Interoperability Challenges & Solutions Case Study

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Summary

In this case study, we present some of the imaging-related IT challenges experienced by a large, nationwide specialty healthcare services provider, along with the steps taken to address the challenges leveraging Dicom Systems' core platform, the Enterprise Imaging Workflow Unifier. We discuss how the deployment of smart appliances improved management of the multiple point-to-point integrations, solved a number of issues related to workflow disruption and loss of productivity, and optimized modality resource management.

The Company

The subject is a leading cancer treatment and research national-level health system, with a global reputation for cancer treatment.

Industry Landscape

A typical healthcare organization's IT landscape shares many of the attributes in common with an archeological dig. The deeper one digs into the history of the infrastructure, the more can be found to trace and understand the history of decision making in the IT department, as well as the technological context and priorities present at the time a solution was deployed.

Over the past two to three decades, hundreds of software solutions have been gradually deployed, interfaced, upgraded, updated, migrated, ripped out and replaced. The IT management tools and standards we enjoy today were not available a decade, or even five years ago. Yet many of the solutions deployed in a bygone technological context are still quietly serving their purpose. Knowledge of some of the older solutions and interfaces is often tribal and marginally documented, which can potentially contribute to extensive unplanned downtime scenarios.

This gradual stratification of IT solutions ultimately morphs into a complex and amalgamated ecosystem that requires constant fine-tuning and vigilance in order to maintain its mission-critical caregiving support purpose. The complexity of the challenge grows proportionately, and sometimes exponentially, relative to the size of the organization.

For every new solution adopted, countless IT resources must investigate the solution, validate its utility, verify that it won't introduce any security vulnerabilities or HIPAA violations, document the ROI, negotiate procurement, plan for its deployment, map out where it fits within the ecosystem, meticulously interface it to other pieces of software, and (hopefully) document the interfaces so they may be maintained appropriately over time.

The Imaging Enterprise is no stranger to these challenges. Although imaging constitutes but a subset of the overall IT infrastructure, it is a demanding and resource-intensive constituent among IT end-users. This is particularly true in the areas of network traffic, storage requirements and processing power for some of the most advanced imaging applications such as 3D modeling, Tomosynthesis or functional MRI.

On a daily basis IT maintains a precarious balance between the necessity to keep established solutions up and running, and the inexorable addition of new solutions. New imaging equipment, along with its own software ecosystem, routinely introduces new puzzles and challenges that are typically solved with the assistance, at high cost, of the solution vendor.

The Challenges and Solutions

1. **Modality resource management**. Imaging modalities are pricy pieces of capital equipment, the amortization of which only materializes if modality time and computing cycles are consistently focused on their primary mission, which is to image patients. In typical imaging workflows multiple protagonists utilize the images for a variety of purposes, which means that modalities were routinely tasked with pushing images to multiple destinations. Computing cycles utilized for routing purposes slow down imaging operations and, therefore, tends to reduce departmental productivity. This resource deficit can result in severe bottlenecks in imaging departments, and loss of revenue from reduced resource utilization.

   In order to refocus modalities on their primary mission, we are planning to deploy smart routing Linux-based appliances, enabling the department to automatically deliver images to multiple destinations based on a variety of smart routing rules, and EATitle of origin. The modalities will route all their images to one destination only – the appliance – freeing them up to dedicate precious scanner time to the purpose of scanning patients vs. routing functions that will be handled by the smart router.

2. **Too many point-to-point integrations**. We have many medical specialties and subspecialties, most of which produce imaging content. In the absence of a cohesive and standardized methodology to handle the installation and interfacing of all these modalities of imaging, departments have historically had to resort to a tedious process of manual, point-to-point integration for each modality, ensuring the imaging output is configured to send the images to the correct destination – with limited to no ability to tag-morph the metadata.

   Beyond internal imaging output, we are also on the receiving end of many imaging exams that originated from outside provider organizations referring patients along with their images. Each of these "foreign" PACS or modalities would typically need their own dedicated VPN in order to securely transmit PHI or, alternately, the referring institution gives the patient their images on a piece of physical media like a CD or DVD[1].

   The same smart routing appliances deployed to relieve modalities from routing functions now enable the subject to identify with precision not only what facility/department the images originated from, but also which specific scanner in which facility created the images. Based on such specific information the health system is able to autoroute and tag-morph incoming exams appropriately prior to accepting them in the PACS/VNA.

   Additionally, the router constitutes a single point of integration vs. myriad point-to-point integrations. When new modalities are installed on the network, the router enables IT and PACS administrators to quickly configure the new connections.

