive and the inherent challenges presented by a best-of-breed solution. It is possible, but unlikely, that a "one size fits all" solution will successfully address such a complex set of problems. The composition of the ideal VNA and the specific configuration, the combination that best meets the initial and long-term requirements of the organization, will more likely be an assembly of best-of-breed components and subsystems from multiple vendors. Therein lies a well-known problem. An end-to-end solution based on choices from multiple technologies, each from individual vendors, will require experienced system integration and very sophisticated back-end support. Is it possible for a single vendor to offer technology choices, multiple configurations, then actually build and support that custom solution? Is it possible for a single vendor to build and support many custom solutions? Can a site-specific, best-of-breed VNA succeed?

Before we can look at composition and configurations, it is imperative that we have a clear and reasonably complete picture of what problems the VNA is supposed to resolve.

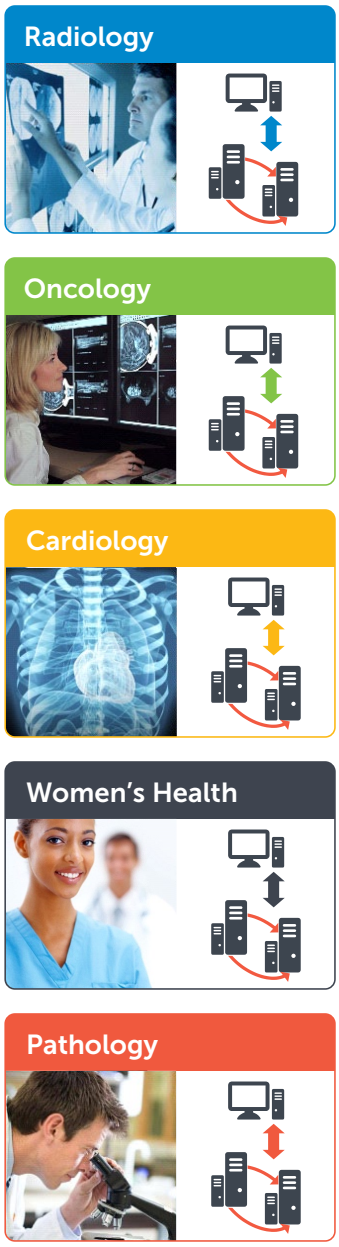
The Problems

Much has been written on the concept of the VNA and the problems that it is designed to address. Those problems that most healthcare organizations are facing will be the prelude to our review of the proposed solutions.

- The Silo Effect — Managing image data in independent PACS results in multiple disparate storage strategies, technical complexity, expensive management/support resources, as well as overlapping media migrations and storage media upgrade/replacement schedules.
- Limited Choice — While most PACS vendors have recently certified a number of storage solutions for use with their PACS, their choices are still limited, and their Service Level Agreements frequently preclude sharing those storage solutions with other PACS.
- Proprietary Data Formats and Compression Syntaxes — All PACS applications manipulate the DICOM header associated with the image data produced by the imaging modality. DICOM tag manipulation on inbound data is how the data is made "compatible" with that PACS. PACS are rarely capable of tag manipulation on outbound data, so they are incapable of assuring data compatible with another PACS. In effect, PACS create proprietary image data.

- Lack of Information Lifecycle Management — Most PACS lack the ability to move data around in a multi-tiered storage solution based on the metadata that defines that image data. Some storage solutions can move data around based on its age, but this is inadequate lifecycle management. PACS are also incapable of purging data, so they tie up large volumes of storage with image data that has exceeded its legal purge date.
- Inadequate Disaster Recovery — Most organizations lack a realistic DR solution. The second copy of the data is either on unreliable media or it is stored in an unreliable appliance. DR solutions that are not geographically separated from the primary data center are at risk from the same disaster that would compromise their primary storage solution.
- Lack of Business Continuity — Most PACS systems do not offer a Business Continuity solution because they do not offer a second instance of the complete PACS application suite co-located with the second copy of the image data. When the typical PACS becomes unavailable, there is no way to access and review the second copy of the image data. Even if the new data can be viewed on the modalities, the lack of priors delays final interpretations.
- Costly Data Migrations — PACS manipulations performed on incoming data effectively creates proprietary data, and nearly every PACS vendor hides behind intellectual property arguments in refusing to disclose their Data Dictionary and Schema. Both practices enforce the proprietary nature of their PACS. Therefore replacing one vendor's PACS with another vendor's PACS will require a time-consuming and expensive data migration. Replacing data management systems that deal with non-image clinical data often require data migrations for exactly the same reasons.
- Data Sharing and Collaboration — Image-enabling the Electronic Medical Record system and sharing image data with outside organizations also presents challenges. If a Radiology PACS is the only image repository, image-enabling the EMR simply requires building one interface between the Portal and the Radiology PACS. The physicians learn to use the Radiology PACS clinical viewer to view radiology, cardiology and any other images forwarded to the Radiology PACS. In a heterogeneous PACS environment, where each department PACS is managing its image data, and each PACS has its own clinical viewer, image-enabling the EMR will require building and maintaining multiple portal/PACS interfaces. Because there is no standard methodology for this Portal/PACS interface, multiple interfaces typically mean multiple methodologies. There are multiple clinical viewers to learn, and arranging all of the patient's images in the same screen window is impossible.

  Sharing data outside of the organization, for both patient referral and collaboration purposes is complicated, because most organizations do not want to open their PACS to outside users, and exchanging data between disparate PACS using DICOM is complicated by the proprietary data formats and compression Syntaxes. The same issues compromise the ability to physically exchange data using CD/DVD. A standards based enterprise archive solution will make it easier for hospitals to share data not only between multiple clinical applications but also with the larger health network through a standards-based Health Information Exchange.
- Multiple Vendors — The medical image data management environment involves multiple PACS vendors, modality vendors, HIS and RIS information system vendors, server and storage solution vendors, second-party specialty application vendors, etc. Achieving any degree of system interoperability requires working with multiple vendors, negotiating intertwined and over-lapping Service Level Agreements.
- Non-DICOM Data — DICOM image data represents the majority of the volume of medical data, but there are also volumes of non-DICOM image data and non-image data that also represent the patient's longitudinal medical record. Image-oriented management systems and viewing applications are primarily designed for DICOM objects. There is currently no uniform methodology for accessing, managing, and viewing non-DICOM data objects. This subject raises many complex issues. The reader may find it useful to read my 2010 white paper[1] on this subject, which can be found on my web site.



