GE Healthcare

Configuring Environments for Centricity® Electronic Medical Record

Version 9.5
April 2011

Centricity EMR
DOC0882441

Revision history

Date	Description
April 2011 DOC0882441 Rev 2	Update for 9.5. Configuration changes for this release include: • Upgraded server requirements to Windows Server 2008 R2 64-bit. • Upgraded to support Oracle version 11g R2. • Removed support of IBM AIX 5.2 and HP-UX 11.11, and 11.23. • Updated support to JBoss Enterprise Application Platform 5.0.1 with 64-bit JVM. • Added configuration information for Server Virtualization. • Added Windows 7 support for workstations. • Removed support for Citrix XenApp Presentation Server 4.5.
September 2009 DOC0554601 Rev 4	Update for 9.2. Configuration changes for this release include: • Increased the supported number of users for Windows 64-bit database servers. • Lowered the supported number of users for Windows 32-bit database servers. • Added hardware specification for Windows 64-bit database servers supporting over 1000 users. • Upgraded to support Oracle version 10.2.0.4. • Added support of IBM AIX 5L release 6.1. • Increased workstation disk size to 80 GB or larger, or 250 GB RAID 1 if the workstation is to be used as a DTS or ePrescribing station. • Added Microsoft Service Pack 3 for workstations running Windows XP Professional. • Added configuration information for mobile/browser access. • Removed support for Citrix XenApp Presentation Server 4.0. • Removed support for Citrix ICA Client versions 9.x, 10.0, and 10.1.
March 2009	Original issue for EMR 9.0.

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Configuring Environments for Centricity EMR

This document contains all hardware and software requirements for a successful deployment of Centricity Electronic Medical Record.

!!! GE may change the configuration recommendations in this document at any time without notice.

GE is not responsible for the performance of Centricity Electronic Medical Record on hardware, software, or network configurations not recommended by GE.

Check the Centricity Services Web site regularly for updates to this document and other configuration requirements.

This specification refers to the following resources available in Adobe® Acrobat® PDF format on the documentation media and on the Centricity Services Web site

- *Preparing and Maintaining Centricity Electronic Medical Record Systems*. This manual includes detailed hardware and software requirements for large systems.
- *Calculating Hardware Requirements for Centricity Electronic Medical Record*. Use this Excel spreadsheet to compute the memory needed for a dedicated EMR database server. The spreadsheet is available in the same folder as this document. On the Documentation CD, the path is *./guides/calculating_hardware_requirements.xls*

Documentation conventions

This document uses the following conventions to represent different types of information:

This convention...	Means this...
`monospaced type`	Type this text exactly as it appears.
Chart > Clinical Lists	Open the Chart folder and select the Clinical Lists item.
Ctrl + U	Hold down the Ctrl key while you press U, then release both keys.
italic type	A term that is being defined. When used in a path or command line, it is a variable that should be replaced with your specific site value.
	Key information about a topic.
✓	Tip. Information about a shortcut or other convenient or optional information.
!!!	Information with an impact on software implementation or performance, or a potential risk of data loss.

Terminology

This term...	Means this...
Application server	A Windows server running Service Layer and JBoss web server to handle all application tasks between user workstations and the database server, including application Web sites and Web services. Application server components can be combined on the Database server (Windows environments) or with Data Exchange components.
Centricity Clinical Gateway	Centricity Clinical Gateway (CCG) provides seamless communications between Centricity products and external healthcare applications and systems. CCG may be required for exchanging data with external systems. CCG is optional. If used, it is installed to the Data Exchange server. Different versions of the gateway cannot be run on the same server.
Cloverleaf 5.7 MB (Multi-Byte) interface engine	Part of Centricity Clinical Gateway, the Cloverleaf interface engine receives messages from internal and external sources in a variety of protocols. Messages are translated as required and routed to specified destinations. Cloverleaf interface engine and sites (interfaces) are required to exchange data. You can continue to use older versions of Cloverleaf on the same system if required for non-GE legacy applications.
Database server	The server that hosts the database that stores Centricity application data.
Data Exchange server	A Windows server used to manage data exchange with remote systems. Data Transfer Stationand Centricity Clinical Gateway may be installed to this server. In limited circumstances, some data exchange components can be installed to the Database server. For best results, GE recommends installing to a separate machine.
Data Transfer Station (DTS)	Runs on a dedicated machine and automates clinical data transfers to and from external systems via LinkLogic and (optionally) Cloverleaf interface engine. Multiple instances of DTS can be implemented. GE recommends locating each instance on a separate machine.
JBoss	See Service Layer.
KnowledgeBase	Clinical content that is updated quarterly. KnowledgeBase updates formulary names, ICD codes, allergy custom lists, medication references and interaction information, and problem references (CPT codes and keywords).

This term...	Means this...
LinkLogic	LinkLogic runs within the Centricity application and is used to exchange information with other health care information systems. LinkLogic imports demographics, documents, lab results, appointments, and references to external images into the Centricity database and exports application data for demographics, documents, observations, procedures, allergies, problems and clinical summaries.
MIK (Millbrook Integration Kit)	MIK is a service that automates business data transfers for Centricity PM. It is installed to the Data Exchange server in a joint EMR-PM implementation.
Service Layer	The Service Layer handles all application tasks between user workstations and the Database Server. It is a service-oriented architecture (SOA) Java-based application server (JBoss) with Web services interface that supports: • Legacy Clinical Web Services (Dosing Calculator, Growth Charts, Medication/Problem Web Lookup) • Tighter integration with Centricity Business Systems (Flowcast) and a platform for future interoperability with other GE systems • Enhanced integration with third-party software applications Service Layer can be installed to the Database server (Windows environments) or to the Application server.
Staging area/ staging location	The directory on the database server that contains the Centricity application and database files used in the installation process. The contents of the Centricity installation media is copied to this directory and remains there during and after installation. The database installation files can be copied to this directory as well. The staging directory should have at least 2 GB of free space.

