

The National University of Lesotho

Department of Mathematics and Computer Science

Faculty of Science and technology



CS4430: Distributed Database Systems System Design

Student Number	Surname initials	Major
202000483	Nteka, M. E	B.Sc. Mathematics and Computer Science
202002857	Khalala M.C	B.Sc. Mathematics and Computer Science
202003231	Makhosane M .A	B.Eng. Computer Systems and Networks
202000020	Mahase K.D	B.Eng. Computer Systems and Networks
202002420	Bokang B.G	B.Eng. Computer Systems and Networks

Detailed Real-World Scenario System Architecture Diagram.

Ntsoekhe DDBMS is built on a distributed architecture model, enabling seamless interaction between multiple nodes distributed across different healthcare facilities.

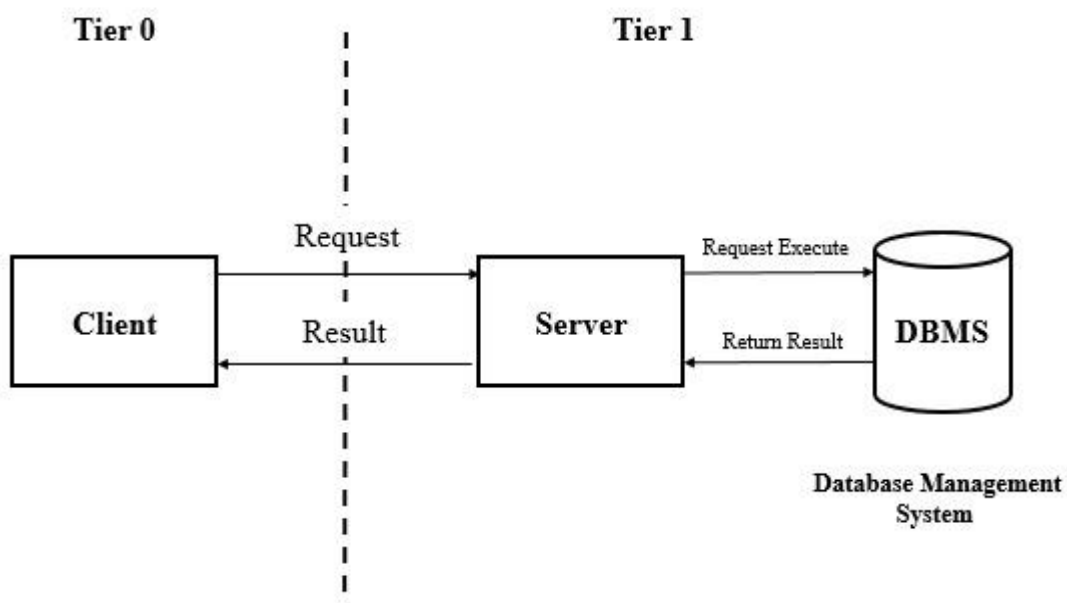
The system is divided into two levels, being the server tier and the client tier.

Server Tier:

- The server tier is responsible for critical functions like data management, query processing, optimization, and transaction management.
- It encompasses physical servers hosting the DDBMS software and managing the database across distributed nodes.

Client Tier:

- Clients interact with the system through user-friendly interfaces, facilitating tasks such as accessing medical records, updating patient information, and managing appointments.
- Clients play a crucial role in ensuring data consistency and partial transaction management.



Hardware Architecture:

The hardware architecture of Ntsoekhe DDBMS comprises both client and server layers, each optimized for their respective functionalities.

Client Layer:

- Clients include devices such as desktop computers, laptops, tablets, and smartphones utilized by healthcare professionals and administrative staff.
- Devices are equipped with modern hardware components, including fast processors, sufficient memory, and high-resolution displays.

Server Layer:

- Servers are deployed across healthcare facilities and are responsible for hosting the DDBMS software and managing the distributed database.
- Hardware requirements include robust server hardware capable of handling the demands of the DDBMS software, efficient power supplies, networking equipment (routers, switches, firewalls), and storage devices (SSDs, HDDs, NAS).