[1] Best Practices Strategy for non-DICOM data in Neutral Archive; Michael J. Gray, Oct 18, 2010

Commercially available VNA solutions meet the functional requirements in varying degrees, because not all "VNA" solutions are created equal.

The Solutions

The concept of the VNA addresses all of the above problems. Unfortunately, commercially available VNA solutions meet the functional requirements in varying degrees, because not all VNA solutions are created equal. Just like DICOM conformance doesn't guarantee support for every single SOP Class, slapping the "Vendor-Neutral" label on an archive does not guarantee support for all of the intricate functionality that is required to facilitate interoperability between disparate systems. Let's review what is meant by the terms Neutral Archive and UniViewer, to clarify the complexity and size of the complete solution.

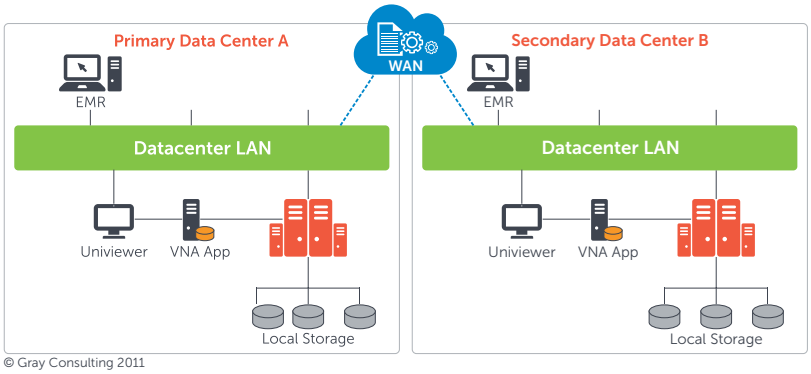
The VNA Application

The Vendor-Neutral Archive application itself has been evolving over the last several years, and it will continue to evolve, in order to meet any newly discovered interoperability issues. A simple summary of the features and functions of the VNA should suffice. Additional detail is presented in a post[2] on my web site.

- Bi-Directional Dynamic Tag Morphing
- Full DICOM conformance (support of all existing DICOM SOP Classes)
- Methodology for addressing non-DICOM data
- Ability to organize/manage data per organizational node (facility, department, etc.)
- Intelligent, metadata-driven Information Lifecycle Management, including purge
- Ability to create/associate a unique patient/study ID
- Pre-fetching an Auto-routing including a user-defined relevant prior algorithm
- Mirrored, dual-sited configurations with automated failover and reconciliation
- Data Integrity (pixel and metadata) and system-wide propagation of HL7 updates
- Storage Reclamation following media migration or data purge
- Data Compression options including negotiating any DICOM-supported syntax
- Create/maintain XDS-I Manifest (optional XDS-I Registry and Repository)
- Transaction Logging and Reporting
- Security including user credentialing and authentication and breach monitoring
- Comprehensive pro-active 7/24/365 remote system monitoring of all components

This list is not comprehensive, but it suggests the complexity of the system, and it is worth emphasizing that nearly 100% of the VNA solutions currently deployed in the United States are configured as dual-sited, mirrored configurations. Such a configuration supports a robust and realistic Disaster Recovery solution. The inclusion of an associated image display application on each side of the mirrored configuration supports true Business Continuity. Additional detail[3,4] on Business Continuity and Mirrored Configurations can also be found on my web site.

The properly configured VNA is a very large and complex system. It is obviously larger than the organization's largest PACS. It will eventually have under management all of the enterprise image and study-related data for at least the previous 7 years, whatever legal retention period is required for this data.



[2] Essential Ingredients of a PACS-Neutral Archive Michael J. Gray, December 15, 2009
[3] True Business Continuity Requires Two Separated Instances of all Key Applications July 21, 2011
[4] Failover Strategies in Mirrored Configurations of Medical Image Management Systems June 28, 2011

The Storage Solutions

VNA applications are fairly hardware agnostic, but they often require specific OS environments, so the choice of hosting servers is somewhat limited by this feature. Many more options are available for the storage solution, ranging from Network Attached Storage (NAS) and Storage Area Network (SAN) solutions primarily managed by the VNA application, to more Intelligent Data Management solutions that feature Object Storage Platforms and Storage Virtualization. These intelligent storage solutions have their own embedded ILM strategies, data protection, data duplication, data tiering and data deduplication capabilities hosted by their own "front-end" server and they offer modular scaling to multiple petabytes and are both self-managing and self-healing. There are multiple interface options for connecting the VNA application server(s) to the storage solution server(s) - NFS, CIFS, simple HTTP and custom API toolkits.

These intelligent storage solutions also manage the metadata associated with each data object, and by referencing this metadata, the storage solution itself is able to optimize the efficiency of data storage and data flow across storage tiers and apply preservation, retention and deletion policies. Thin provisioning capabilities help to optimize disk utilization, avoiding the need to pre-allocate capacity and eliminate the practice of buying capacity before it is required. In a sense, the high-end, intelligent storage solution is a subsystem unto itself and an equal partner with the VNA application.

The right storage solution can manage all of the image and study-related data "front-ended" by the VNA application, as well as serve as the single multi-purpose storage system for static data across many other clinical systems. That is why the storage decision is just as critical as the VNA decision. Besides medical images, the right storage solution can also be used to store emails, Sharepoint files, videos, pictures, digital documents, etc.

I offer a few final comments on intelligent storage solutions.

- Because of their ability to manage each data object based on its defining characteristics (metadata) and manage the virtualized storage pool, the total cost of ownership of these storage solutions over 5+ years is actually less than the TCO for the seemingly less expensive NAS and SAN solutions.
- These storage solutions are based on open standards, so the organization will not have the expense and pain of rip-and-replace every 3-5 years.
- The system can scale incrementally, and the advanced load balancing capabilities ensure that system performance actually increases as it scales.

The UniViewer Application

The VNA concept represents a paradigm shift in enterprise clinical data management. Rather than having medical image data scattered across multiple department repositories (PACS), the VNA consolidates the entirety of a patient's medical imaging information and a good deal of related clinical information in a single repository. It wasn't until the first few VNA solutions were deployed, that the parallel concept of an enterprise data distribution/display concept began to clarify in one of those "aha moments".

Electronic Medical Record (EMR) systems generally do not store image data or feature an image viewing application. Image-enabling the EMR typically requires building individual interfaces between the EMR portal and each clinical viewing application associated with the image repositories (PACS) in the enterprise. That strategy will eventually require supporting multiple interfaces. Alternatively, if all of the image data is consolidated in a VNA, only one interface is required between the portal and a single universal clinical viewer, and only one other interface is required between that viewer and the VNA.