Evaluation version

Follow the specifications for Workstation hardware on page 19 and Workstation software on page 21 to configure a system to run the Centricity Electronic Medical Record Evaluation version.

Server Virtualization specification

Virtualization is a technology where a physical “host” operating system supports one or more virtual “guest” operating systems. This document uses the terms “host” and “guest” to refer to the physical systems and the virtual systems they support.

When considering the performance of Centricity EMR in a virtualized environment, be sure to measure the performance of the host systems as well as the guest systems.

Host specification

The tests on which these recommendations were based were completed on host systems similar to the one described below. The use of Solid State Drives (SSDs) helps achieve high IOPS and helps minimize the physical footprint.

Hewlett-Packard ProLiant DL 380 G6 Server (with both SSD and HP MSA70 Arrays)

Dual Intel Xeon X5550 CPUs (2 CPUs, 4 cores each, hyper-threading enabled)

72GB RAM (18 x 4GB)

4 x 1GbE NICs

Fiber Channel P2000 series and up to EVA storage for site +1000 users

11x SFF SAS 10K 300GB Raid-5 with hot spare

Windows Server 2008 R2 64-bit

Each customer installation requires a different combination of guest operating systems. Allocate the guest operating systems across the host operating systems. Balancing how the guest systems use CPU, memory, disk and network across the available hosts will improve the performance of the Centricity EMR installation.

Guest specification

Guest systems support the database, secondary servers and third party extension modules.

Database Guest specification

The Centricity EMR product relies on the Oracle database. The releases described in this document require 64-bit Oracle 11gR2 and the 64-bit Windows Server 2008 R2 operating system.

Refer to the Calculating Hardware Requirements spreadsheet to determine the RAM, IOPS, Network, CPUs and disk space needed to support these configurations.

Users	**1-125**	**126-500**	**501-up**
CPUs VMWare	2	4	8
CPUs Hyper-V	2	4	Not supported

RDS/XenApp Guest specification

The Centricity EMR product may be used either with Citrix XenApp or with Microsoft Remote Desktop Services. For Citrix, the minimum supported version of XenApp Presentation Server is 6.0 and the minimum supported version of the ICA Client is 11.2. For Microsoft, Windows Server 2008 R2 contains the minimum supported RDP server and 6.1 is the minimum supported version of the RDP client. This client is available for Windows 7, Windows Vista and Windows XP Sp3.

Refer to the Calculating Hardware Requirements spreadsheet to determine the RAM, IOPS, Network, CPUs, disk space, the number of hosts and guests needed to support the configurations in the table below. Additional hosts and guests are added as needed to provide the required number of terminal services connections.

Users	**1-25**	**26-up**
CPUs VMWare	2	Add hosts and/or guests
CPUs Hyper-V	2	Add hosts and/or guests

Secondary Servers Guest specification

The application server needs to scale as the number of users grows.

Service Layer: 64-bit OS Only			
Users	**RAM**	**Cores**	**CPU Class**
500	8GB	4	X5550
1000	16GB	6	X5670
2000	32GB	12	X5670
3000	64GB	16	X7560
4000	96GB	32	X7560

Use the information in the table below to estimate the guest operating system needs to support the secondary servers.

Secondary Servers	**Processor**	**RAM**
Data Exchange Server (Interface)	2 CPU	4 GB
MQIC (Quality)	1 CPU	4 GB

Third-Party Extension Module Guest Specification

Use the information in the table below to estimate the guest operating system needs to support the Third-Party Extension Modules. Many of these extension modules may be run in either 32-bit or 64-bit guest operating systems, either Windows Server 2003 or Windows Server 2008 R2. Verify the requirements with the provider of the extension module.

Third-Party Extension Module	Processor	RAM	Disk
eScript Messenger (eRx)	2 CPU	4 GB	50 GB
Document Management (1-25 Users)	2 CPU	2 GB	500 GB
Document Management (26-125 Users)	2 CPU	4 GB	1 TB
Document Management (126+ Users)	2 CPU	4 GB	1.5 TB
Web Server (Centricity Portal and Secure Messenger) (1-125 Users)	2 CPU	4 GB	50 GB
Web Server (Centricity Portal and Secure Messenger) (126+ Users)	2 CPUs	4 GB	50 GB
Faxing (Bizcom – Faxcom CV plus)	n/a for virtualization. Use separate host		

Sample configurations

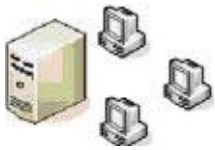
Sample Configuration for 25 users

		
Database server	Combined Application server and Data Exchange server	Client Workstations Remote Access Client
Server software: Windows Server 2008 R2 Oracle EMR database	Required software: Windows Server 2008 R2 Service Layer / JBoss Optional software: Data Transfer Station Centricity Clinical Gateway	Workstation software: Windows 32-bit or 64-bit EMR application client

Sample Configuration for 26 - 100 users

			
Database server	Application server	Data Exchange server	Client Workstations Remote Access Client
Server software: Windows Server 2008 R2 Oracle EMR database	Required software: Windows Server 2008 R2 Service Layer / JBoss	Windows 32-bit or 64-bit Optional software: Data Transfer Station LinkLogic Centricity Clinical Gateway	Workstation software: Windows 32-bit or 64-bit EMR application client

Sample Configuration with Citrix XenApp

			
Database server	Application server	Data Exchange server	Citrix server / clients
Server software: Windows Server 2008R2 Oracle EMR database	Required software: Windows Server 2008 R2 Service Layer / JBoss	Windows 32-bit or 64-bit Optional software: Data Transfer Station LinkLogic Centricity Clinical Gateway	XenApp software: Windows Server 2008R2 Citrix XenApp Citrix clients

