



evorad RIS-PACS 2

Solution Configuration

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TABLE OF CONTENTS

1	Evorad	5
2	Offered Application Software	6
2.1	Security.....	6
2.2	Application Parameters.....	7
2.3	RIS	7
2.4	PACS.....	9
2.4.1	Image Archiving/Storage Levels.....	9
2.4.2	Image reading	10
2.4.3	Image Printing.....	14
2.4.4	DICOM.....	14
2.5	Integration with other systems	15
2.6	System Administration	15
3	System Architecture	16
		18
4	Recommended Hardware (not included)	18
4.1	Server	18
4.2	Workstations	18
		19
5	Services	19
5.1	Support.....	19
5.1.1	User support	19
5.1.2	Technical support on Evorad software	20
5.1.3	Technical support on hardware and system software.....	20
5.1.4	Evorad software updates	20

1 Evorad

Evorad (<http://www.evorad.com>) was founded in 2006 to develop medical information systems and provide related services. Evorad offers solutions for imaging examinations ranging from small practices to hospitals and research centres. Solutions combine specialized families of products, which are based on technology under development since 2003, with appropriate services ranging from installation and support to customizations and localizations.

The name of the company stems from the phrase «Evolution in Radiology» and summarizes the introduction of a new approach in medical software development and in particular software for imaging laboratories, which is based on innovative technologies and offers:

- Increased productivity for end-users. Evorad products are designed to simplify and accelerate even the most complex tasks such as medical image processing.
- Flexibility in adapting to continuously changing needs. Evorad is capable of continuously adapting its products to fit changing needs quickly and at the lowest possible cost.
- “Smooth” scalability to fit increasing needs. Solutions offered by Evorad start for independent workstations and scale smoothly to and at normal cost to multi-user system clusters with Internet access and vast image storage capabilities.
- Expandability including customizations of existing functionality by third-parties including end-users. Evorad products are open to developing extensions such as new image processing techniques using tools provided for free. Additional trained third-parties (e.g. VARs) can customize existing functionality to fit special customer needs.
- Choice in IT infrastructure (hardware and system software). All popular operating systems are supported (Microsoft Windows, Linux, Mac OSX, Sun Solaris 10) on hardware by any vendor. Any storage solution can be used ranging from DAS to NAS to SAN. Any single or multi-head monitor configuration is supported including mixing regular with diagnostic monitors.

The major investor of Evorad is Velti Center of Innovation (VCI) which is one of the most important business initiatives of Velti (<http://www.velt.com>). Velti is one of the fastest growing IT companies and is listed in London Stock Exchange (AIM market). Velti excels in offering software solutions and software for telecommunication companies and mobile operators, media and advertising agencies, and organizations offering financial services.

2 Offered Application Software

Product: Evorad RIS-PACS 2

Licenses:

	License	Quantity	Comments
1	Evorad PACS Server	1	
1.1	Modality DICOM Connection	3	
1.2	Concurrent RIS users	0	
1.3	Concurrent PACS users	4	
1.4	Concurrent Clinical View users	2	

Supported languages:

English

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2.1 Security

	Function	Included	Comments
1	User authentication	✓	
1.1	Internal database	✓	
1.2	Integration with MS Active Directory		
1.3	Integration with LDAP Server		
2	User authorization	✓	
2.1	Roles	✓	
2.1	Hierarchical User Groups	✓	
3	Data encryption		

4	Network encryption	✓	Activated on demand
5	Audit trail of all user actions/transactions	✓	

2.2 Application Parameters

	Function	Included	Comments
1	Imaging department management	✓	
1.1	Linking of related personnel	✓	
1.2	Definition of medical and accounting categorization of exams	✓	
1.3	Definition of templates for results/diagnosis editor	✓	
1.4	Definition of common phrase shortcuts for results/diagnosis editor	✓	
2	Table of referring healthcare organizations and clinics	✓	
3	Basic personnel management	✓	
4	Resource (doctors, modalities) availability management for automatic scheduling of exams	✓	
5	Medical Equipment management	✓	
5.1	Modality types	✓	
5.1.1	Predefined viewing windows (width, level pairs)	✓	
5.1.2	Hanging protocols	✓	
5.2	Modalities	✓	
5.2.1	DICOM configuration	✓	
5.3	Printers (DICOM, Postscript)	✓	
6	Basic parameters (insurance institutes, doctor specialties, etc)	✓	

