Healthcare activities from anywhere anytime

Health Information Exchange and Secure Collaboration among users through OHMS™

1.0 Overview:

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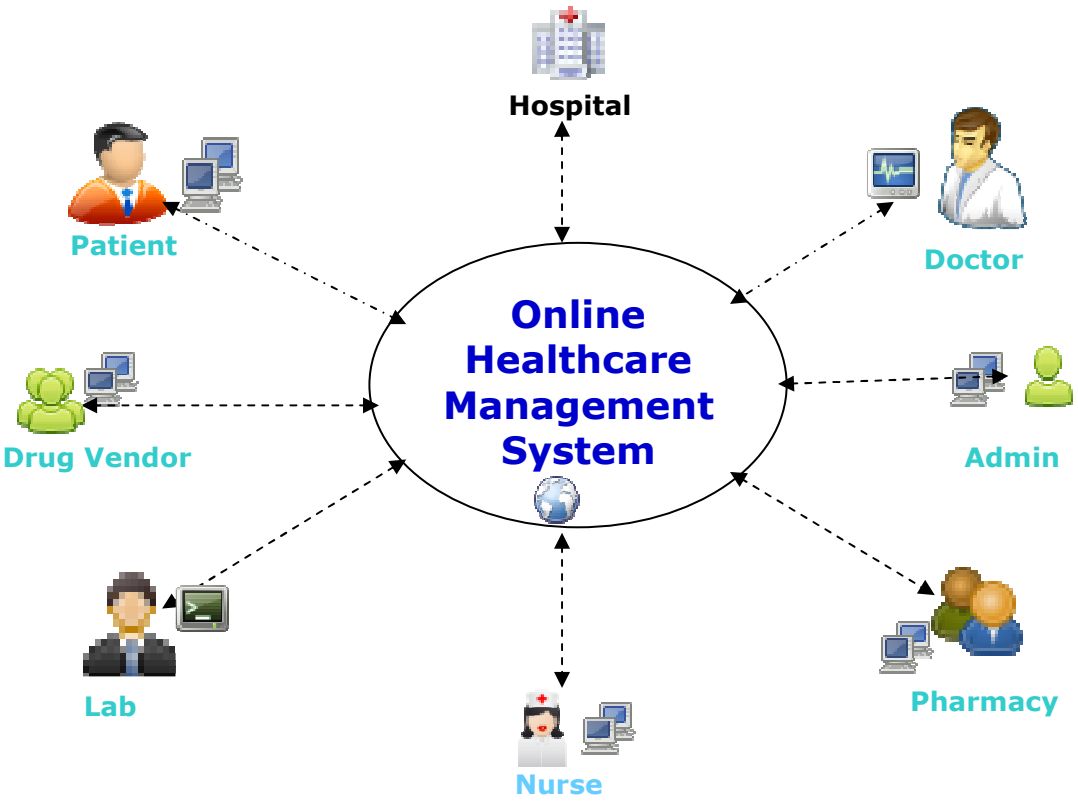
OHMS™ is software as a service (SaaS) platform that enables the multiple users to login from anywhere and any device and execute healthcare activities in secure way. The vast majority of SaaS solutions are based on a multi-tenant architecture.With this model, a single version of the application, with a single configuration is used for all customers ("tenants"). To support scalability, the application is installed on multiple machines called horizontal scaling.

Users or Actors who are part of this system are Physician, Patients, Clinical Labs, Radiologist, Pharmacy, Drug Vendor, Patient Care (Nurse), Hospitals Admin etc
The following figure shows how each and every user is connected to the system and collaborates with each other.



User needs to register first to OHMS™ system and set username and credential. The system in turn generates unique ID called UHID which classifies user records by associating with it. In this system, users like physician, patients, or clinic initiate healthcare activities like creating event, schedule and electronic medical record. As this system is hosted in cloud, user's workspace consisting of records is within the boundary protected by cloud security. The medical records are kept in this protected region under the ownership of given user. The system provides user identity (authentication) based security and role based access control. The system provides features based on certain roles. Every Role has certain permissions on the record objects which are configurable by system administrator. For every record, there is an associated role corresponding to given record id and owner id with given permission set.

User can perform collaborative activities like sharing, referring, updating, deleting, notifying, tracking on Electronic Medical Records (EMR).