Networking Architecture:

Ntsoekhe DDBMS employs a sophisticated networking architecture to facilitate seamless and real time communication between distributed nodes and ensure data integrity and security.

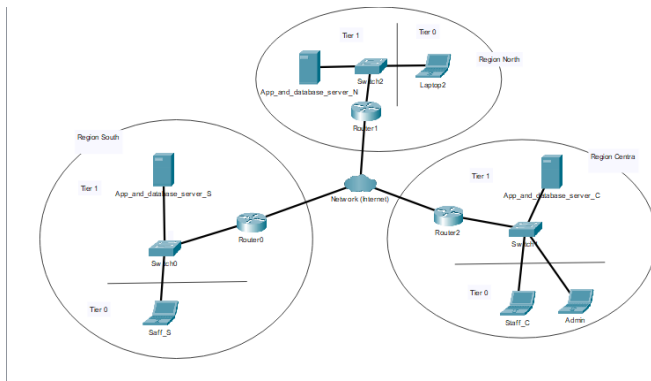
Local Site:

- A Local Area Network (LAN) connects servers and client devices within each healthcare facility, facilitating efficient data transfer and communication.

Remote Connectivity:

- A Wide Area Network (WAN) connects distributed nodes across different healthcare facilities, enabling secure communication and data exchange.
- WAN supports the distributed nature of the system, ensuring connectivity between nodes regardless of geographical location.

Conceptual Real world network Architecture:



All servers within a local area network host both the application and database.

Routers use Ospf for network discovery.

ACL config allows only communication by servers and only for database communication.

Software Architecture:

The software architecture of Ntsoekhe DDBMS comprises of various components tailored to meet the specific requirements of digital health applications.

Platform:

- The platform includes the operating system, web server, and database management system (DDBMS), providing the foundation for hosting different modules of the system.

Application:

- Web-based applications serve as the primary interface for users, offering functionalities such as patient management, electronic health records (EHR), appointment scheduling, and reporting.

Third-Party Integration:

- Integration of third-party software enhances the system's capabilities, enabling advanced features such as data visualization, analytics, and interoperability with external healthcare systems.

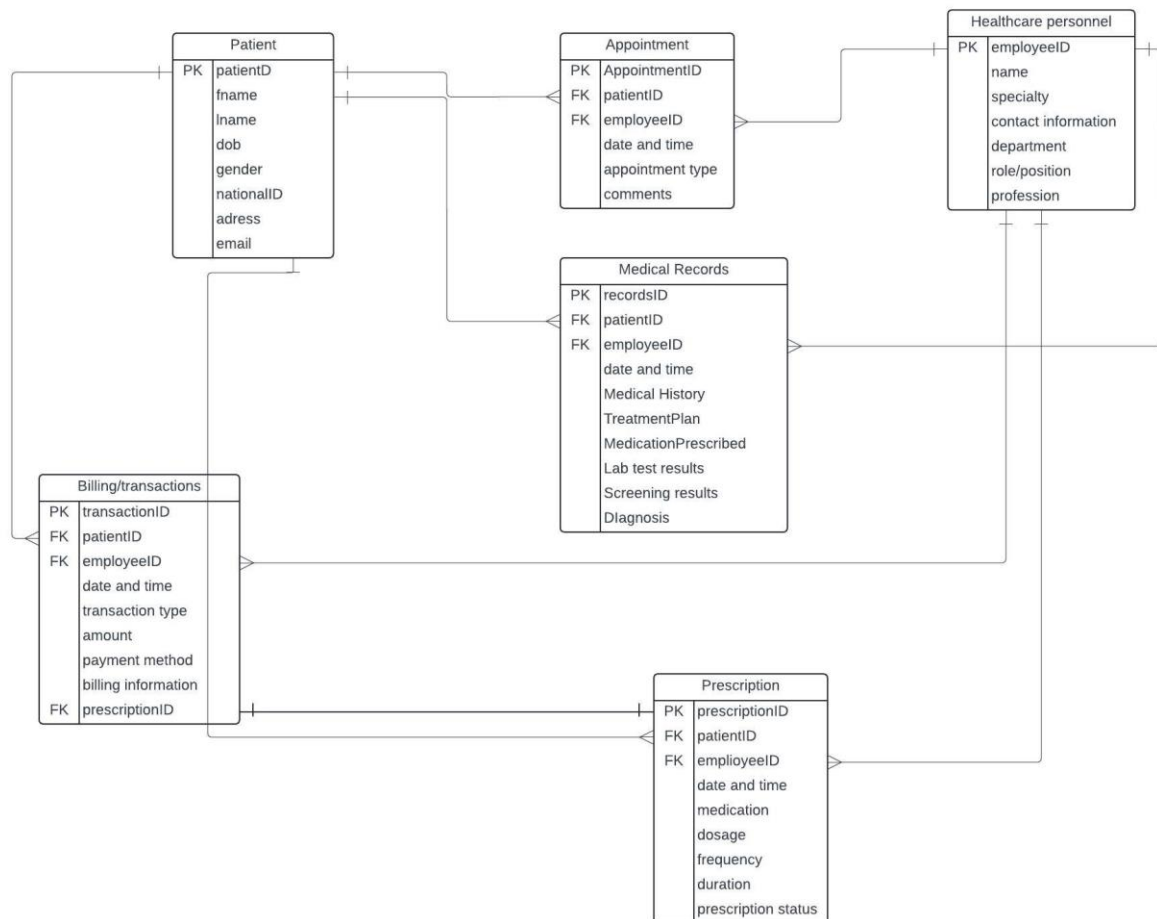
Rationale for Design Choices:

The design of Ntsoekhe DDBMS prioritizes scalability, security, and interoperability to meet the complex demands of digital health applications effectively.

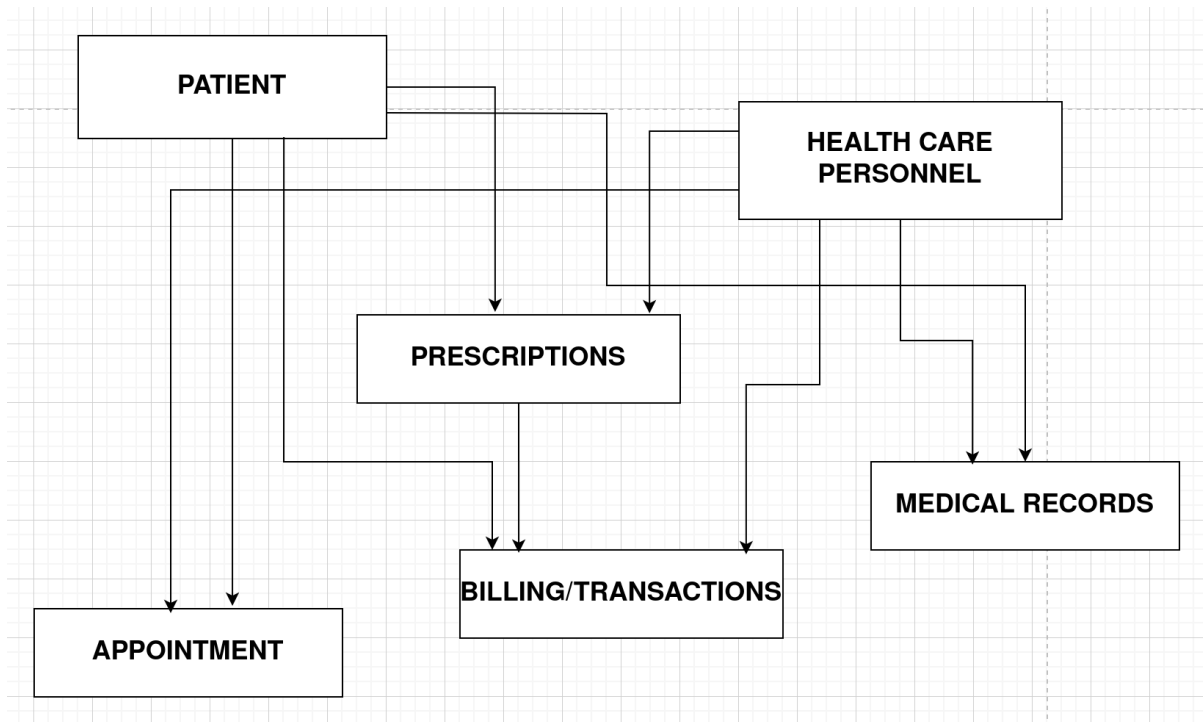
- Distributed architecture ensures scalability and fault tolerance, allowing the system to accommodate growing data volumes and handle network failures gracefully.
- Robust networking architecture ensures secure communication and data exchange between distributed nodes, safeguarding sensitive medical information.