2.3 RIS

	Function	Included	Comments
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1	Exam order management		
2	Exam scheduling		
2.1	Graphical calendar (total and per related resource)		
2.2	Order scheduling		
2.3	Automatic exam scheduling based on resource availability constraints		
3	Basic Patient Medical Record (EMR)	✓	
3.1	Name and demographic information	✓	
3.2	History of exams and results/diagnoses	✓	
3.3	Imaging exams	✓	
3.4	Table of patients and exams with sorting and filtering capabilities	✓	
3.5	Burning patient record with images and results/diagnoses on CD/DVD that included full featured image viewer	✓	
3.6	Patient / Exam transfer between nodes (workstations, servers) through network (and Internet)	✓	
3.6.1	Automated transfer for database synchronization in a multi-site implementation	✓	
4	Result/Diagnosis editor		
4.1	Automatic generation of headers and with organization and patient information		
4.2	Results/Diagnosis templates		
4.3	Results/Diagnosis common phrase shortcuts		
4.4	Spell checking		
5	Exam Workflow management		
5.1	Continuous exam status update		
5.2	Pending exams list		
5.3	DICOM Worklist	✓	

5.4	Daily exam list for modalities without DICOM Worklist	✓	
6	Consumables warehouse management		
7	Management Reporting		
7.1	Basic Reports		
7.2	Business Intelligence		

2.4 PACS

2.4.1 Image Archiving/Storage Levels

	Functions	Included	Comments
1	1 st Archiving/Storage Level	✓	
1.1	DICOM format storage with lossless compression	✓	
1.2	DAS Architecture	✓	
1.3	NAS Architecture		
1.4	SAN Architecture		
2	2 nd Archiving/Storage Level		
2.1	DICOM format storage with lossless compression		
2.2	NAS Architecture		
2.3	SAN Architecture		
3	3 rd Archiving/Storage Level	✓	
3.1	DICOM format storage with lossless compression		
3.2	DICOM format storage with lossy compression		
3.3	Tape Library Technology		
3.4	CD/DVD Burner Technology	✓	

Archiving/Storage Levels Explanation:

1. On-line short-term storage. Refers to the full patient and exam database and includes images and optionally related digital diagnosis voice recordings of the most recent exams. This storage actually supports the diagnosis cycle. All images are stored in the exact DICOM format sent originally by the corresponding modality but their files are externally compressed using an absolutely lossless technique. The recommended technology at this level is very fast hard disks (e.g. SAS) installed internally in the server chassis or externally in Directly Attached Storage (DAS) enclosure. Alternatively this storage can be part of Storage Area Network (SAN) solution.
2. On-line medium-term storage. Refers to images of all images acquired during the historical retention period specified by system administrator. All images are stored in the exact DICOM format sent originally by the corresponding modality but their files are externally compressed using an absolutely lossless technique. Images can be optionally compressed using a lossy technique. The recommended technology at this level is more cost-effective hard disks (e.g. SATA) in enclosures which implement either Storage Area Network (SAN) or Network Attached Storage (NAS) architectures. Lower speed hard disks do not actually compromise system performance taking into account that historical images have lower demand; on the other hand they provide larger storage capacity at the same cost with fast hard disks.
3. Off-line or near on-line storage for back-up and long-term archiving. Refers to archiving all images for back-up purposes but also for implementing a long-term storage for absolutely all acquired images. The recommended technology at this level is tape libraries, although DVD burners could be used in limited image production cases.
4. Disaster recovery storage. For maximum data integrity a parallel storage solution duplicating any related information (patient database, images, etc) is required. This solution should be also located in geographically remote site to compensate for physical disasters. Evorad RIS-PACS can also support outsourcing the disaster recovery system to a third-party data centre services provider, utilizing data encryption to ensure information confidentiality.