1.1 Actors & Users

a) **Physician**
b) **Patient**
c) **Radiologist**
d) **Clinical Labs**
e) **Pharmacy**
f) **Drug Vendor**

g) **Patient Care(Nurse)**
h) **Administrators**

2.0 Information Exchange & Collaboration Workflow:

Collaboration could be between physician and patient, physician and clinical labs or pharmacy, physician and nurse etc. Each and every actor works on EMR at their stake. For example, patient can view the complaint, diagnosis or medications record created by owning physician. Similarly, clinical labs can view patient diagnosis record when diagnostic tests mentioned as part of diagnosis record, are requested to that lab. Patient clinical tests and radiological diagnostic image are uploaded so that referring physician and concerned patient can view that and delete whenever done. Physician also notifies the pharmacy by the patient medications record so that pharmacy can collaborate both with physician and concerned patient for the drug availability or its inventory purpose.

The following workflow is the most fundamental multi actor's workflow OHMS system supports.

2.1 Basic Workflow:

- Users register into the system
- Respective users log into system with username and credential
- Patient search doctor into the system over internet.
- Patient creates appointment with the required doctor.
- Doctor logs into system and confirms/cancels appointment
- Patient gets notified about this.
- Doctor keeps patient record (complaint to treatment) into the system.
- Doctor sends diagnostic test request to Clinical Labs.
- Clinical Lab logs into the system and checks test request.
- Clinical Lab schedules appointment with patient for sample collection and clinical tests.
- Clinical Lab uploads test results.
- Radiologist uploads image and updates his/her diagnosis (Radiology Information) to the referring doctor.
- Doctor sends prescription to pharmacy.
- Patient collects medicine from the pharmacy.
- Drug vendor publishes drugs to doctors.

2.2 Physician outpatient practice workflow:

- Physician checks patient appointment and start diagnosing.
- For walk in patient, Physician registers the patient and generates patient UHID

- Physician adds new complaint record or adds complaint to existing complaint record. There will be single complaint record for a given physician and patient
- Physician adds diagnosis record. There can be multiple diagnosis records for a given complaint record
- Physician adds medication and treatment record. There can be multiple medications and treatment (or surgical) records for a given complaint record.
- Physician may add detailed system examination record after system wide clinical and diagnostic tests are complete
- Physician generates the online prescription report and take a print out.
- Physician may add details organ specific record after diagnostic tests are complete
- Physician notifies diagnosis record to clinical lab for test
- Physician may notify registered pharmacy about the patient prescription so that patient can collect the prescribed medicines

2.3 Inpatient management workflow:

- Physician creates complaint record
- From the complaint record, physician creates the admission record (inpatient record) meant for registered patient care (nurse).
- Nurse logs into system and acknowledges the admission record by providing bed and ward to the patient and updates the same inpatient record.
- Physician prescribes and suggests the emergency medications, treatment etc in the admission record so that patient treatment starts.
- Nurse creates the inpatient activity records as per the suggestions provided by physician. The nurse updates regular status of patient given certain medications and treatment.
- Physician creates the inpatient diagnosis and medication record just like outpatient and shares the same with the concerned nurse.
- Nurse acknowledge the same and provides the above diagnosis, clinical tests, and treatment and creates the new activity items in the same activity record.
- Every activity and associated costs are recorded in the inpatient billing record.
- Based on the patient status, referring physician creates the discharge status record for the patient where nurse updates his/her comments.
- The patient gets discharge after paying the bill to hospital from insurance and billing provider.

2.4 Patient remote diagnosis workflow:

- Patient finds the physician from system and creates appointment for remote diagnosis.
- Physician confirms the appointment and patient gets notification about this
- Patient creates remote diagnosis complaint record and updates his/her complaints and other history.

- Patient attaches laboratory test reports and other radiological diagnostic report.
- Physician asks for consultancy charges and patient pays for it.
- Physician may add some diagnostic query in the same diagnosis complaint record and patient updates that in the same.
- Physician creates remote diagnosis and prescription and may suggest further tests
- Patient updates with new test report and other findings
- Patient follows up with physician

2.5 Physician Appointment workflow:

- Registered Patient logs into OHMS.
- Patient searches into the system the physician with given city or name or specialty.
- Patient creates appointment with the above physician by providing the date and time appointment
- Physician or physician assistant logs in to OHMS and checks the appointment calendar and updates the appointment with modified date or time.
- Patient gets to know the updated schedule of appointment.