3. **Non-standard DICOM**. For a multitude of reasons, modalities and other DICOM devices may transmit image sets that include non-standard or proprietary DICOM tags. Some modalities will undergo software upgrades, fixing some issues but also routinely introducing new non-compliant data. DICOM confomance statements are generally accurate, but often constitute boilerplate documents that aren't updated as diligently by the vendor, or as often as software updates are deployed.

   Smart routing technology helps the subject to quickly recognize non-compliant DICOM tags and fix them prior to sending them to the VNA. Standardization and compliance are key success factors for a large imaging enterprise, therefore, any data sets that are out of compliance with the standards set in the VNA archiving policies will introduce challenges that can be very time-consuming to fix.

   For example, the ability to accurately query and retrieve relevant priors could be impaired if non-compliant tags are preventing images from being included in C-Find results. These routing appliances assist the subject in the consistent enforcement of compliance with image repository policies.

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[1] Handling of outside physical media presents its own set of interoperability challenges for the receiving institution; a separate case study will present these challenges and solutions.

4. **Mitigation of Workflow Disruptions and Productivity Loss**. Prior to deploying smart router appliances, any unplanned downtime in the PACS, RIS or EMR would cause substantial imaging workflow disruptions and productivity losses that far outlast the downtime itself.

   The health system estimates that for every hour a mission critical system like a PACS is down, the operational recovery time averages between *2 to 3 hours* before normal operations are fully restored, depending on the length, nature and severity of the outage itself.

   For example, if modalities are programmed to send all images to the PACS, and the PACS suffers a downtime episode, patient workflows are disrupted because the images have nowhere to go for a period of time. Techs may continue to scan patients if they are able to provide a modality work list independently of the PACS - if there is no DICOM Modality Work List (DMWL) available, scanning of patients will take place with manual input to the modality and will have to be resolved after PACS functions have been restored.

   Assuming patients are still getting scanned during the PACS outage, the database reconciliation on the PACS side may require significant manual intervention by technologists and PACS admins. The smart routers act as an effective buffer against such outages by providing continuity of DMWL for the modalities, as well as routing and storage of images. Once the PACS is operational again, the smart router appliances automatically reconcile and update the database with events that occurred during the outage.

5. **Fragmentation of DICOM Modality Work Lists (MWL)**. Each PACS/RIS vendor typically provides its own unique flavor of Modality Work List, which turns into a configuration and business continuance challenge in the event of a system failure.

   There is an opportunity to leverage the same smart routing appliance as a single point of DMWL configuration enabling the aggregation of existing modality work lists, and the standardization of integration methodology. Standardization of MWL Worklist functionality allows the departments to aggregate many HL7 feeds into a unified environment, and to create an unlimited number of modality worklists as needed, without the necessity to continually go back to the vendor for additional professional services.

6. **Tedious HL7 feed enabling**. For each new HL7 feed request, IT would typically need to undergo a tedious, time-consuming integration with the EMR vendor, a process that could span a period of several weeks of bidirectional configuration and testing.

   In order to reduce the health system's exposure to interface-related delays and workflow interruptions, the HL7 module of the smart appliances were enabled. Using the appliance as an interface engine, the subject is now able to activate a new feed in a matter of minutes using the appliance's user-friendly and efficient GUI.

The Conclusion

The common denominator among the six challenges identified above is a dilemma. In each use case, the dilemma is whether or not to rely solely upon the IT vendor's expertise and solutions to solve everyday problems. Some vendors place an unusually high, arbitrary and often prohibitive cost barrier on connecting their solution to other vendors or to solve an interoperability challenge.

Poor interoperability or lack thereof, inconsistent vendor support of industry standards, poor system design and user experience, cumbersome and labor-intensive systems configuration, fragmented data flows and market protectionism are all elements that contribute heavily to operational, clinical and financial burdening of the caregiver organization.

The health system has shown that it is highly desirable, and absolutely possible, to deploy smart "Swiss-Army knife" vendor-neutral technology that can solve a multitude of interoperability, routing and integration challenges within one platform, without the usual and customary high cost, and without compromising the continuity of its mission-critical operations.

A hospital's IT department has a responsibility to make technology choices that generally empower IT to address many of the basic issues themselves, without having to open a ticket with the vendor for every little change request, or challenge encountered. The subject's current solution achieves this purpose.

As an open, transparent and vendor-neutral technology, the health system can leverage the appliances to constantly improve Imaging workflows, and therefore also improve clinical care. This new solution has provided the health system with a controlled environment, and technology that empowers IT and clinical personnel to own the entire process without having to develop or maintain a costly homegrown product.