2.4.2 Image reading

Evorad RIS/PACS offers an innovative graphical environment for presenting, processing and reading images by radiologists with the following main features:

- Specially designed in cooperation with radiologists to be easy to learn and use while not sacrificing the breadth of functionality.
- Ability to handle high resolution images (such as mammography) but also examinations containing thousands of images (e.g. multi-slice CT).
- Lossless compression of images during image transfer through network and Internet. Optionally image can be lossy compressed for preview purposes.

Compression increases the speed of image retrieval and reduces the load of the networking infrastructure. Every lossily compressed image bears a sign informing the user about its status and allows with one click the immediate retrieval of the original image acquired from the modality.

- Temporary storage of images in the workstations local hard disk to reduce communication with server and therefore reduce the load on the network infrastructure. Temporary images may be optionally deleted when the workstation closes for security reasons.

In particular the following functions are provided:

1. All patients' exams are presented in a list and once an exam is highlighted thumbnails of its containing series are displayed. The user can select which series to retrieve simultaneously from each series for comparative reading. Fast navigation between exams and image series using the mouse and keyboard.
2. Arbitrary layout of windows presenting images and series of images so that the user can define infinite combinations of windows in parallel and tabbed form. In each window the user defines at any time the image grid (from 1X1 to 6X6 including all intermediate combinations such as 3X2). Series are presented with their first image visible allowing the serial navigation through the rest of the images using the mouse or keyboard.
3. Tiled view that mimics film layout by presenting concurrently individual images of a series with synchronized viewing parameters (window level and width, zoom factor, etc) and changeable grid layout (from 1X1 to 6X6 including all intermediate combinations such as 3X2) at any time.
4. Access to associated exam and patient information from any image series for instant identification of image source. Access to exam result/diagnosis by directly opening the editor for viewing and changing the text.
5. Searching and retrieval of additional patients and exams for comparative reading. Every patient appears in separate tab to facilitate navigation between complex combinations of patients-exams.
6. Patient and exam information is displayed as overlaid text on each image. In particular information includes patient code and name, exam code and date, series description, acquisition parameters (e.g. slice thickness, tilt, geometric location, protocol, modality, user of contrast agent, etc). The user can hide overlaid text in selected windows.
7. The DICOM Header (DICOM fields) of the current image can be displayed in a separate window.
8. Definition and application of hanging protocols per modality type and examination protocol. A generic hanging protocol handles examinations that do not match any of the user-defined ones.

9. Associations of multiple image series with localizer to visualize the geometric location of each slice with respect to slices in other series.
10. Synchronization of multiple image series with respect to geometric location, window level/width setting, zoom factor and panning displacement and other parameters (e.g. trigger time, echo time, etc). Parameter synchronization completely automatic in the sense that the workstation detects without user intervention the available parameters. Changing the current image in a series causes an automatic change of the current image in the rest of the series in the same synchronization set to match the criteria. Multiple "persistent" set can be defined from any current set. The synchronization criteria can be interactively changed.
11. Sorting of image series by geometric location or other DICOM fields such as:
 - Acquisition date and time
 - Image number
 - Slice location
 - Other modality type specific parameters such as echo time (TE) in MRI
12. New series creation from selected images of existing series or synthetic series such as the series generated by 3D reformatting techniques (MPR, MIP, etc).
13. Window level/width can be interactively changed. The change can be limited to a specific ROI while the current setting is displayed as part of the overlaid text on the each image. Predefined window level/width pairs can be defined per modality type and applied directly to the current image series. When images of a series are initially displayed the modality's preferred window level/width is applied.
14. Zoom tool supporting a factor up to 30 times and panning tool. Zooming can be applied gradually and using a user selectable technique. Available techniques are replication and interpolation. It is also possible to have continuous zooming using the mouse. Panning is applied horizontally, vertically or both (pan, scroll).
15. Image gray scale values colors can be inverted to produce the photographic negative of the image.
16. Images can be rotated clockwise and anticlockwise by a 90 degree step. Images can be also flipped horizontally and vertically.
17. Measurement tools for distance which can be calibrated by the user and angle (in degrees). Measurement can be moved and modified at any time by the user. Distance label can be moved to a user specified location.
18. ROI definition tools in different shapes (rectangle, polygon, oval, freeform), which can be moved and modified at any time by the user. For each ROI the following values are displayed:
 - Maximum, minimum and mean value in image units (e.g. HU for CT images)
 - Standard deviation