UniViewer refers to a viewing application that would draw upon one or more image repositories to access images and present them in a display window according to formats similar to the clinical PACS viewers. In this case, the format would allow radiology images and cardiology images, any combination of images related to a patient's condition, to be arranged in a collage that would enable the user to quickly grasp the clinical implications.

The application should satisfy the image viewing needs of 100% of the image users across the enterprise, excepting those physicians making a diagnostic interpretation using their diagnostic PACS displays. This means that the UniViewer has to support a feature/function set just short of "Advanced". This also means solving the classic problems related to network bandwidth, size

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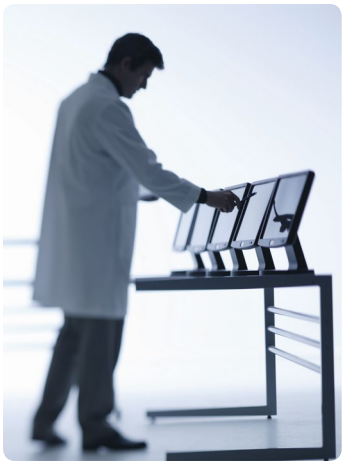

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of the client app, display platform restrictions, etc. A summary of the characteristics of the ideal UniViewer follows.

- Near Zero or Absolute Zero client — An Absolute Zero client means that there is no application or applet downloaded to the display platform and there is no requirement for any browser plug-in like Adobe Flash or Microsoft Silverlight. Alternatively, a near-zero client might require a very small download or a browser plug-in; but a near-zero client might limit platform choices and be sensitive to plug-in versioning.
- Server-side rendering — All of the pixel manipulations and image processing directed by the user are rendered on the loss-less version of the image in the centralized application server(s). These operations typically produce a lossy JPEG representation, which is forwarded to the display platform as an HTML object (web page). The reduced data density of the download allows for acceptable performance over low band-width networks.
- Cache-less — The UniViewer rendering server does not require a local cache of image data, unless the PACS outbound interface characteristics or the network limit performance. In this case, a typical cache might hold the most recent 30 days of image studies from all of the PACS.
- Virtualization — The UniViewer application supports server virtualization, making it very easy and efficient to expand server resources to accommodate additional concurrent users. This usually means that the display application is pure software and does not require any accelerator hardware to perform the rendering.
- Supports multiple OS and multiple Browsers — The UniViewer can run on Windows, Mac OS, Linux, iOS, Android, etc. platforms, within any of the current generation of Browsers.
- URL-based portal interface — The Portal interface utilizes a dynamic URL created in the EMR Portal to communicate the appropriate metadata identifying the requested Patient/Study to the UniViewer application.
- EMR Authentication — The UniViewer application accepts the EMR user authentication, so the user does not have to go through another log-in.
- Auditable Transaction Logging — The UniViewer logs every user interaction with the application, every attempted access, every interaction with the data. The log can be mined for HIPAA purposes, and the data can be organized and exported.
- Non-DICOM — While primarily a DICOM viewer, the UniViewer supports a methodology for displaying non-DICOM image and non-image data objects.
- Medium to Advanced Features/Functions – More than a basic display application.
- Optional Web Services — A web services interface would be the preferred interface between the rendering server and the non-DICOM data sources. A web services interface, such as the one under development called Medical Imaging Network Transport (MINT), is a high-performance alternative to using DICOM to access data in the PACS and VNA. This type of performance eliminates the need for the UniViewer Cache.

Architecture and Deployment — Issues and Options

A properly configured VNA is big and complex. Determining the actual composition of the system, the system architecture and the deployment strategy that best meets the present and long-term requirements of a specific organization is a challenging process. This section will address Considerations, Architecture and Deployment Options that every organization must carefully consider in that process.

Considerations

That process should begin with an introspective focus on the organization itself. The project team must reach an informed consensus (decision) on the following subjects.

- IT Resources — Does the IT department have the staffing level and skill set to assist in the initial deployment of the system and then the ongoing 7/24 administration and operational support of the VNA? Numerous interfaces will have to be maintained, if not actually developed. Transaction logs will have to be monitored regularly. Security breaches will have to be tracked down. IT should compliment the vendor's pro-active system monitoring.

Storage utilization requires attention, as does continuous refinement of the relevant priors algorithm. The system's execution of the Retention/Purge Policy will require continuous attention. If the organization does not believe that it has the talent and numbers, any initial intentions to self-manage the VNA should probably give way to covering support of some percentage of the system with a Software-as-a-Service contract.

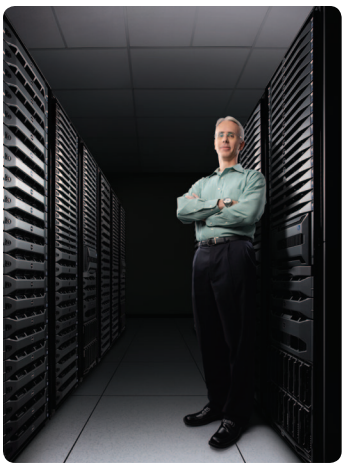
- Second Data Center — A properly configured VNA will require a second, geographically remote data center. Does the organization already have that second data center? Is co-location with a business-class provider a viable option, especially considering the HIPAA and HITECH requirements for electronic Protected Health Information (PHI)?
- Storage Utilization — The organization needs to find a way to procure storage in a just-in-time model to avoid/incur all of the costs associated with storage that is under power but sitting idle. That means matching the storage procurement process with the actual storage utilization.
- Disaster Recovery (DR) Strategy — Specify the infrastructure and associated professional services that will achieve a reasonable recovery time for replacing any of the primary data that is lost or damaged. Considerations include availability of replacement hardware, damage assessment, access rates over the WAN, manpower, etc.
- Proximity Requirements for the Business Continuity (BC) solution — A true BC solution requires access to a second instance of a display application and a second copy of the data. Most PACS do not support a second instance of the application suite, and drawing image data over the WAN would not meet performance requirements. A second instance of the UniViewer located in close proximity to a second instance of the VNA and its storage solution, all in the second data center, is a realistic BC solution.
- Funding — The major decision is between investing capital funds, funding the system through an Operational Lease, or entering into a multi-year Fee-per-Study contract. A further refinement is the Software-as-a-Service contract that bundles all hardware, software and full system support services into the deal. Timing is also an issue. Can the organization afford to implement the entire system in one year, or will it be necessary to break the system up into functional subsystems that are deployed over multiple budget cycles?