Sample Configuration for 101 - 500 users

				
Database server	Application server	Data Exchange server	Additional Servers	Client Workstations Remote Access Client
Server software: Windows Server 2008 R2 Oracle EMR database	Required software: Windows Server 2008 R2 Service Layer / JBoss	Windows 32-bit Optional software: Data Transfer Station LinkLogic (shared network folder)	Optional software: Windows 32-bit or 64-bit Data Transfer Station LinkLogic Centricity Clinical Gateway	Workstation software: Windows 32-bit or 64-bit EMR application client UNIX Installation workstation

Sample Configuration for 501 - 3000 users

				
Database server	Application server	Data Exchange server	Additional Servers	Client Workstations Remote Access Client
Server software: Windows Server 2008 R2 or UNIX Oracle EMR database	Required software: Windows Server 2008 R2 Service Layer / JBoss	Windows 32-bit or 64-bit Optional software: Data Transfer Station LinkLogic (shared network folder)	Optional software: Windows 32-bit or 64-bit Data Transfer Station LinkLogic Centricity Clinical Gateway	Workstation software: Windows 32-bit or 64-bit EMR application client UNIX Installation workstation

Sample Configuration for over 3000 users

				
Database servers	Application server	Data Exchange server	Additional Servers	Client WorkstationsRemote Access Client
Server software: UNIX Multiple Oracle EMR databases on multiple servers	Required software: Windows Server 2008R2 Service Layer / JBoss	Windows 32-bit or 64-bit Optional software: Data Transfer Station LinkLogic (shared network folder)	Optional software: Windows 32-bit or 64-bit Data Transfer Station LinkLogic Centricity Clinical Gateway	Workstation software: Windows 32-bit or 64-bit EMR application client UNIX Installation workstation

Database server hardware

A dedicated database server is required. The hardware recommendations are based on user loads with only Centricity EMR and CCCQE forms installed. While a small amount of file and print server activity can occur on the database server, it is recommended you use a separate server for other networked applications.

The following equipment recommendations provide satisfactory performance for Centricity Electronic Medical Record including its options. Requirements for satisfactory performance of other software may be higher.

Performance depends on processor speed and memory configuration. Review these recommendations before purchasing and configuring equipment.

Processor, RAM, and Disk Space

This table contains the minimum recommendations for database server hardware. For recommended disk space, refer to Calculating disk space requirements.

Users	Operating System	Processor/Cores	RAM
1 - 500	64-bit Windows Server	Xeon 5520 / 4 cores	16 GB
501 - 1000	64-bit Windows Server	Xeon 5520 / 4 cores	24 GB
1001 - 2000	64-bit Windows Server	Dual Xeon 5550 / 8 cores	32 GB
2001 - 3000	64-bit Windows Server	Dual Xeon 5650 / 12 cores	48 GB
3001 - 4000	64-bit Windows Server	Quad Xeon 7650 / 32 cores	64 GB
1 - 4000	UNIX	CPUs = # of Concurrent Users / N Refer to Calculating UNIX processor requirements.	2.4 GB per 100 concurrent users

Calculating UNIX processor requirements

CPU selection is based on the number of concurrent users. To determine the number of CPUs needed in a system, use this calculation:

CPUs = # of Concurrent Users / N

Use a CPU with a faster clock speed and more cache for multiplier performance gains. Minimum 2 MB cache required on CPUs. Base box must support the required CPUs.

X database instances can be supported per server up to a maximum average server CPU utilization of 75 percent, as measured over a 1 -hour period, at 5-second intervals, during your heaviest usage periods. Other factors include memory utilization, swapfile utilization, and CPU queue length. These combined factors affect the performance of the database(s) as well as end-user client responsiveness.

Processor	Clock speed	Cache	Recommended value of **N** per processor core
PA-8900	1.0 GHz	64 MB	50
Itanium	1.42 GHz	12 MB	75
Itanium	1.66 GHz	24 MB	150
Power 5	1.65 GHz	3.8 MB L2/72 MB L3	100
Power 5+	1.9 GHz	3.8 MB L2/72 MB L3	120
Power 5+	2.2 GHz	3.8 MB L2/72 MB L3	140
Power 6	3.5 GHz	16 MB L2/64 MB L3	160
Power 6	4.2 GHz	16 MB L2/64 MB L3	180
Power 6	4.7 GHz	16 MB L2/64 MB L3	200

Calculating disk space requirements

Disk setup is based on the number of patients, the number of concurrent users, and high-frequency disk access. To calculate disk space requirements for your environment, use the spreadsheet *Calculating Hardware Requirements for Centricity Electronic Medical Record* to calculate memory and disk space requirements. The spreadsheet is available in the same folder as this document: *./guides/calculating_hardware_requirements.xls*

See also "Large system planning" in Preparing and Maintaining Centricity Electronic Medical Record Systems, for the process to determine space requirements and number of disks based on volume layout.

These resources are available on the Centricity Services Web site at: http://centricitypractice.gehealthcare.com/

Disk setup for performance and reliability

- **Mirroring:** Mirror server disk(s) so the system remains available in the event of disk failure.
- **Server OS on separate disk drive:** Install the Oracle database on separate physical disk drives from the disk drive containing the server operating system software. Use RAID 1 for the OS drive for availability if the disk fails.
- **Disk arrays:** SAS or Fibre Channel RAID 1+0 disk arrays (Disk Mirroring with Striping) increase database disk performance and reliability and lower CPU utilization.
- **Swap space:** Set the swap space = 1.5 * the total system RAM

  Locate swap space on different physical disk drive(s) from the one(s) containing the EMR application database.
- **Redundancy:** For maximum reliability, use a redundant server for virtually instantaneous recovery if the primary server fails.
- **Optimize server memory usage:** Windows Server operating systems have a setting for maximizing throughput. Refer to Workstation software on page 21.