- Pixel/voxel number
- Surface area and volume

This value table can be moved independently from the ROI.

19. Annotation tools with user-definable position and orientation, which can have various shapes such as line, arrow or a ROI and can be associated with an independently movable text box.
20. ROI, measurements and annotations can be copied from a set of selected images or series of images and pasted to another set of selected images or image series.
21. ROI, measurements and annotations can be shown/hidden.
22. Selected ROI, measurements and annotations can be deleted.
23. ROI, measurements and annotations along with window width/level and zooming/panning settings can be saved with each image leaving the original image acquired from the modality intact. This function is subject to security rights assigned to each user.
24. Images can be exported to DICOM files or any popular image format such as BMP, PNG, JPEG, etc. Images can also be copied to the system clipboard so that they can be pasted to other office automation applications such as a word processor.
25. Images can be imported from DICOM files or any other popular image file such as BMP, PNG, JPEG, etc (DICOMizer).
26. Manual and automatic cine function with user definable frame rate up to 60 fps and pause/resume capabilities. Image rolling can be repeating or "back and forth". More than one cine window can be open at each time and can be synchronized with other image series as described in 10.
27. 3D reformatting of image series using the MPR technique with double angle rotation. Reformatting is real-time even without a special graphics card.
28. 3D reconstruction of image series using the MIP and minIP techniques with or without graphics card acceleration.

The workstation supports multiple monitors in various configurations even mixing diagnostic with clinical review or regular monitors. Evorad recommends a regular or clinical review monitor for the patient/exam information (RIS) and some image processing techniques that require color or graphics card acceleration and a pair of diagnostic monitors for image reading.

2.4.3 Image Printing

The system provides image printing functionality to both film using a DICOM printer or paper using a regular postscript printer. There is a graphical user interface for laying out images in pages and choosing printing parameters, which is common irrespective of the printing device. Printing is also subject to user security rights.

Images layout can be defined in two ways:

1. Print current tab of images using their current layout at any grid configuration (from 1X1 to 6X6 with all intermediate combinations such as 3X2) ("What you see is what you get, WYSIWYG" printing).
2. Open a special tiled view that mimics films in which the user can gradually gather images from various series. Images are automatically place in new pages/films if the current one cannot fit them. Images can be individually or collectively modified in terms of window level/width, zooming, etc. Measurements and annotations can also be added at this point. The grid of the current page/film can be changed at any time and images will be rearranged to the rest of the pages accordingly. Printing settings such as film type or paper size, orientation and resolution can be changed at any time by the user. This view is also a preview of what is going to be printer.

Print jobs are executed in the background allowing the user to continue working on the system. The user will be informed on the completion or failure.

2.4.4 DICOM

	Function	Included	Comments
1	DICOM – Client Role (SCU)	✓	
1.1	Query/Retrieve (Find/Move)*	✓	
1.2	Send	✓	
1.3	Print	✓	
2	DICOM – Server Role (SCP)	✓	
2.1	Storage / Storage Commitment	✓	
2.2	Query/Retrieve (Find/Move)	✓	
2.3	Worklist	✓	

*In the case of the client role (SCU) Query/Retrieve can be performed through the Internet with system server serving as mediator between the user and the modality

without compromising the modality's security since it can still operate in a private network that does not have access to the Internet.

