High Availability of VistA EHR in Cloud

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Abstract

Inspite of the accelerating migration to cloud computing in the Healthcare Industry, high availability and uptime concerns rank as one of the top challenges for Healthcare Organizations looking to adopt cloud services, states the 2014 HIMSS Analytics Cloud Survey report.

This white paper focuses on achieving High Availability for VistA EHR in Cloud. The importance of cloud for healthcare IT and potential down-time scenarios due to hardware failure and software failure is highlighted in addition to cloud monitoring solutions that assures High Availability of VistA applications in cloud. VistA EHR is the most popular Open Source EHR that has been deployed in over 2,300 healthcare facilities across the U.S. and around the world.
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Executive Summary

Designing fault tolerant applications that will run on legacy infrastructure is a familiar process, given that there are proven best practices to ensure High Availability.

However, cloud-based architectures are quite different making it vital for hospitals to upgrade its technology for better security, interoperability, performance and most importantly to safeguard against unplanned downtime.

ViSolve’s managed cloud services focuses on Regulatory Compliance, Availability Auto-Scaling, High Availability considerations, Cloud Bursting, Continuity Backup, Failover, Disaster Recovery and Security. Also Includes Monitoring, Orchestration and Automation, Auditing, Access Management, Incident Management, Optimization and Continuous Improvement for a high value delivering cloud ecosystem.

The following sections define the business challenges and potential solutions to deal with down time that can occur because of two main reasons - Hardware failure and Software failure, and architectures that support these techniques.

Business Challenges

Maintaining the data locally, increases the possibility of disk data loss and theft which is a security breach as per the HIPAA standards.

The current infrastructure that is designed to handle limited or specific number of users may not support the performance of applications when the staff or users of a hospital increase in size.

Hardware failure can occur any time. Multiple hardware failure like CPU failure, memory failure, and disk corruption requires hardware to be replaced and infrastructure to be upgraded after a specific period of time so that the performance and service standards are not compromised.

Most importantly physicians need to have access to the EHR application round the clock to be able to take timely decisions and provide enhanced patient care. Hospitals needs to maintain sophisticated infrastructure to provide high-availability of the application as required by potential users.

Addressing all the above mentioned concerns, also increases cost for a hospital.

VistA and FIS GT.M™

VistA EHR is the most popular open source EHR System for hospitals. It has already been deployed in 1,300 VA sites of care that serves nearly 9 million Veterans as part of the largest healthcare system in the United States. In addition to its deployment by VA, VistA serves more than 1,800 hospitals and other healthcare providers around the world.
VistA is developed using M or MUMPS database and programming. Mumps database can easily emulate all 4 NoSQL database types key/value, tabular, document and graph and supports great balance between in-memory versus on disk. Its performance competes with many modern no-sql databases. Open Source MUMPS database engine FIS GT.M™, is a high performance key-value database engine optimized for transaction processing and it is widely used in HealthCare and Banking sectors.

Why Cloud?

Technology Infrastructure
Cloud provides options in assisting with hardware, from the pool of computing, network and storage as service. Cloud services are very flexible enabling a standard and virtual operating environment through which a consumer can access the services without any human interaction. Cloud vendors provide the appropriate control panel to manage the cloud resource based on the user on-demand.

Cloud provides a rapid and elastic resource scaling as per consumer needs, and with some cases it is automated. Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer who utilize the service. Cloud systems supports metering capability to control and optimize resource use at some level of abstraction appropriate to the type of service.

Cloud based support also reduces the impact related to hardware failures such as CPU failure, Memory failure, Network outage, Disk corruption, etc., and failure of those hardware will not affect the end users as the cloud service provider takes care of the failure that has happened, without any interference to the client’s accessibility. Most of the cloud service providers tend to offer solutions to recover the user’s data when the whole data center goes down due to natural disaster or down-time scenarios.

Reduce Capital Cost
Migrating your infrastructure to cloud reduces the following expenses:

- Acquiring a new hardware or upgrading it for running the new or updated software
- Internal IT Team
- Resources required in making the system highly available

Improve Accessibility
Hospital staff and clinicians are always in need of access to patient data from anywhere, anytime which is possible with Cloud based solutions. Further monitoring and managing the applications is also possible through cloud and internet.

Software Update
Access to automatic software updates can also be included as a part of Software as a Service package. Depending on your cloud computing service provider, the system will be updated regularly with the latest technology ensuring up-to-date versions of software, as well as upgradation of the computer’s processing power.
GT.M replication

Replication provides equivalence between multiple databases. Some of the benefits of replication are continuous availability, real-time decision support, warehousing, analytics, and auditing. There are two types of replication available in GT.M they are:

1. Business Continuity
2. Supplementary Instance

Business Continuity (BC)
When the master instance receives an update, it will replicate the data to the slaves which can again propagate the changes to its slaves. An originating server can replicate data to 16 slaves and each of those slaves can propagate the data to further 16 instances. This is intended mainly for mission-critical applications that must be available 24*7 and 365 days.

Supplementary Instance (SI)
SI replication is similar to business continuity but the only difference is that the slaves can also receive updates locally (as a master) which will also be replicated to its slaves again. SI replication allows a slave instance to act as originating instance and also its own local database. For example, in the given below diagram, Slave A and B1 receives updates from production instance. Slave B1 will also act as originating instance which will have its own slave B2. SI replication is intended for general purpose mechanism whose utility includes applications as real-time decision support, analytic and auditing.
Why not GT.M replication for VistA’s High Availability?