Architecture

There are a number of variations on system architecture, each addressing the specific requirements of the organization. The major architectural variances follow.

- Mirrored Configuration — An instance of each VNA and UniViewer application and all of the major interfaces including HL7 is represented in two nearly identical subsystems...a Primary and a Secondary...each located in a geographically separate data center. (The Test System is generally only represented in the Primary subsystem.) The Storage Solutions associated with each subsystem do not have to be configured identically. This configuration represents a true Disaster Recovery solution, and because it includes separate instances of the UniViewer, it represents a true Business Continuity solution.
- Local Facility Cache Servers — In organizations that have multiple imaging departments located in physically separate facilities, it is often desirable to deploy a local instance of the VNA application configured with a small local storage cache in each of the larger facilities. This local cache server functions as a local gateway to the VNA and provides a measure of backup for that facility, should the VNA become temporarily unavailable. There are numerous failover and recovery scenarios between the Local Facility Cache Server and the VNA.
- Virtualization — Ideally both the VNA and the UniViewer applications support virtualization. This simplifies failover scenarios, as well as system expansion.
- Direct DICOM Image Acquisition — The VNA architecture must provide some methodology for supporting image acquisition directly from DICOM-conformant imaging modalities that are not interfaced to a department PACS. This includes technology and workflow to associate patient and study ID with the acquired image data (i.e. the way a Radiology PACS utilizes DICOM Modality Work List and the accession number).
- Direct non-DICOM Image Acquisition — The VNA architecture must provide some methodology for acquiring image data directly from non-DICOM Image Sources. There are numerous strategies for interfacing to these Source devices as well as numerous strategies

If the organization does not believe that it has the talent and numbers to self-manage the VNA, it should consider covering support of some percentage of the system with a Software-as-a-Service contract.



The VNA will significantly affect the operational efficiency of the organization for many years to come, which is why it is imperative that the VNA be comprised of the right combination of options with the right partners involved.

for how the non-DICOM data object is managed by the VNA and displayed by the UniViewer. A detailed discussion of this complex subject is presented in a 2010 white paper[5].

Deployment Options

The various deployment options available for the VNA will be presented below in a logical order. Decisions made in each step lead to the next set of decisions.

- Economics — The first decision is whether the organization should capitalize the purchase and thereby own the system, or operationalize the system and never own the system. An alternative to signing a lease is simply signing a fee-per study type contract that bundles hardware, software and management/support of the system by a single vendor. This first decision will also determine whether the system can be deployed in a single year or will require multiple consecutive years. A staged VNA deployment is reminiscent of the early years of radiology PACS, when small functional subsystems were initially deployed, then upgraded, and finally stitched together to form the complete system.
- System Management — The second decision is how the system will be managed. Is the organization capable of Self-Management or should the vendor manage the system under a Managed Service contract? This choice depends largely on the organization's IT resources, experience and staffing level.
- Storage Utilization — Paying in advance for unused storage is an economic burden. Can the Organization create and execute a storage procurement schedule that minimizes the amount of idle storage, or is it better to enter into a contract that provides On-Demand Storage assignment?
- On-Premise/Off-Premise — This is the big decision. Can the organization shoulder the expense and complexity of locating the Primary and the Secondary VNA subsystems, in two separate "On-Premise" data centers? The alternative is the Hybrid VNA — Primary is located in the organization's on-premise data center and Secondary is located in the vendor's Cloud Infrastructure. There are emotional components to this decision; trusting the vendor to securely manage the data off-premise. There are economic components...verifying that the hybrid solution really does save money. Finally there are legal components...verifying that the vendor's solution meets all of the strict and well defined HIPAA and HITECH requirements governing electronic Protected Health Information.

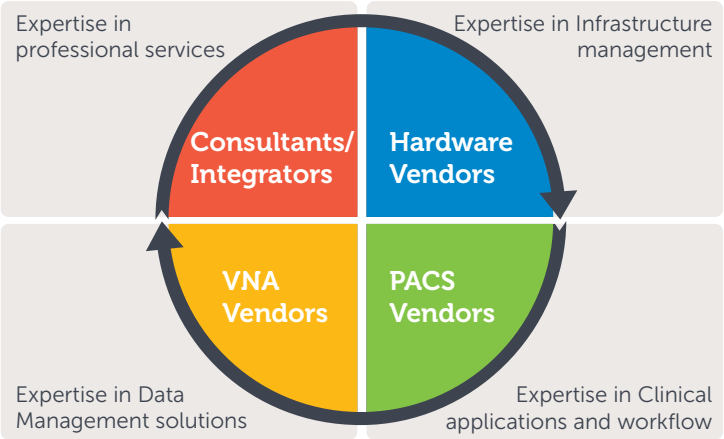
Considerations for Selecting a Solutions Partner

There are many options to weigh when considering a VNA including technology, economics, IT resources, logistics, etc. The VNA will significantly affect the operational efficiency of the organization for many years to come, which is why it is imperative that the VNA be comprised of the right combination of those options. Unfortunately most organizations will find themselves choosing from a very limited number of options.

Consider that there are four key stakeholders.

- The PACS Vendors are primarily the developers of the clinical applications used in each department to collect or create data that is then interpreted resulting in a text-based report object.
- The VNA Vendors are primarily the developers of the clinical data management software, but in partnership with a chosen UniViewer vendor, they provide the tools for distribution of the image and report data throughout the enterprise.
- The Consultants / Integrators are primarily the providers of a series of professional services that facilitate product and vendor selection and then provide project management.
- The Hardware Vendors are primarily the providers of the servers and storage, the Infrastructure of the system.

[5] Best Practices Strategy for non-DICOM data in Neutral Archive; Michael J. Gray, Oct 18, 2010



Any single one of these stakeholders will typically lack the depth and breadth to be experts in all areas, to understand and have control of every one of the many options required to constitute the right VNA solution for the organization. Any single one of these stakeholders can only present a limited number of options to the organization.

Consider that most commercial VNA packages are best-of-breed solutions that combine multiple software applications, hardware infrastructure, and support resources, but the vendor chose each of these specific components in advance. That vendor may in fact have configured their offering from a limited number of options available to them. As a consequence, the configuration options that they are offering suits their requirements. Their sales process is essentially focused on making the convincing argument that one of their pre-configured systems would ideally suit the organization's needs.

It is understandable why the VNA and UniViewer software developers and the hardware developers can only focus on their specific components, and why the system integrators and the cloud providers can only focus on their limited configuration options.