2.6 Clinical Lab tests workflow

- Physician adds diagnosis record for a given complaint.
- Physician adds lab test and diagnostic imaging test to be done by clinical labs or radiologist
- Physician or Patient selects the registered clinical lab or radiologist in the same city and notifies about the diagnosis tests
- Clinical labs or radiologist logs into OHMS and checks the clinical test requests.
- Labs or Radiologist views the diagnosis record and adds pathology record or radiology image respectively after conducting the tests with patients.
- Clinical Test request status is automatically changed to “uploaded” and alert is sent to referring physician.
- Physician tracks the request in case of emergency and checks the test report as soon as the tracked request shows status of “uploaded”

2.7 Hospital Provider to Insurance Payer workflow

- The Patient is registered into OHMS and complaint details and other demographic details are entered into EMR.
- Physician refers patient to hospital in-patient care by making admission record with medications and procedures if required.
- In-patient care allocates bed for the patient and updates the in-patient record.

- The patient goes through treatment and procedures.
- In-patient care (Hospital provider) adds the patient insurance details to OHMS
- Provider sends patient insurance details to payer for pre-authorization or for verification of other insurance details
- Provider keeps recording the patient billing details against each activity and procedure in the OHMS as activity and billing records.
- After the patient is discharged (discharge record is generated by physician), the provider generates the patient insurance claim from given discharge records.
- The claim is automatically generated inside OHMS and associated payer is also sent the access of this claim records. Internally claim is linked to patient demographic record, billing record, discharge record, and other procedure record.
- The Payer logged into OHMS and verified the patient insurance details by providing patient payable amount, co-pay amount if any.
- The payer verifies patient demographics, each billing entries for each CPT entry against the patient's insurance details in payer's in-house database and finally confirms and rejects them.
- Provider can then resubmit the whole claim after payer's comments on certain billing entry if it finds different justification.
- Payer can then verify again the resubmitted claim from provider.
- Finally the claim is settled or rejected
- Provider initiates the payment that is claimable and patient can pay the rest to provider to get final discharge report

3.0 Healthcare Information Exchange Specification:

There are several categories of records which are exchanged between different users.

1. **Appointment**: This record is mostly created by patient or physician assistant and is exchanged between patients and physician. This record satisfies the requirement of consultation with physician on a given date and time.
2. **Discussion Message**: this record is again exchanged between physician and patient. This is needed for either of users to interact asynchronously with others for follow ups and other queries and clarifications
3. **Calendar Events:** This record is solely used by physician for managing any particular schedule.
4. **Patient Record:** This record has several sub-categories of records mainly exchanged among physician, patient, clinical labs, radiologist, pharmacy, nurse etc. All sub-categories of records have some fixed attributes and dynamic attributes if chosen by each record owner. As all the users log

into same system, there is no issue of record compatibility. When records are exchanged, both sender and receiver of the records understand this data protocol without having any issues.

a) **Complaint:** It contains patient details and basic complaints. For a given physician and patient, there is only one complaint record. Complaints for multiple visits of same patient are updated in the same complaint record instead of creating multiple complaint records.
b) **Diagnosis:** It contains details like diagnosis, investigation, physical examination, laboratory and diagnostic tests, detailed system examination and organ specific details. There can be multiple diagnosis records for a given complaint record of a given patient during the course of patient diagnosis.
c) **Medication:** It contains patient medicines and prescription details. Like diagnosis, there can be multiple medications record for a given patient complaint record.
d) **Treatment:** It contains details like any therapy and other non-drug related activities.
e) **Surgical:** In case of surgery or operation, this record contains necessary details.
f) **In-Patient Record:** It contains the patient hospitalization details like bed, ward, admission diagnosis, emergency treatment. Before inpatient record is created for hospitalization, patient complaint record is created. There is a one-to-one association of inpatient record with patient complaint record.
g) **In-Patient Activity & Billing:** It contains the in-patient activity details maintained by patient care and activity wise billing details. There is single patient activity record for each inpatient record. During the course of patient diagnosis, multiple patient activities and status feedback are put in the same activity record. There is similar one-to-one association of patient activity record wit patient billing record.
h) **Patient Examination:** It consists of system wide examination and analysis records. These records are associated with patient diagnosis record as mentioned above. These system wide records formats are customizable as per physician's own choice.
    1. **Abdomen:** Detailed examination about Abdomen system
    2. **Cardiac:** Detailed examination about Cardiac system
    3. **GI:** Detailed examination about Gastrointestinal system
    4. **General:** Detailed examination about General system
    5. **Haemato:** Detailed examination about Haematology system
    6. **MSK:** Detailed examination about Muskulo Skeletal system
    7. **Nephro:** Detailed examination about Nephrology system
    8. **CNS:** Detailed examination about Central Nervous system