Network	Use trained professionals. Systems and network cabling should be installed and configured by trained network professionals. Plan to engage a network support specialist for installation and ongoing support. **!!!** Do not use Network Hub devices for network connectivity. ■ Switches: For maximum throughput, use 1000Base-T or greater switches. ■ Network card: Dual-port 1Gb Ethernet (1000Base-T) network card ■ Wiring: Ethernet twisted pair CAT-5e, or CAT-6 compliant wiring or better. ■ RDS/XenApp: While the ICA/RDP protocol is highly compressed, make sure your network has sufficient bandwidth to carry the traffic your environment requires. ***Windows***: Gigabit (1000Base-T) preferred. ***UNIX***: In large systems, the number of network cards and network setup impact system scalability significantly. The recommended configuration is: ■ Minimum one 1000Base-T network adapter (or better) in the database server. ■ Minimum one 1000Base-T network adapter between database and application servers. ■ Multiport Gigabit switch(es).
Network protocol	TCP/IP only.
UPS	Minimum 15 minutes emergency full load backup power from uninterruptible power supply (UPS). To avoid possible data corruption during power brownouts, connect the server and concentrators to a UPS (uninterruptible power supply) with at least 15 minutes of full load backup power. Set the UPS to shut down the server automatically after a specified period. During an extended power outage, this gives users time to log out before the server goes down.
Monitor for Windows environments	Color SVGA Display (1024x768 minimum resolution - Small Fonts), High Color (16 bit, 65536 colors) or greater.
Internet connection	High-speed connection recommended for accessing Web-based Problem and Medication reference and downloading product updates and documentation.
Media drive	16x-speed DVD or faster ***Windows***: The DVD-ROM drive must be connected to the dedicated EMR database server during EMR/Oracle installation and update so that the installation program can access and update the server's registry. ***UNIX***: Oracle installation programs require a DVD drive on the dedicated UNIX database server for installing the UNIX OS, Oracle RDBMS, and other software. The EMR application can be installed from any network workstation with a DVD drive.
Backup tape drive	For detailed backup and recovery strategies, see "Perform backups and recover data" in Preparing and Maintaining Centricity Electronic Medical Record Systems available on the Centricity Services Web site at: http://centricitypractice.gehealthcare.com/
Other	AC power, network, keyboard, and display extension cables for optimal placement. Power surge protector to protect your equipment against voltage variations.
Base server	There is a limit of 100 user-authorized Locations of Care for systems with over 1000 database users.

Database server software

Operating systems

Microsoft Windows Server 2008, R2 Standard Edition and Enterprise Edition (64-bit)

HP-UX 11i 64-bit, Foundation Operating Environment or better, with required OS patches. OnlineJFS 4.1 or higher is recommended on HP systems to improve Oracle db cache I/O performance.

- HP-UX PA-RISC Version 11i v3.0 (11.31) 64-bit: no OS patches required
- HP-UX Itanium Version 11i v3.0 (11.31) 64-bit: no OS patches required

!!! Older HP-UX versions are no longer supported. Check the support site at http://centricitypractice.gehealthcare.com/ for updated information.

IBM AIX 5L 64-bit with required OS patches.

- IBM AIX 5L release 5.3
  - IY58143, IY59386, IY60930, IY66513
  - TL 06, SP 7
  - TL 07 SP 4
  - TL 08 SP 2
- IBM AIX 5L release 6.1
  - TL 00 SP 5
  - TL 01 SP 1

!!! Older AIX versions are no longer supported. Check the support site at http://centricitypractice.gehealthcare.com/ for updated information.

Oracle on Windows servers

Oracle 11g R2

- Maximum 4 processors for Standard Edition.
  Utilization of more than four processors may require Oracle Enterprise Edition. Use Oracle Corporation's Licensing Guidelines and Processor Core Factor Table to determine the CPU licensing requirements. Contact Oracle to purchase Enterprise Edition and the required licenses.
- Disable compression for all Oracle directories and files.

For Windows Server operating systems, multiple database instances are generally limited to one per processor core or N database instances up to a maximum average server CPU utilization of 75 percent, as measured by your Windows Performance tool (Control Panel > Administrative Tool > Performance) over a 1-hour period, at 5-second intervals, during your heaviest usage periods.

The primary factor determining number of supported database instances is maximum average server CPU utilization. Other factors include memory utilization, swapfile utilization, CPU queue length, and so on. All these factors combined can affect the performance of the database(s) as well as end-user client responsiveness.

Oracle on UNIX servers

HP-UX: Oracle 11g R2
IBM AIX: Oracle 11g R2

- One Oracle database instance per processor.
  Utilization of more than four processors may require Oracle Enterprise Edition. Use Oracle Corporation's Licensing Guidelines and Processor Core Factor Table to determine the CPU licensing requirements. Contact Oracle to purchase Enterprise Edition and the required licenses.
- Disable compression for all Oracle directories and files.
- X-terminal client.
- PERL v5.6.1 (needed for **opatch** utility).

Oracle on HP-UX requires:

- JAVA SDK (JDK) 1.3.1
- JDK 1.3.1.02, JRE 1.1.8.06 with recommended patches PHNE_23456, PHNE_24034
- C/ANSI C compiler or C++ development kit with HP ANSI C compiler release B.11.01.25171, PHSS_25171, PHSS_25249 or HP C++ A.03.27

Oracle on AIX requires:

- IBM JDK 1.3.1.11 (32-bit) IY47055
- IBM JDK 1.4.1.2 (32-bit) IY47536
- IBM JDK 1.4.1.1 (64-bit) IY47538
- C/ANSI C compiler or C++ development kit: VAC 6 C and C++ for AIX July PTF (6.0.0.4) U489726
- Required AIX filesets: bos.adt.base, bos.adt.lib, bos.adt.libm, bos.perf.libperfstat, bos.perf.perfstat, bos.perf.proctools

Application server and Data Exchange server hardware

The hardware requirements for an Application server and a Data Exchange server are identical. Refer to Terminology on page 3 to review the purpose of each server.

Processor, RAM, and Disk Space

This table contains the minimum recommendations for the Application and Data Exchange server hardware.