- Limited Core Competencies — The software vendors are focused on the development of their specific software applications and the hardware vendors are focused on development of their specific hardware. The Integrators are focused on specific software/hardware combinations.
- Limited Integration Experience — A good deal of experience is required to successfully integrate a number of separate components. It is another level of complexity if there are multiple options for each of those individual components.
- Limited Resources — They have limited staffing with limited experience. Perhaps they have limited data center resources.
- Limited Technology — They have limited themselves to specific hardware and software choices, and as a consequence they have limited system monitoring and support capabilities.
- Limited Business Partners — A company can only support so many business relationships before running into conflicts of interest.

There is also considerable complexity in working with multiple vendors. The VNA system integrator must develop a working relationship with each of the vendors supplying the individual hardware and software components of the VNA. Those relationships are key to achieving successful system integration and also a successful post implementation support program. In a multi-vendor strategy, the customer needs a single point of contact for issue resolution and troubleshooting. This means that the system integrator must develop a working relationship with each of the organization's individual PACS vendors, the HIS/RIS vendor, the EMR vendor, and the individual vendors who supplied any of the imaging sources that will feed their images to the VNA. In the future, the VNA system integrator will have to develop a working relationship with the vendor that will provide some yet-to-be-developed clinical application that will require access to the VNA image data. The day will also arrive when the VNA system integrator will have to develop a working relationship with other galaxies of vendors associated with other organizations that have decided to share their clinical image data through a Health Information Exchange (HIE).

What single vendor can support all of these VNA options, all of these vendor relationships, and still present to the customer a single source end-to-end supported solution?

Any single one of these stakeholders will typically lack the depth and breadth to be experts in all areas...

Unfortunately, there are very few vendors in any of the four key stakeholder categories that can offer that degree of choice, actually integrate all of the chosen components and options into the customized system, and then take responsibility for this unique system.

Ideal Solution

Ideally an organization would be able to configure their VNA system with choices in each of the three major categories: Software, Hardware, and Services. Those choices would be based on the organization's specific needs and preferences identified in a thorough and reasonably unbiased analytical process. The resultant system components would then be integrated, installed and supported by an engineering team with experience with that specific configuration. The following component categories are organized under the appropriate heading and listed in the logical order in which they would be chosen.

Software

• Vendor Neutral Archive — This package encompasses all of the applications, features and functions summarized under The VNA Application presented earlier in this paper. This would include any second party specialized applications (i.e. HL7 interface engines) that might be integrated into the solution.

• Non-DICOM Source Interfacing — Choices include DICOM Wrapping or Encapsulating applications either integrated into the VNA package or freestanding external devices that are interfaced to the VNA application. There is also the option of preserving the native data object by deploying customized non-DICOM interface applications designed for a specific imaging Source.

• UniViewer — This viewing application would encompass all of the features and functions summarized under The UniViewer Application section of this paper. This application could be integrated into the VNA application package, but more likely it is a standalone application hosted by its own server resources.

• System Monitoring — Most software and hardware components include their own monitoring application that allows the system support team to monitor the component remotely. A complex system comprised of multiple components from different vendors requires an umbrella monitoring application that would link to individual component monitoring applications in order to track the overall functionality of the system. While this application belongs in this subsection, it would most likely require custom development by a system integrator, once all of the system components have been selected.

Hardware

- Hardware Infrastructure — There are numerous choices for servers, load balancers, network components, etc.
- Storage Solution — There are numerous choices for the type of storage solution associated with the primary and the secondary VNA subsystem.

Note: The choice of hardware should be compatible with future technology enhancements and should not necessitate forklift system upgrades. The storage platform should be incrementally scalable to the petabyte level without loss of performance. In short, the organization should seek to "future proof" its hardware investments.

Services

- Integration Services — Which organization will provide the integration services; the software vendor, the hardware vendor, the hardware reseller, the value added reseller, etc.?
- Project Management — Which organization will provide the project management services; the software vendor, the hardware vendor, the hardware reseller, the value added reseller, etc.?
- System Monitoring and Support — Which organization will provide the System Support services; the software vendor, the hardware vendor, the hardware reseller, the value added reseller, etc.?
- Hybrid VNA — If the organization elects to deploy a Hybrid VNA, there are choices of vendors that will provide the Cloud Infrastructure and all the related software and support services related to this configuration, for both the on-premise subsystem and the off-premise subsystem.

The ideal partner would be able to present the organization with the opportunity to make choices in each of the above categories. At the end of that process, that partner would be responsible

for the entire system. Unfortunately, there are very few vendors in any of the four key stakeholder categories — PACS Vendors, VNA Vendors, Consultants/Integrators, and Hardware Vendors — that can offer that degree of choice, actually integrate all of the chosen components and options into the customized system, and then take responsibility for this unique system.

Requirements to Assure Success

When it comes to VNA, one solution does not fit all. Of course there is a good deal of uniformity among healthcare organizations, but each organization has its specific pain points, its own set of problems, and its own long-term goals. In this regard, each healthcare organization is unique. The enterprise image data management and distribution system must match the uniqueness of the organization. If ever there was an argument for a best-of-breed solution, this is it.

Once again, therein lies the problem. Truly customized, unique solutions comprised of so many choices in software, hardware, and service components are extremely difficult to build and then support. The vendor would have to possess a good understanding of the many potential components of the solution, expertise in all three major categories; software, hardware and services.

For a vendor to be successful at executing this best-of-breed strategy, that vendor should be able to demonstrate strength in three major categories:

- Strong services capability: consulting, design, implementation and support
- Ability to offer choice and flexibility in Hardware and Software platforms as well as deployment models
- Ability to meet the future needs of the customers

If we look at these categories in more detail, the vendor would have to meet every one of the following requirements.