9. **Resp:** Detailed examination about Respiratory system
10. **Vascular:** Detailed examination about Vascular system
11. **Genito:** Detailed examination about Genitourinary system

i. **Patient Special Organ:** It consists of special organ or specialty records. These records are associated with patient diagnosis record as mentioned above. These organ and specialty records formats are customizable per physician's choice.

1. **Bone:** Detailed examination about Bone.
2. **Breast:** Detailed examination about Breast.
3. **Connective Tissue:** Detailed examination about Connective Tissue
4. **Critical Care:** Detailed examination about Critical Care
5. **Dental:** Detailed examination about Dental system
6. **Endocrine:** Detailed examination about Endocrine
7. **ENT:** Detailed examination about ENT
8. **Eye:** Detailed examination about Eye
9. **Genetic:** Detailed examination about Genetic System
10. **Head & Neck:** Detailed examination about Head and Neck
11. **Immunology Allergic:** Detailed examination about Allergy and Immune System
12. **Liver Billiary Tract:** Detailed examination about Liver Billiary Tract System
13. **Obstetrics & Gyne:** Detailed examination about Gynecology
14. **Oncology:** Detailed examination about Oncology
15. **Pancreas:** Detailed examination about Pancreas system
16. **Pediatrics:** Detailed examination about Pediatrics specialty
17. **Nerve Skeletal Muscle:** Detailed examination about Peripheral Nerve Skeletal Muscle system.
18. **Psychology:** Detailed examination about patient psychological system
19. **Pulmonary:** Detailed examination about pulmonary system.
20. **Skin:** Detailed examination about skin
21. **Diet:** Detailed examination about patient diet and nutrition system

j. Clinic & Lab Record: Patient clinic & lab records are based mostly on pathological test data. The OHMS classifies all kinds of patient laboratory tests in certain system wide categories of test types. All these categories of test records have a skeleton of fixed tests parameters and other parameters which can be added as per clinics test parameters. The categories of tests records are mentioned as follows. Every record has common general record attributes like name, patient, doctor UHID, laboratory name, and specimen.

1. **CVCELT:** Cardio Vascular Cardiac Enzymes Lipid Category Test
2. **CVECT:** Cardio Vascular Electrolyte Coagulation Category Test
3. **CVPMT:** Cardio Vascular Pericardial Miscellaneous Test
4. **EAdrenal:** Endocrine Adrenal Category Test
5. **EPancreas:** Endocrine Pancreas Category Test
6. **EThyroid:** Endocrine Thyroid Category Test
7. **EPit:** Endocrine Pituitary Category Test
8. **FBUrine:** Female Blood Urine Category Test
9. **MBUrine:** Male Blood Urine Category Test
10. **HBCell:** Hematology Blood Cell Category Test
11. **HCIron:** Hematology Coagulation Iron Category Test
12. **HMisc:** Hematology Miscellaneous Test
13. **GIGAT:** Gastrointestinal Gastric Analysis Category Test
14. **GIIT:** Gastrointestinal Intestine Category Test
15. **GIOST:** Gastrointestinal Esophageal Stomach Category Test
16. **GIPFFT:** Gastrointestinal Peritoneal Fluid Faecal Category Test
17. **GISLT:** Gastrointestinal System Liver Category Test
18. **Immuno:** Immunology Diagnostic Category Test
19. **MSEMT:** Muskulo Skeletal Enzymes Metabolic Category Test
20. **MSJT:** Muskulo Skeletal Joint Category Test
21. **MSST:** Muskulo Skeletal Synovial Category Test
22. **NeuroBG:** Neurology Blood Gas Category Test
23. **NeuroCSF:** Neurology CSF Fluid Category Test
24. **NeuroMisc:** Neurology Miscellaneous Test
25. **PulmBSP:** Pulmonary Blood Sputam Category Test
26. **PulmMisc:** Pulmonary Miscellaneous Test
27. **RenalB:** Renal Blood Category Test
28. **Urine:** Urine Category Test
29. **Pregnancy:** Female Pregnancy Category Test
30. **Tumor:** Tumor Marker Category Test