Server	Processor / Cores	RAM	Disk Space
Application server	Xeon 5520 / 2 cores	4 GB	36GB of free disk space (after operating system installation). Total page file space should equal 2X physical RAM.
Data Exchange server	Xeon 5520 / 2 cores Refer to High data transfer rate considerations	4 GB	36GB of free disk space (after operating system installation). Total page file space should equal 2X physical RAM.
Remote Desktop Services / Citrix XenApp	Xeon 5550 / 4 cores Refer to High data transfer rate considerations	16 GB	Mirrored 146 GB drive. SAS RAID 1 Total page file space should equal 2X physical RAM.

All the third party applications are able to run on a Single Quad Core Xeon 5200 processor. RAID 1 is recommended for all the third-party applications. Many of these extension modules may be run in 32-bit or 64-bit guest operating systems, either Windows Server 2003 or Windows Server 2008 R2. Verify the requirements with the provider of the extension module.

Extension Module	**RAM**	**Storage**
eScript Messenger (eRx)	2 GB	Mirrored 36 GB (Avail)
Document Management	2 GB	Mirrored 250 GB
Web Server (Centricity Portal and Secure Messenger)	2 GB	Mirrored 36 GB (Avail)
Faxing (Bizcom – Faxcom CV plus)	4 GB	Mirrored 146 GB
Charge Mobile	4 GB	Mirrored 146 GB

Disk space usage

There are several software components that require disk space on the servers:

Centricity Clinical Gateway	Up to 2.0 GB This does not include space required for archiving messages.
Data Transfer Station	Up to 520 MB (300 MB for DTS, 220 MB for page file space)
Service Layer	575 MB
JBoss Enterprise Application Platform	175 MB
Additional Service Layer instance	400 MB

High data transfer rate considerations	The Data Transfer Station message transaction rate (TPH) is influenced by the size of the DTS server and the database server. For a data exchange transfer rate exceeding 1800 message transactions per hour, GE recommends a Quad processor-based or higher server with proper disk configuration to maximize DTS performance.

Transactions per hour (TPH) measures the number of patient-related messages that can be processed per hour. Tests were performed with one patient-related message per import file. This is the preferred method of data import.

TPH rate is also influenced by other factors in the computing environment, for example:

- Number and speed of database server processors
- Amount of memory on the server and database server
- Network speed (100 Mbit, or 1000 Mbit)
- DTS hard disk drive speed and throughput (SATA or SAS)
- Server hard disk drive speed and configuration (stripe or hardware RAID)
- Data Exchange server throughput speed

For information on disk setup and volume layout, see "Large enterprise systems" in *Preparing and Maintaining Centricity Electronic Medical Record Systems*.

Network	Gigabit (1000Base-T) preferred.
Network protocol	TCP/IP only.
Internet connection	High-speed connection recommended.

Application server software

Operating System — Windows Server 2008 R2

Service Layer — JBoss Enterprise Application Platform 5.0.1 with 64-bit JVM, a Java EE edition 6 compliant platform. This includes the 64-bit Java Development Kit (JDK) 1.6, and the Java Runtime Environment (JRE) 1.6.

The Service Layer includes internal EMR services used by the application for certain business logic and data access functions..

!!! GE provides the correct version of JBoss on the installation media.

If you already have JBoss, the only supported version is one obtained from Redhat under a support and maintenance agreement. The tag must be **5.0.1 GA Build SVNTag=JBPAPP_5_0_1 date=201003301050** or higher. Downloadable versions of JBoss do not support the Service Layer.

The tag is written to the JBoss boot log. For example:

```
14:51:00,437 INFO  [ServerImpl] Starting JBoss
(Microcontainer)...
14:51:00,437 INFO  [ServerImpl] Release ID: JBoss [EAP] 5.0.1
(build: SVNTag=JBPAPP_5_0_1 date=201003301050)
```

Web browser — Browsers must have 128-bit encryption and the latest security patches for proper operation of Centricity software.

- Microsoft Internet Explorer (IE) 8.0 32-bit only
  Program Files (x86)\Internet Explorer\iexplore.exe

Data Exchange server software

Operating System

Windows Vista Business or Enterprise
Windows 7
Windows Server 2008 R2

Contact Centricity Services for latest qualified service pack information.

Network connection limits

Workstation operating systems (Windows 7 and Vista) support a maximum of 10 network resource connections into the workstation. Each interface / LinkLogic station deployed consumes one resource connection. (Socket interfaces are exempt.) If you plan to use multiple interfaces without sockets or more than six LinkLogic stations, GE recommends Windows Server 2008 for the operating system.

Centricity EMR Advanced ePrescribing

GE's ePrescribing partner, Kryptiq Corporation, recommnds installing eScript Messenger System (eSM) to a dedicated server. For low volume of ePrescribing transactions, eSM can be run on a combined Application/Data Exchange Server, or on a separate qualified workstation or server.

LinkLogic

LinkLogic interfaces with Data Transfer Station to automate data exchange with other systems through files and TCP/IP socket connections. Ideally, LinkLogic should be installed on the Data Exchange server, and the folder shared on the network to be accessible to multiple Data Transfer Stations.

Data Transfer Station (DTS)

Data Transfer Station interfaces with LinkLogic to automate data exchange with other systems through files and TCP/IP socket connections. One or more DTS can be used by clinics to automate data transfer operations and balance the transfer load. For best results, GE recommends you install each DTS instance to a separate qualified workstation or server.

!!! You can only run one instance of DTS as a service per machine. Running DTS as a service is a configuration that automatically restarts the DTS in the event of a crash or other system restart.

CCG

Centricity Clinical Gateway, CCG 8 includes ServiceMix ESB and Cloverleaf 5.5 MB interface engine as installed components. Interfaces (sites) are licensed separately.

!!! This implementation of CCG only supports interfaces developed for this release. If you have an existing CCG implementation supporting other GE products and interfaces such as Centricity Imaging, contact Centricity Services for guidance in integrating your implementations.