- Consulting — The vendor should provide the healthcare organization balanced and reasonably unbiased consulting services. This should be a substantive process and not merely a thinly veiled sales program. The consulting services would include conducting a formal needs assessment and assisting the organization in evaluating its resources, including IT staffing, facilities, and operations. Since many organizations have difficulty evaluating or quantifying their resources, the vendor should provide a standard list of resource categories and national or regional cost guidelines for each.
- System Design — The vendor should facilitate the organization's understanding of each of the available options (software, hardware and services) and then review their associated advantages and disadvantages. At this point, the vendor would work with the organization in matching the component options to the organization's needs and resources. The result would be a customized system design.
- Financial Modeling — The vendor should assist the organization in building a financial model that compares the projected total cost of ownership (TCO) of the existing heterogeneous PACS environment with the TCO for the proposed custom VNA solution. Since many organizations have difficulty quantifying some of their internal operating costs, the vendor should also be able to provide some regional average values to complete the model.
- Flexible Financing — The vendor should be able to provide a range of financing options from fully capitalized to fully operationalized. The later category should also include leveraging the Cloud Infrastructure.
- System Integration — The vendor should be able to demonstrate extensive past experience in complex system integration in healthcare by providing real world references.
- Flexible Financing — The vendor should be able to provide a range of financing options from fully capitalized to fully operationalized. The later category should also include leveraging the Cloud Infrastructure.
- System Integration — The vendor should be able to demonstrate extensive past experience in complex system integration, preferably in healthcare. The promise of competence in this requirement is not the same as real world references.
- System Monitoring and Support — The vendor should be able to identify the staff that will

Dell Services: Driving efficiency for archiving data

From start to finish, Dell Services can help organizations realize the full potential of a data archiving solution, enabling them to match the appropriate technologies with specific requirements. Features of this approach include the following:

- Skilled solution architects: Seasoned consultants identify high-impact, fixedscope projects that can deliver measurable return on investment.
- Automated tools, analysis, and industry best practices: Expert analysis and actionable recommendations help speed time to value.
- Modular, flexible approach: The Dell consulting process can provide clear assessment, design, implementation, and support phases with built-in decision points.
- Regulatory compliance: Development of organization-specific access policies helps mitigate risk through enhanced data management.
- End-to-end solutions: Comprehensive data archive solutions can include hardware, software, and services

A well-designed and implemented data archiving approach is integral to streamlined operations that help minimize risk and provide a flexible infrastructure for future growth. In addition to data archiving, Dell consultants can optimize data management with other offerings, including tiered storage as well as backup and recovery with deduplication. For more information, visit dell.com/services.

Dell Cloud Clinical Archive:

- Managing over 4.5B medical imaging objects across hundreds of clinical sites
- Broad protocol support (DICOM, HL7, XDSi)
- Supports an easy to use CIFS or API interface to store non-standard information to the cloud
- Integrates with most PACS and modalities
- VNA features include forwarding, routing, tag morphing, and image sharing
- Sophisticated monitoring tools provide real time views of all data center / client site status with guaranteed image integrity, delivery and transfer
- Supported by two mirrored data centers (Wallingford, CT and Phoenix, AZ)
- XDSi.b support for an enterprise or HIE (only archive vendor to pass all relevant tests at IHE Connectathon)
- One-time per study pricing stores 2 copies of every image in geographically separate datacenters
- Integrated web based universal viewer for direct access to images from archive

build the system and subsequently play an integral role in monitoring and supporting the system.

- Meet Future Requirements — Through examples, the vendor should be able to demonstrate the ability to expand the system to meet future requirements such as image enabling other clinical applications, accommodating non-image data, and electronic image sharing through participation in a Health Information Exchange.

I realize that this is a demanding set of criteria. Yet any vendor that claims to offer a best-of-breed VNA solution, but cannot meet these exacting criteria, would most likely fail to meet the required service level agreement…assuming that they could deliver the system in the first place.

Dell Healthcare's Approach to the Enterprise Archive

Dell Healthcare's approach to the VNA market is an end-to-end process, which results in making available to the imaging market an Enterprise Archive solution that is customized to meet the unique requirements of an organization of any size. The process starts with those thorough and reasonably unbiased consulting services I alluded to earlier and delivers a solution that Dell refers to as Unified Clinical Archive. UCA is the umbrella term that refers to Dell's solution portfolio which provides a unique degree of flexibility in system architecture and deployment options along with numerous choices in each of the component categories; software, hardware and managed services. Ordinarily a vendor would not dare offer such a wide range of options in a system configuration, because of the resulting complications to system integration and support, but then most vendors do not have the breadth of resources offered by Dell. Dell's recent acquisitions* and its commitment and focus on solutions and managed services for Healthcare IT has made them the #1 service provider in Healthcare IT Services, giving them the confidence to allow choice and the ability to back each configuration with a solid Service Level Agreement. Today Dell is managing over 4.5 Billion medical images for healthcare providers across hundreds of clinical facilities and providing ITO services to over 400 hospitals in US. This differentiates Dell as the unique 5th Stakeholder, a partner that can leverage its strong in-house services capability, expertise in enterprise hardware manufacturing and a robust integration processes for the multitude of partners it currently works with, to effectively build and support an enterprise class data management and distribution system customized to meet the needs of any size of healthcare organization.

Key features of Dell's Unified Clinical Archive solution:

- Multiple Data Management tools within an integrated package: The Clinical Data Management component of UCA offers a range of best-of-breed VNA choices each of which is integrated within the overall solution. Dell also has in-house software solution that offers a hybrid VNA configuration.
- Multiple deployment modes and architectures: There are multiple variations of deployment options ranging from the fully capitalized, dual-sited, self-managed, on-premise solution, to the Software-as-a-Service (SaaS), dual-sited, vendor-managed, Hybrid VNA solution (Primary on-premise, Secondary in the Cloud). Based on organizational needs and priorities, the solution can be tailored for high availability, disaster recovery and business continuity.
- Internally developed software technology for cloud-based enterprise archive: Dell's UCA portfolio includes Dell Cloud Clinical Archive, which is a cloud- based managed archival solution with an FDA certified software layer for data management and archive. It has IHE standards-based protocol support (DICOM, HL7, XDSi) and integrates with major PACS and HIE. It provides a hybrid solution and can be customized for high availability, disaster recovery and business continuity all under a one-time fee- per-study pricing. With an integrated web-based universal viewer and connecting APIs, the solution supports clinical collaboration and data sharing using an IHE compliant, standard-based approach.
- Broad portfolio of Enterprise storage solutions: Dell's enterprise storage solutions leverage fluid data architecture to automate a tiered storage strategy and ensure that the right data is stored at the right platform at the right time and at the right cost.