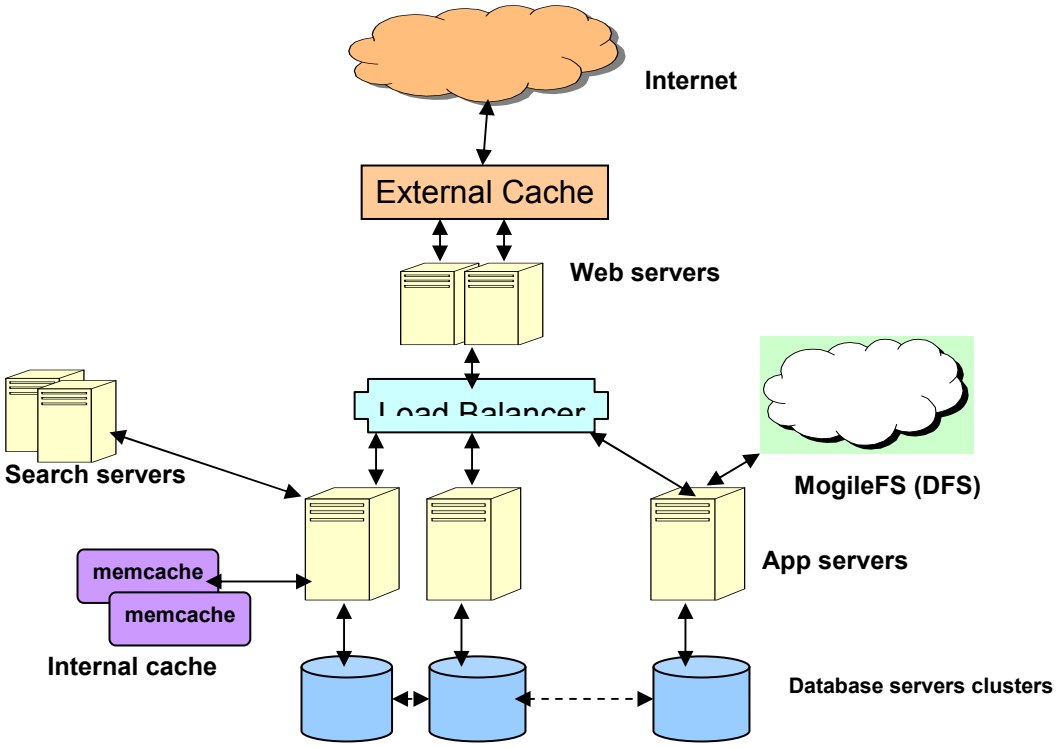
k. Electronic Content: This format is for storing and exchanging any types of electronic document with different attachment. The content could be of type Jpeg, PNG, Gif, PDF, or any other MS document. This record stores the content metadata and attachment in binary file format.

4.0 Security in collaboration:

Every user or actor has to login to the system to start accessing the OHMS over web from any where and any device. The user needs identity (username and credential) based authentication to get access to the system. As the software is hosted as service in private/public cloud, the system provides the time bound user session. After certain time of user remaining idle in session, the system forces user to login again so as to forbid un-authorized access by stealing the session cookie. Each record has owner and role associated with it. The system maintains certain categories of groups and corresponding roles based on the type of users associated with each group. For Example, Doctor Group has corresponding role which is owned by any doctor logging into system. Every role has certain permissions on each feature. The permissions are CRUD (Create, Read, Update and Delete) type. Different Role may have different permissions on each feature being used by each group. The permissions are set by OHMS administrator.

We provide OHMS application both in private cloud as individual license and public cloud where individual is given subscription based usage.
In case of private cloud, the application will be hosted in the customer premise and administration will be handled by them. For application hosted in public cloud, the user will use the application as and when needed based on their yearly subscription. In this case, application and data will be maintained by OHMS Healthcare Pvt. Ltd in a secure data center. The following figure depicts the OHMS SaaS infrastructure and it's capability to service the customer's need.