GE does not recommend running all Cloverleaf interfaces on the same machine without testing for performance and version compatibility between Cloverleaf and the actual interfaces.

Web browser

Browsers must have 128-bit encryption and the latest security patches for proper operation of Centricity software.

- Microsoft Internet Explorer (IE) 8.0 32-bit only
  Program Files (x86)\Internet Explorer\iexplore.exe

Installation workstation for UNIX

An installation workstation is required to perform the UNIX installation.

> The configuration for the installation workstation is different than the configuration required for user workstations. For user workstation requirements refer to Workstation hardware and Workstation software in this document.

Processor	Pentium 4, 1 GHz or higher
RAM	512 MB minimum
Disk space	2 GB minimum free space 4 GB or larger hard disk recommended
Media drive	16x-speed or faster DVD drive on the workstation. A remote, network drive does not work.
Staging directory disk space	450 MB minimum of disk space available on the drive containing the staging directory. This directory contains the contents of the Centricity EMR media. This directory remains after installation for future database and client upgrades.
Modem/phone	Access to Centricity Services via both modem and phone line.
X-Terminal client	An X-Terminal client application must be running on the workstation. For example: *ReflectionX* or *Exceed*.

Workstation hardware

Workstations are deployed to run the client application. The client running on the individual workstation is also known as a *thick* client.

The following are the minimum equipment recommendations for satisfactory performance for Centricity Electronic Medical Record including its options. This specification can also be used for additional Data Transfer Stations.

Processor	Dual core processor, 2 GHz or higher
RAM	4 GB
Virtual memory/Page file	At least 1.5 times the size of the available RAM
Disk space	36 GB or larger hard disk recommended. 250 GB/RAID 1 if the workstation is to be used as a DTS or ePrescribing station.

> **!!!** This recommendation assumes the workstation is used only for the operating system, Centricity EMR and other GE software, and Oracle client software.
>
> The EMR application requires 850+ MB for EMR/fax, Oracle client, and Services, with a minimum 300+ MB for swap file space for the operating system. Optimally, swap file space should equal physical RAM.
>
> Formulary Editor v 6.0 and its database require an additional 300 MB. Formulary Editor uses less disk space when only one formulary is loaded at a time. Frequent compacting of the database will reduce disk space requirements

Disk space for Evaluation version	Any disk with 4 GB of free space.
Network	Gigabit (1000Base-T) preferred.
Protocol	TCP/IP only.
Monitor	Color SVGA Display (1024x768 minimum resolution - Small Fonts), High Color (16 bit, 65536 colors) or greater
Photo ID and image capture	GE supports any digital video device, digital camera, or scanner that plugs into a USB port. The EMR application captures still images directly from the device in **.bmp** or **.jpg** formats. Images can also be acquired from file system image files, or by copying and pasting from another application.
	 For best results, test image capture solutions with the EMR application prior to purchase.
Internet connection	High-speed connection recommended for accessing Web-based Problem and Medication reference and downloading product updates and documentation.
Modem	DSL/cable or other high-speed fax/modem Modems may be needed for faxing or remote access by providers and other users not directly connected to the server.
UPS	Minimum 5 minutes emergency full load backup power from uninterruptible power supply (UPS) Connect workstations and the Data Transfer Station (DTS) workstation to a UPS with at least 5 minutes of full load backup power to protect against brownouts and other. electromagnetic interference.
Media drive	16X-speed DVD drive or faster A DVD-ROM drive is required to install the application and Oracle on workstations. It can reside on the dedicated EMR database server or on a workstation. In either case, the workstation that is used to run the installation program must have access to the file system of the dedicated database server.
Other	AC power, network, keyboard, and display extension cables may be required for optimal workstation placement. Power surge protector for each workstation to protect against voltage variations.

Workstation software

Workstations are deployed to run the client application. The client running on the individual workstation is also known as a *thick* client.

Operating System

Microsoft Windows 7 Business (32-bit or 64-bit
Microsoft Windows Vista Business (32-bit or 64-bit)
Microsoft Windows XP Professional, Service Pack 3 (32-bit)

In addition, Microsoft Windows 2008 R2 is supported for the DTS, and hosted RDS/XenApp.

Contact Centricity Services for latest qualified service pack information.

OCR

GE does not support Optical Character Recognition (OCR). However, you can scan documents and store the acquired images into a patient chart.

Web browser

Microsoft Internet Explorer (IE) 8.0 (32-bit only) with 128-bit encryption and latest security patches or higher is required for proper operation. If you are running a 64-bit operating system, the 32-bit version of IE is located in **Program Files (x86)\Internet Explorer\iexplore.exe**

Faxing

Biscom's Faxcom® 6.1.5 is the verified fax solution for the EMR application. For detailed fax server configuration information, go to http://www.biscom.com.

CardioSoft

CardioSoft must be installed on the same workstation as the EMR client. For EMR 9.5 and earlier, only 32-bit platform CardioSoft installations are supported.

Context Manager (CCOW)

Centricity Context Manager is an optional software product based on technology licensed from Carefx Corporation. Contact your Centricity Services account manager for more information about this product.

Sentillion's Context Manager™, Vergence® 3.0.0.0 is a context manager application verified to work with the EMR application. For details: http://www.sentillion.com

Reports

Crystal® Reports Professional XI R2 by SAP BusinessObjects. The reports included in the application are written in Crystal Reports XI R2. Customers must use this version to modify them.

Customized factory reports created or converted to Crystal Reports v10.0 should open without any issues. The Crystal Reports 11 migration guide contains information for solving migration and connectivity issues.

Do not open reports in versions higher than the recommended version. Once a report is opened in a later version it might not be compatible with the recommend version.

For more information about Crystal Reports, go to http://www.crystaldecisions.com.

!!! Pre-install or upgrade Crystal Reports on any workstation to be used to create custom reports before installing the EMR application. If you install or upgrade Crystal Reports after installing the application, some EMR reports may fail.