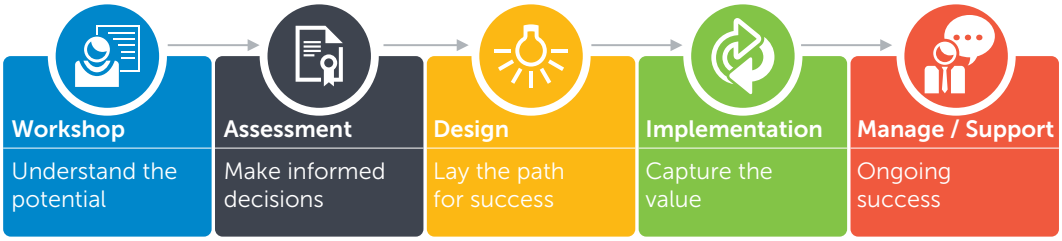
  Dell's UCA uses the DX6000 object based storage platform for on-premise long term archive. The DX Object Storage Platform offers multiple file system interface options and a REST-

based API that will enable any system to store both DICOM and non-DICOM data. A rich set of metadata fields support future Analytics, eDiscovery and participation in exchanging information via current and future HIE standards. Dell is also actively tracking the MINT (web services) initiative.

Dell also provides a range of server, storage, workstations and networking options that is tested and certified for various PACS platforms.

Storage Portfolio: DX6000, Compellent, EquaLogic, PowerVault
Server Portfolio: PowerEdge series
Workstations: Precision series

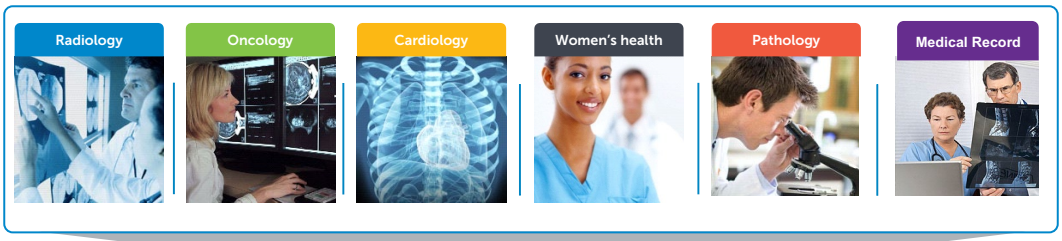
- End-to-end services including consulting, implementation, data migrations and support: As the #1 service provider in Healthcare IT, Dell has a unique strength in HC IT issues. Dell provides a single point of contact for the customer during and after implementation process. Guided by various SLAs, Dell provides the first line of resolution for both Hardware and Software issues. It uses remote monitoring and diagnostic tools for proactive troubleshooting for its cloud-based managed enterprise archive.

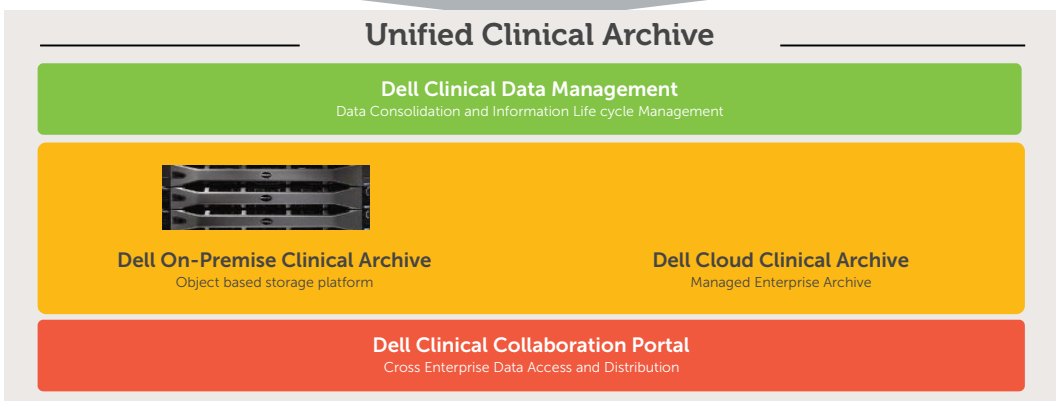


- Collaboration tools for data sharing and distribution: Dell's UCA integrates and provides several collaborative tools for clinical viewing using a range of universal viewers, image enabling various clinical applications and secure image share for CD replacement. This includes Enterprise information sharing across the health network.
- Multiple Distribution Channels: Dell resellers can also deliver the Dell Cloud Clinical Archive solution. This distribution channel allows the Reseller to offer a uniquely tailored solution bundled with hosted services along with the other Dell Enterprise products that they currently sell to their customers.

Dell Unified Clinical Archive

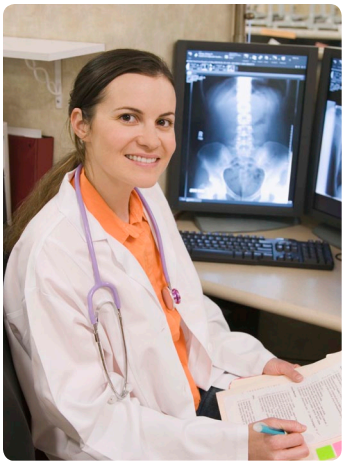
Helping Healthcare providers efficiently store, manage and share medical image data





DX6000 Platform

- Automated and secure policy-based retention, replication, distribution & deletion
- Self-replication and self-healing to minimize IT staff demands
- Standards-based x86 hardware and integrated software in an end-to-end solution
- Continuous migration and investment protection with non-disruptive security and capacity upgrades and node replacement/retirement
- Standard HTTP interface and CIFS/NFS support
- Selectable data immutability for compliance needs
- Solutions for health care, archive, content management, eDiscovery, tiered storage, and cloud