OHMS SaaS infrastructure: (Public Cloud)

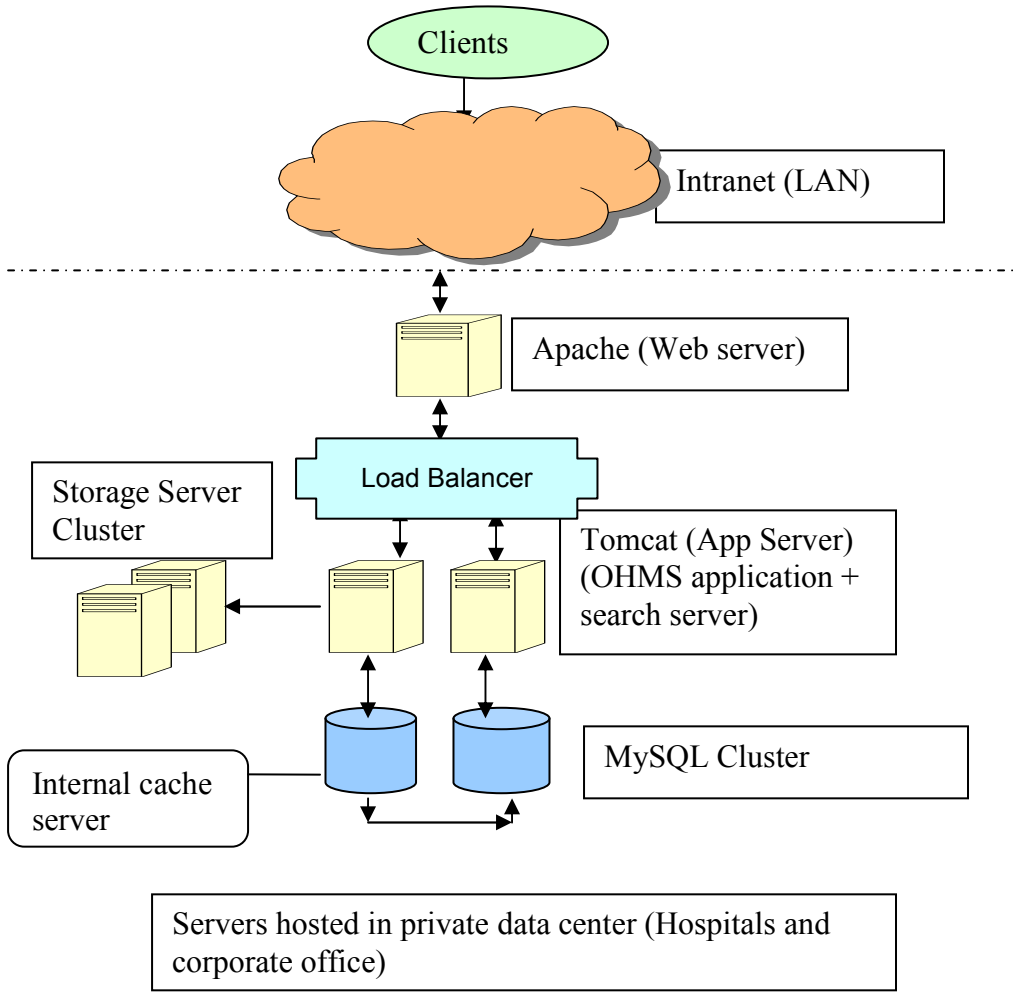


Data Centers:

The Web servers and App servers are running in Intel Xeon Quad core box with 16 GB RAM, 1TB SAS/SATA disk space. The OHMS application and search servers are running in the App server Box. Internal caches are distributed among these boxes where RAM size is very high.

The MySQL clusters are formed with several instance of Server running in box with similar configuration. The Storage servers are running in Intel Xeon Quad core box with several TB of SAS/SATA disk spaces. The data centers can be scaled up to 100 of such hardware boxes base on the demand of concurrent user who access the OHMS application over Wide Area Network (Internet).

OHMS Deployment: (Private Cloud)



Deployment Configuration:

The private cloud is hosted in the company premises as much scaled down version of public cloud data centers. As shown in the above figure, there are a couple of hardware boxes which are sufficient to cater the limited number of users who access the OHMS application over LAN (intranet). In this case, there is one instance of Apache web server that load balances the multiple client requests to a couple of app servers (preferably 2 instance of Tomcat for number of users in the range of 200 – 400). The App servers connect to DB clusters consisting of a couple of hardware box. The Storage servers and internal cache servers are used in separate boxes.

Doctor