- Integration of third-party software enhances the system's functionality, providing healthcare professionals with valuable insights and improving patient care outcomes.

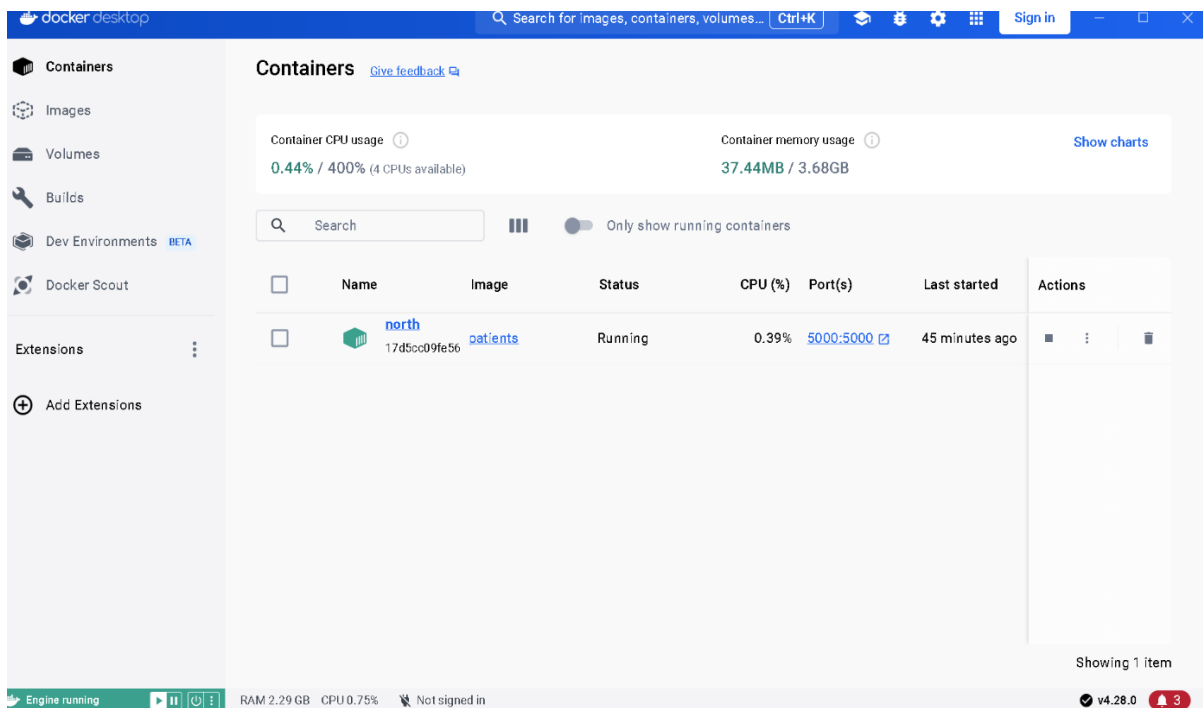
ER Diagram for GCS:



Join Graph for the above ERD



The system is organized by region, like if it's in the north, south, or east of Lesotho. The data is spread across three different nodes. Right now, we're just starting, so we only have one of these nodes set up, and it's containerized in Docker Desktop. This single node manages data tasks (like adding, reading, updating, and deleting data).



Conclusion:

Ntsoekhe DDBMS represents a sophisticated solution for digital health applications, leveraging distributed architecture, robust hardware infrastructure, and advanced software components to streamline healthcare operations and enhance patient care delivery. By prioritizing scalability, security, and interoperability, Ntsoekhe DDBMS is well-equipped to meet the evolving needs of modern healthcare environments.