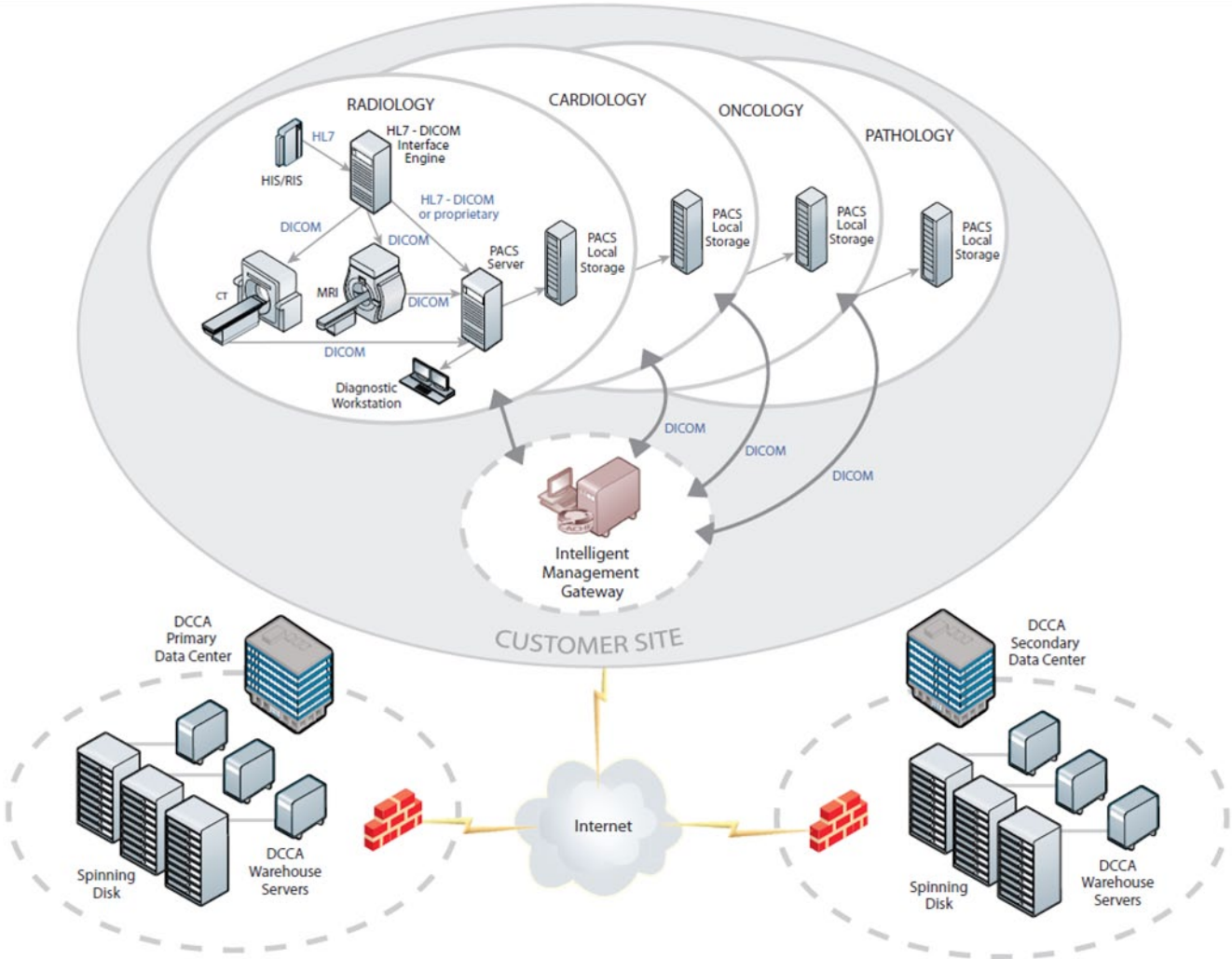


Dell ranked #1 service provider in Worldwide Healthcare IT Services — Gartner 2011

Dell's consultative sale process:

According to Dell, the key to providing a consultative sales process is the identification of the healthcare organization's needs and requirements for the matching of available solutions to drive the greatest value for the organization. Dell Healthcare has invested significantly in developing a sales force with a deep breadth of industry knowledge who understand the needs of PACS users and the clinical imaging archiving requirements. Leveraging Dell's process of identifying customer needs in Creating Customer Value (CCV), the UCA team works with the healthcare organization to determine the challenges they face in creating an enterprise archive environment to support the types of clinical data being generated and the strategy they hope to implement for the storage and distribution of that data to their various stakeholders. Having integrated with the major providers of VNA solutions in the market through Dell's Enterprise Solutions Group, the Dell team has a unique perspective for matching the requirements and desires of the healthcare organization with the features and delivery capability of Dell's VNA partners. Using tools provided by the Enterprise Solutions Group, Dell UCA sales teams then guide the healthcare organization to decisions that best meet their requirements and budgets. These tools include a process for driving out specific needs the organization has, what impacts are being driven by their infrastructure environment and budgetary constraints, with an eye on their response to retention compliance. Other tools support the sellers in matching the healthcare organization requirements with specific features provided by the UCA portfolio to enable the organization to make choices that make the most sense in their environment.

UCA Implemented as a Dell Cloud Clinical Archive



Conclusion

The concept of VNA is straightforward. Actually configuring a VNA is complicated. There are fully integrated, single vendor solutions worth consideration, but when the organization considers all of the variables that must be addressed to configure an enterprise image data management and distribution solution that matches the uniqueness of the organization, it becomes clear that "one solution does not fit all". If ever there was an argument for a best-of-breed solution, this is it.

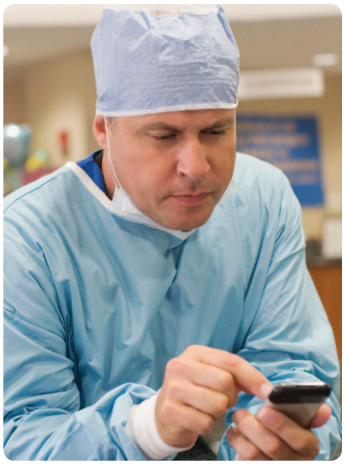
After reviewing all of the problems that the VNA is designed to address, the long list of functional requirements that define the solution, and finally the various architectural and deployment options, it appears that all VNA solutions are not created equal. That is understandable. Nearly all of the vendors offering VNA solutions typically lack the depth and breadth to be experts in all areas, to understand and have control of every one of the many options that would be required to constitute the right VNA solution for a specific organization. As a consequence, the configuration options that they are offering suit their requirements, and their sales process is focused on making the convincing argument that one of these pre-configured systems would ideally suit the organization's needs.

Unfortunately, an end-to-end solution based on choices from multiple technologies, each from individual vendors, will require experienced system integration, the ability to work with a galaxy of other vendors that all have some stake in the organization, and very sophisticated back-end support. That's a tall order and perhaps why the current VNA market is full of vendors offering pre-configured solutions based on a somewhat limited range of options that they are reasonably confident they can support.

Maybe a single vendor solution or one of these limited option solutions will actually fit the organization's requirements, or at least come close enough. If not, then don't give up looking for a real best of breed solution. Dell Healthcare has a compelling approach to the VNA market. Their Unified Clinical Archive solution can be customized for an organization through the combination of components selected from a lengthy list of options. Ordinarily a vendor would not dare offer such a wide range of options in a system configuration, because of the resulting complications to system integration and support, but then most vendors do not have the resources of Dell. In my opinion, that makes it worthwhile to check out the Unified Clinical Archive story.

**Dell's recent acquisitions include Perot Systems in 2009 and InSite One in 2010*

For more information about Dell's Unified Clinical Archive, contact your Dell account representative or visit dell.com/UnifiedClinicalArchive



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