Though GT.M provides different kinds of options for data availability, those methods are not going to be used for High Availability (HA) solution because of the following reasons.

a. Storage - Replication will create duplicate data across the system for the business continuity. The reason for replication is to have access to data even when the hardware failure (storage disk failure) happens. On using a solution based on Cloud, hardware failures will be taken care by Cloud service vendor.

b. Cost - Cost for the solution will increase in two areas. Cost incurred for extra storage required for replication as well as extra server required to run the replication process.

c. No Active-Active – As explained above, in order to use the replication, it is required to have the secondary server that will run the processes needed for the replication and this server has to be always up and running to get the data replicated with time. As GT.M doesn’t provide Active-Active replication, the secondary server will be used very minimally (only when the primary server is down).

d. VistA Architecture - As GT.M doesn’t support Active-Active replication, another option to use secondary server effectively is to have read requests handled by the slaves whereas writes requests will always be processed to single server. Since OSEHRA VistA architecture doesn’t provide option to separate the read and write requests, it is not possible to use the secondary server effectively other than data replication.

VistA HA Architecture in Cloud

High availability can be calculated based on total availability of the system (total time - down time) against the total time. Downtime can happen mainly because of two reasons – Hardware failure and Software failure. It is already discussed that the hardware failure will be taken care of by the Cloud service provider.

Software failures can be classified as unavailability of the software service or some means of operating system failure. In such situations, cloud service providers can’t assist much as they do not have greater support to control software failures. Please refer the architecture diagram given below that discusses about the HA of VistA EHR in Cloud.

High availability can be achieved with the help of the monitoring service.

Monitoring service will be implemented using Zabbix and Heartbeat. Monitoring service is always kept active towards the current production server to monitor the availability of instance. The responsibility of monitoring service is not only to monitor the availability of the primary instance but also to make corrective action such as bringing up the secondary server.
Solution 1 – Dedicated Secondary Server
In this solution, there is a secondary server which has all the required components pre-installed and ready. On a continuous basis, the monitoring service will verify the availability of the primary instance. Whenever primary server or service is not reachable by the monitoring service, it is assumed that the primary server or service is down. As the secondary server is already up and running, the monitoring server just starts the service with secondary server and the IP / DNS will be updated as per the secondary server.

Pros:
- Improves application reliability. Application failures doesn’t impact operations much as secondary node will be available instantly when primary goes down since the secondary server is always on the run

Cons:
- It is very expensive in having the secondary server just as a standby
- Increased overhead on updating application changes where it should be updated in both the servers

Solution 2 – On Demand (Preconfigured VM)
In this solution, there is no dedicated server as explained in the first solution. But there is a preconfigured VM which is similarly to the secondary server mentioned above but will not be running. Here whenever primary server or service is not reachable by the monitoring service, it will again assume that the primary
server or service is down. In this failure case, monitor service will initiate the process to start the VM which start the entire required server with the appropriate configuration.

Pros:

- Standby machines do not cost much with cloud environment
- Easy to implement
- Bringing up the preconfigured secondary server will take only seconds to be available for operations reducing the time

Cons:

- Increased overhead on updating applications where it should be updated in both the servers

Solution 3 – On Demand (Snapshot)

In this solution, there is no preconfigured VM. Instead there will be a snapshot of the primary server and as soon as the monitoring service identifies the unavailability of the primary service, it will start a process to create a new VM itself. Since the snapshot is from the primary server, all the required components are readily available.

Pros:

- Overhead on updating applications is less because only the primary server snapshot will be used
- Set up in cloud is simple to implement
- No hassle in maintaining the additional server on cloud for high availability

Cons:

- Very slow to create an instance from the snapshot

Conclusion

High Availability of EHR Applications can be affected due to hardware and software failures. By moving the infrastructure to the Cloud it is assured that the cloud service will be responsible for hardware availability. In terms of software availability for VistA EHR, there are three different scenarios of VistA in Cloud with HA; each has its own advantages and disadvantages. Based on specific requirements of potential customer, appropriate solutions can be implemented.
About ViSolve

ViSolve is a leading provider of customized solutions and services based on Open Source and Leading Edge Technology for Healthcare Organizations and Enterprises.

Who we are?

- Established in 1995. Headquartered in San Jose, California (SF Bay Area)
- Software development / Support centers in USA / India with expertise in Cloud Services and Healthcare Domain led by PMP® certified managers

What we do?

- Cloud (VMWare, AWS, HP), DB (MongoDB / Hadoop), Migration, Enterprise Security, Performance, Deployment, Support and monitoring of customer environment with a focus on leading edge technologies
- Product development, build, QA and support of applications and kernel modules on VMware, HP-UX, Linux platforms
- 15+ years of experience in Open Source Solutions - Customization, Development and Support; leading contributor to the open source communities including Hadoop, Openstack, OpenEMR, OSEHRA, Mongo DB, MySQL etc.

Why ViSolve?

- More than 15 years of strategic relationship with Enterprise Customers including Leading System Vendors, Financial Institutions, Healthcare Organizations /Vendors
- Experience in successfully migrating over 160 healthcare customer environments to cloud with a focus on High Availability, Security, Disaster recovery, Performance and scalability
- As an extension of your R&D IT team - We Deliver Results of High Quality, On Time and Within Budget
- Expert Onsite Team & Low cost Offshore Team based in India that works in customer’s preferred Time zone
- No ‘one-size-fits-all’ solution provider. Customization - Key Differentiator
- Key Advocate and Contributors of Open Source Communities including Customized Open Source Solutions with leading edge technology
- Access to a wide Pool of talented Engineers highly skilled in Leading Edge Technologies and extensive knowledge in Healthcare Domain
- We know our Customers, Partners and Technology inside-out, with clear perspectives on what is most fitting to solve our customer’s challenges
- Avoid Vendor Lock in with Flexible Contractual Models. Competitive SLAs and Response Times, reduces internal cost and complexity, decreases Time to Market

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