2.5 Integration with other systems

	Function	Included	Comments
1	Integration with Hospital Information System (HIS)		
1.1	Through HL7		
1.2	Through Web Services		
1.3	Through database tables		
1.4	Through ASCII files		
2	Integration with dictation/transcription system		
2.1	Voice recording (dictation)		
2.2	Archiving		
2.3	Reproduction (transcription)		
3	Integration with speech recognition system		

2.6 System Administration

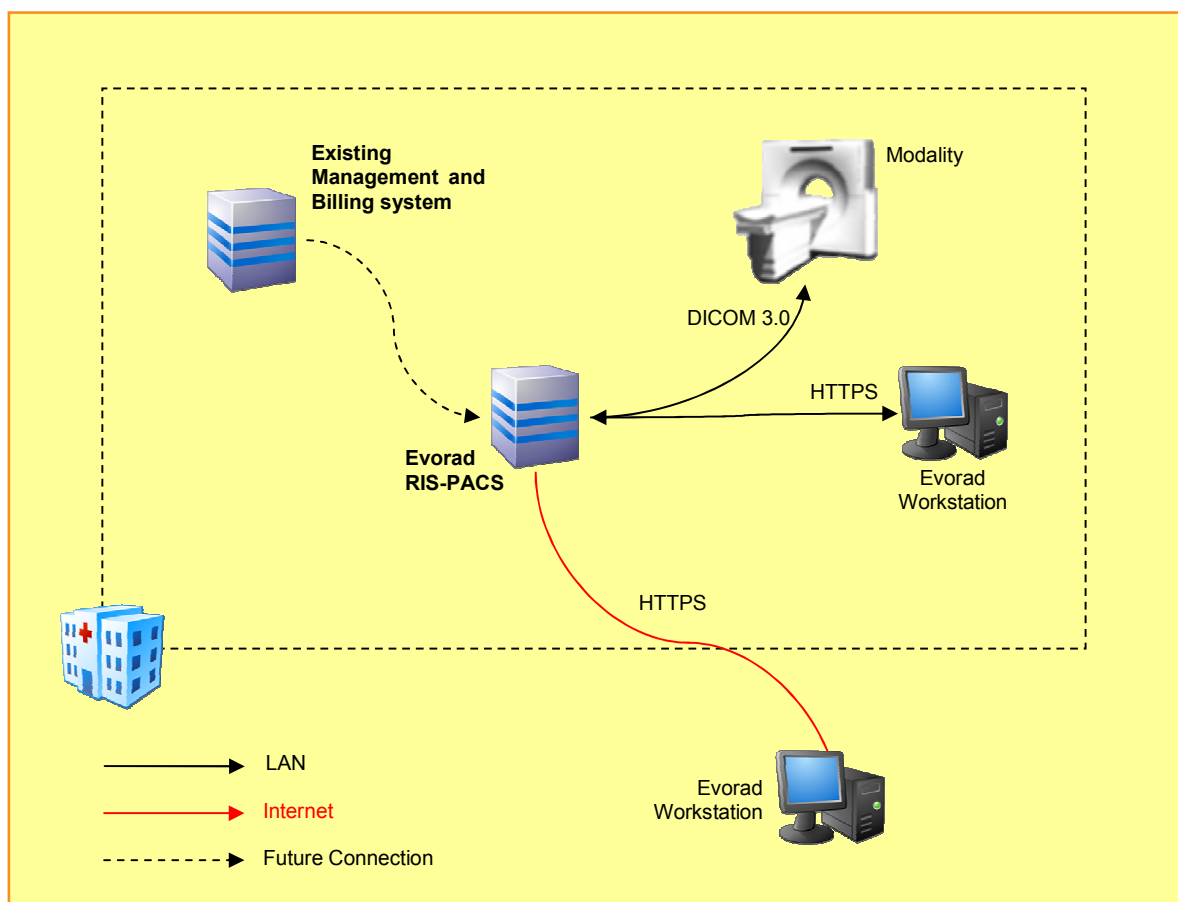
For users with system administration rights there is a separate graphical user interface offering the following functions:

1. Security Administration. All connected users are displayed allowing forced disconnection. Users, groups, roles and associated rights can be managed in a graphical way. Audit trail reports user interactions with the system.
2. Long process administration. All scheduled and currently running processing at the server are displayed in a list allowing the administrator to stop them. The history of all completed or failed processes is also displayed.
3. Command script execution. Administrators can run command scripts to perform configuration and data importing/exporting task while the server is in operation.

3 System Architecture

A central server is proposed with internal storage capacity, which communicates with the modalities and workstation through a LAN. Modalities should be normally connected to a different protected physical network than the workstations and the server should have two network cards to connect to both networks.

The architecture of the system in its operational environment is depicted in the following schematic diagram.



The server hosts Evorad PACS Server software and the RDBMS and communicates with modalities using the DICOM 3.0 protocol. Communication with a management/billing system can be implemented in the future using HL7 or other protocols.

The workstation is implemented using Evorad Workstation software as a standalone application, which is automatically updated by the server once a new version is available. The workstation can also use the web-based edition of Evorad Workstation, which is activated through a web-page within a web browser offering the full functionality

of the standalone edition The workstation communicates with the server using the HTTP or HTTPS (SSL encryption) protocol minimizing network configuration requirements (e.g. firewalls).



4 Recommended Hardware (not included)

4.1 Server

Item	Quantity	Specifications

* The actual capacity regarding medical images is approximately three times larger than the physical capacity based on lossless compression technology that keeps the original DICOM information intact.

4.2 Workstations

Item	Quantity	Specifications

5 Services

The following services can be offered as part of an Evorad RIS-PACS Solution:

- System implementation. Refers to analyzing customer existing infrastructure and requirements, installing the hardware and software, configuring the application software based on customer needs, training users and delivering the solution in operation.
- Customization on special customer needs. Refers to development of changes and new functions to customize the application software on special customer needs which are not satisfied by current system features.
- Support. Refers to offering support at the user and technical levels.

5.1 Support

Support services fall into one of the following categories:

1. User support
2. Technical support on Evorad software
3. Technical support on hardware and system software
4. Evorad software updates

5.1.1 User support

User support refers to answering questions that relate to system usage and ways to perform certain tasks (e.g. export images to DICOM files). It does not refer to technical issues such as network infrastructure failures between a workstation and the server.

This service is offered in one of the following models:

	Service Model	Included	Comments
1	<u>8X5</u> (business hours and days)	✓	
2	<u>8X6</u> (business hours and days plus Saturdays)		
3	<u>12X6</u> (8 am to 8 pm everyday except Sundays)		

5.1.2 Technical support on Evorad software

Technical support on Evorad software refers to solving technical issues related to application software over the phone and if necessary by on-site visit. It does not refer to hardware or infrastructure failures. Accordingly it does not refer to question related to system usage (e.g. exporting images to DICOM files).

	Service Model	Included	Comments
1	<u>8X5</u> (business hours and days)	✓	
2	<u>12X6</u> (8 am to 8 pm everyday except Sundays)		
3	<u>24X7</u> (24 hour – 7 days a week)		

5.1.3 Technical support on hardware and system software

This service refers to solving technical issues related to hardware of system software failures. This service is normally offered by hardware vendors.

5.1.4 Evorad software updates

This service refers to updating Evorad software with new releases that include new functions or improvements of existing ones without any additional cost. New releases that just fix software bugs are distributed to all customers even if they have not purchased this service.

This service does **not** include new extensions (modules) to Evorad products (options).