Remote Desktop / Citrix server hardware

RDS/XenApp is deployed to serve multiple (*thin*) clients to terminals or workstations.

The application should never be hosted via RDS/XenApp on the dedicated Database server. It should be hosted a separate server dedicated to serving the application to client workstations.

The following configurations or features are not supported in a RDS/XenApp server environment:

- Centricity EMR Evaluation version.
- Photo-ID capture.
- Scanning.
- LinkLogic and Data Transfer Station (DTS) applications should be installed on a separate server, not the Terminal/Citrix server.
- The EMR /Oracle database cannot be on the same server as the application server.
- Encounter Form Editor, Formulary Editor.
- Dragon speech recognition software must be installed on the same server as the Centricity application. The hotkeys do not work if the two applications are installed on different servers.

Processor

Choose the fastest processor within your budget that is not less than the recommended value. CPU selection is based on the number of concurrent users. The following recommendations are based on user loads with Centricity EMR and CCCQE forms installed.

Application	Processor	RAM
RDS/XenApp	Dual Xeon 5550	16 GB

Optimizing server memory usage

Take the following steps to optimize how RDS utilizes server memory:

1. Go to **Start > Settings** and select **Control Panel > Network and Dialup Connections.**
2. Double-click any enabled network connection, then click **Properties**.
3. Select **File and Printer Sharing for Microsoft Networks** and click **Properties**.
4. On the **Server Optimization** tab, select **Maximize data throughput for network applications.**
5. Click **OK** and then exit the **Control Panel.**

Page size	Configure the page file on all of the XenApp servers that have more than 3 GB of physical RAM equal to the amount of physical RAM. The page file minimum and maximum size should be set the same to avoid page file fragmentation.
Disk space	8 GB for Microsoft Windows Server (RDS and/or XenApp) 2x 146 GB SAS HDD (or larger) in a RAID 1 configuration + 600 MB for Centricity EMR + page file size (2x physical RAM)

This assumes the EMR application and the page file reside on the same disk drive as the Citrix server OS.

Network	Gigabit (1000Base-T) preferred.
Network Protocols	Connection to Database server: ■ TCP/IP. Thin client terminal: ■ ICA over TCP/IP: Refer to Citrix documentation or consult a Citrix Gold Reseller. ■ RDP over TCP/IP: Refer to Microsoft documentation.
UPS	Minimum 15 minutes emergency full load backup power from uninterruptible power supply (UPS). To avoid possible data corruption during power interruptions, connect the server and concentrators to a UPS (uninterruptible power supply) with at least 15 minutes of full load backup power. Set the UPS to shut down the server automatically after a specified period. During an extended power outage, this gives users time to log out before the server goes down.
Monitor	Color SVGA Display (1024x768 minimum resolution - Small Fonts), High Color (16 bit, 65536 colors) or greater
Internet connection	High-speed connection recommended for accessing Web-based Problem and Medication reference and downloading product updates and documentation.
Media drive	16x-speed DVD or faster is required on the server to install the server operating system.
Backup tape drive and backup software	For detailed backup and recovery strategies, see “Perform backups and recover data” in *Preparing and Maintaining Centricity Electronic Medical Record Systems* available on the Centricity Services Web site at http://centricitypractice.gehealthcare.com/.
Other	AC power, network, keyboard, and display extension cables may be required for optimal workstation placement. Power surge protector to protect your equipment against voltage variations.

Remote Desktop/Citrix server software

RDS/XenApp servers are deployed to serve multiple (*thin*) clients to terminals or workstations.

Operating system

For **Remote Desktop Services**:

Microsoft Windows Server 2008 R2, Standard, Enterprise, and Datacenter Editions

!!! MetaFrame XP, Presentation Server 3 and 4 are not supported. Presentation Server 3 reached End Of Life (EOL) December 31, 2007. Presentation Server 4 reached End Of Maintenance June 30, 2009. For details, contact your Citrix reseller.

For **XenApp**:

Microsoft Windows Server 2008 R2 Standard Edition with XenApp 6.0 (64-bit)

Connection load balancing is only available in Citrix; it is not available in Windows RDS running RDP. Connection load balancing is handled outside RDS through a combination of hardware and software. Contact your Microsoft representative for details.

Clients

Citrix Online Client v11.2 or higher, configured for 1024x768 High Color (16 bit, 65536 colors) or greater display resolution.

Microsoft RDP client: v6.1 or higher.

Web browser

Microsoft Internet Explorer (IE) 8.0 (32-bit only) with 128-bit encryption and latest security patches or higher is required for proper operation. If you are running a 64-bit operating system, the 32-bit version of IE is located in **Program Files (x86)\Internet Explorer\iexplore.exe**

Browser/mobile access

EMR is available as a web application running on a device with internet access. Browser/mobile access enables secure, remote access to patient charts. It does not allow access to the full functionality of Centricity EMR.

Web browsers

- Internet Explorer version 8 or 7.x
- Mozilla Firefox 3.x
- Safari 3.x

Mobile devices

Mobile devices should have a touch screen, 64 MB of RAM, and a minimum resolution of 240x320. Supported devices are:

- Apple iPhone™ , Safari Mobile Edition
- Apple iPod touch™ , Safari Mobile Edition

Due to the limited memory of mobile devices, Safari may hang while downloading a large document. Press and hold the Home button for 10 seconds to Force Quit Safari. Restart Safari to continue.

Non-GE software and hardware

GE highly recommends a separate server for applications other than Centricity EMR, such as electronic mail, workgroup applications, and unrelated file and print services.

!!! For best results, do not use the dedicated EMR database server for non-GE software activity.

Microsoft Word 2007

Microsoft Word 2007 is incompatible with Centricity EMR. Text from Word 2007 cannot be pasted in EMR text fields that include RTF controls (chart update, text components, templates, history views) or in imported transcription documents. Previous versions of Word do not have this incompatibility. To copy text from Word 2007, paste the selection into WordPad, then copy and paste to the EMR RTF field.

Modem

Optional DSL/cable or other high-speed fax/modem.

Modems may be needed for remote access by providers and other users not directly connected to the server.

Printers

Windows server-based required. Additional printers will be required depending on the size an requirements of the clinic or enterprise. Printer locations should support workflow plans.

While a small amount of print server activity can occur on the dedicated database server, consider a separate server for print services. See Workstation hardware on page 19.

Midrange laser printers recommended. GE has tested Centricity Electronic Medical Record on midrange laser printers from HP. Some low-end printers do not have a large enough printable area. For additional information, contact Centricity Services.

Printable area limits

EMR application printing functions are supported on any printer capable of handling a printable area of 8 inches by 10.6 inches on letter-sized paper.

Crystal® Reports area limits

The Crystal Reports driver used in the EMR application supports page margins of 0.17 inches top, 0.25 inches left / right sides, and 0.23 inches bottom for letter paper size by default.

Remote access

Depending on your organization's implementation, some users may need to access the dedicated the EMR database from home. Affiliated clinics at remote locations may need to access their database hosted at your data center. Remote access solutions should ensure maximum performance of the EMR application.

Recommended:

- Windows Server 2008 Standard/Enterprise/Datacenter Edition 64-bit with Remote Desktop Services, with or without XenApp

This solution provides good performance over narrow bandwidth connections. Consult your GE representative or Centricity Services about this solution.

Important features and system settings

The following features and system settings impact memory requirements and system performance.

- Enabling Auditing features
- Storing images in the database
- Configure RDS users
- Usage notes for RDS
- Critical system settings

Enabling Auditing features

Enabling all available auditing features significantly increases EMR database storage and growth requirements, possibly by a factor of 2 or greater. Consult Centricity Services when enabling auditing features.

To learn more about setting up auditing features and their impact on your database, in EMR application Online Help, see **Setting up EMR > Setting up Security.**

Storing images in the database

You can add image attachments to a chart document and store them in the database, including still images from a digital camera or video camera or scanned documents.

Disk space requirements for images vary considerably. Use *Calculating Hardware Requirements for Centricity Electronic Medical Record* to calculate memory and disk space requirements. The spreadsheet is available in the same folder as this document. On the Documentation CD, the path is *./guides/calculating_hardware_requirements.xls*

Configure RDS users

When setting up users on RDS, configure how users connect to and disconnect from RDS sessions:

- For **On a Broken or Timed-Out Connection**, choose **Disconnect**, which is the default.

This ensures that a broken or timed-out session will not be lost. Security may be maintained by limiting knowledge of the Winstation password, which is needed in order to reconnect. You may want to consider setting a time-out limit that eventually logs the user off.

- For **Reconnect Sessions Disconnected**, choose **From Previous WinStation Only**.

This forces the next login of a specific WinstationName (RDS User ID) to connect to the previously disconnected session.

- For other attributes, use defaults or set time-outs as desired for security purposes. Consider setting an idle user time-out.

Usage notes for RDS

When using Centricity Electronic Medical Record,

- **For security reasons, always exit EMR before disconnecting a session.**

You can reconnect, then restart Centricity Electronic Medical Record during the same session with the original EMR workstation description, WSID, and L3ID maintained.

- **Disconnect sessions rather than logging off.**

This maintains the session and the EMR workstation description, WSID, and L3ID.

!!! Remember that disconnecting leaves a RDS license and an EMR license in use. Infrequent users of Centricity Electronic Medical Record, such as administrative staff, may want to log off to free the license.

Critical system settings

The following settings are set automatically when you install/upgrade the application. Do not change these settings without contacting Support.

Oracle 11g R2 initialization parameters

Oracle 11g R2 initialization parameters are set to the following:

***.cursor_sharing='FORCE'**

***.optimizer_mode=FIRST_ROWS**

***.session_cached_cursors=50**

Oracle Redo log sizing

Oracle redo logs are set to reduce redo log switching and archive log file creation. At installation, the *resize_redo_logs* is set based on your current EMR licenses:

Number of users	Redo log size per file
100	100 MB
200	200 MB
400	400 MB
800	600 MB
1200	800 MB
1600	1000 MB
2000	1250 MB
2500	1500 MB
3000	1750 MB
3500 +	2000 MB

!!! 2000 MB is the maximum allowable file size.

Manually adjusting the Oracle Server *sga_target* parameter

After an initial install or a server memory upgrade, you may need to increase your current *sga_target* value. *Sga_target* determines how much memory is allocated to the Oracle process. This affects database and application performance.

View the current *sga_target* setting

1 Log on to your Oracle server.

2 Run the following SQL command from SQLPLUS or another SQL tool:

```
select value/(1024*1024) from v$parameter where
name=sga_target
```

For *value* enter the current size in bytes.

Determine server RAM on Windows

1 Open a command window and run **systeminfo**.

2 Look for the value of **Total Physical Memory**.

Change the *sga_target*

Use the following guidelines to determine whether you should increase your *sga_target*:

- **Server RAM less than 2 GB:** do not increase the *sga_target* value.
- **Server RAM greater than 2 GB:** if your current *sga_target* value is less than 1000 M, run the following SQL statements to change the *sga_target* parameter:

  Alter System set sga_target='2000M' scope=spfile;

  Alter System set sga_max_size='2000M' scope=spfile;

You must restart Oracle for these parameters to take effect.

Adjust HPUX file system cache

To prevent file buffer cache from consuming half of available RAM on HPUX systems, adjust the default file system cache as follows:

Set dbc_max_pct => to <=50
Set dbc_min_pct => to <=5

Documentation survey

Help us improve our customer documentation. All responses are confidential. A brief documentation survey is available at:

http://supportcentral.ge.com/esurvey/takesurvey.asp?p=17778&d=2243072