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Design and Implementation of a Scalable Cloud-Based File Sharing System Using Amazon Elastic Compute (EC2) and Amazon Simple Storage (S3)

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ABSTRACT

The rapid growth of digital collaboration and remote work has created a demand for secure and scalable file-sharing systems. This research focuses on the design and implementation of a cloud-based file-sharing system utilizing Amazon Elastic Compute Cloud (EC2) and Amazon Simple Storage Service (S3). The system is architected to provide a user-friendly platform for efficient file sharing, prioritizing scalability, security, and reliability.

Amazon S3 is leveraged as the primary storage solution, offering robust, cost-effective, and scalable storage for user files. EC2 instances serve as the application layer, managing user authentication and facilitating secure access to files. To enhance data security, the system employs encryption and decryption mechanisms for Remote Desktop Protocol (RDP) passwords, ensuring secure access to the infrastructure.

This research outlines the system's architecture, focusing on its modular design that enables easy scalability to accommodate growing user demands. It also highlights the system's security measures, including encryption protocols and access control mechanisms, ensuring the confidentiality and integrity of shared files.

The results demonstrate the system's capability to efficiently handle large-scale file-sharing operations, offering a secure and scalable solution for modern cloud-based environments. This work contributes to the field of cloud computing by providing a practical framework for secure file sharing that can be adapted to various organizational needs.

Keywords: ***Cloud computing, file sharing, Amazon EC2, Amazon S3, scalable architecture, RDP encryption.***

1. Introduction

The rapid expansion of cloud computing in recent years has redefined how data is stored, shared, and managed. Cloud-based file sharing systems have become indispensable for both organizations and individuals by providing scalable, secure, and efficient data management solutions. As the digital transformation accelerates, the internet increasingly serves as a platform for virtual interaction, driving a shift toward large-scale distributed computing environments (Marinescu, 2021). Major technology companies such as Google and Amazon have engineered robust web-scale infrastructures capable of supporting vast data storage and high-performance computing demands. This infrastructure can be viewed as a form of a "virtual supercomputer," where centralized data and computation offer unprecedented capabilities—hallmarks of modern cloud computing.

Cloud computing is defined as a model for delivering on-demand computing services over the internet, enabling users to access a shared pool of configurable resources with minimal management effort or service provider interaction (ISO/IEC,

2020). Traditional file-sharing systems often face significant challenges related to scalability, security, and performance. As data volumes grow, these systems struggle with efficiency and reliability, leading to bottlenecks and increased risk of data breaches. In contrast, cloud-based systems—particularly those utilizing platforms such as Amazon Web Services (AWS) Elastic Compute Cloud (EC2)—overcome these limitations through distributed architectures, advanced encryption standards, and integrated performance optimization tools (Syed et al., 2021).

This study seeks to design and implement a robust, scalable cloud-based file-sharing system using AWS EC2, with a primary focus on optimizing performance, enhancing data security, and improving user accessibility. As cloud adoption increases across sectors, the need for efficient, secure, and adaptable file-sharing solutions becomes more pressing. Cloud-based approaches offer a viable alternative to traditional systems by supporting massive data handling capabilities while ensuring secure, real-time access to users across various platforms.

2. Aims of the Study

The study aims of this research is to Design a scalable file sharing system leveraging AWS EC2 to handle large volumes of data efficiently and also to evaluate its performance based on key metrics.

The primary objectives of this study are:

- To design a scalable file sharing system using AWS EC2.
- To implement the designed system and evaluate its performance.
- To ensure the security of the file sharing system.
- To enhance user accessibility and ease of use.

3. Significance of the Study

This study is significant as it addresses the critical need for scalable and secure file sharing solutions in the era of big data. By leveraging AWS EC2, the study provides a framework for developing robust file sharing systems that can handle large volumes of data efficiently. The findings of this study will benefit organizations looking to implement cloud-based file sharing solutions, offering insights into best practices and performance optimization.

4. LITERATURE REVIEW

The Cloud, which eliminates the need for consumers to purchase and install storage devices, processing power, or software in order to have internet access to these resources, is the event that fundamentally altered the connection between IT users and computer data. This principle integrates that the services our customers need will be available at an aberration of their wills; while instead of having them to own or operate the hardware, a shared infrastructure will be available whenever needed. Three primary models are available for cloud computing: SaaS, PaaS and IaaS stand for the three biggest layers of a SaaS platform referred to as SaaS, PaaS and IaaS respectively. Virtual various tools offer consumers the opportunity to dynamically adjust how many resources they use with enumerating the amount they pay only for what they actually consumed. Cloud computing let remote jobs perform at the highest levels, and by means of cost reduction, scalability, flexibility, or accessibility (overall). On the other hand, resource optimum; the number of data centres used will be reduced even if they are kept running for maintenance (Blacharski 2010, 14).

a. Cloud services

The cloud servers offer the people available from the online platforms where the customers can use the computing, memory, database and applications from the cloud without any physical infrastructure requirements. This transformation has marked

out a completely new trend in the methodology of IT services building leading to the creative use of the influence of globalization in the direction of X4 platforms (scalability, flexibility, affordability, and cooperation) sharing for architecting IT models of the new-generation courses. The technology sector is the realm where the main components, uses, downsides and future vision of cloud services are elaborated (Boutaba 2015, 5-6).

b. Cloud computing deployment models

The deployment modes for using and making available cloud computing products and services to other users are referred to as cloud computing deployment models. These models depict that who all are responsible for managing cloud infrastructure, the level of customization and security that it provides, and how it is managed are decided here. Usually, there are four primary models for deploying cloud computing:

c. Private cloud deployment model

Supposing that private cloud deployment model incorporates private cloud environments, the latter provides the organization more control, customization, and security due to the fact that resources and services are devoted to the organization's sole use. Following this model, it might be either a third party or a vendor hired to manage this concept; alternatively, it can be done on site at the company's data center. Upgraded environmental safety and accepted policies, integration and custom applications, and industry-specific resources encompass the main features. A cloud is a cloud, be it public or private. But a subset of users, such as healthcare kingdom, finance and government, have mandatory compliance rules and they have further need of private clouds. The firms may redirect the scenario of the private clouds to their form and its functions, thus tailors their needs according to the workload and applications.

d. **Community cloud deployment model**

The community cloud service is aimed to bridge common objectives of the enterprises based on the concept of sharing resource pooling and infrastructure. Hence, the industries follow common standards, guarantees on security, and compliance with regulations. The members of the community can join each other and exchange resources while not having close contact. Activeness, common health issues, and taking safety precautions among the residence are the main features.

e. Cloud providers

Locations as companies with a range of offerings regarding cloud computing that include the hardware and software resources are called cloud providers. As for the online services, they handle and monitor networking, hardware, software, and infrastructure mainly. They open multiple data centers in different locations and fill them up with networking gadgets, storage devices, and other servers. Different services and capabilities are offered by different kinds of cloud providers:

Public cloud providers: The service providers such as AWS (Amazon Web Services), Microsoft Azure, and GCP (Google Cloud Platform) along with IBM Cloud and OCI (Oracle Cloud Infrastructure) are the examples of the public cloud that collectively provide the internet based cloud computing services to a numerous number of users and businesses. They go beyond compute resources, storage solutions, databases, networking, AI, ML, and IoT technologies. Many other services are available.

Private cloud providers: The enterprise level can use network infrastructure, cloud platform, and computer hardware to create a company-shared and secured private cloud environment for storage, communications, and monitored access either from internal IT department or external third parties. Insights of the solution that is customized to meet the user need proves the case that the aforementioned, OpenStack based, VMware, Dell Technologies Cloud and Nutanix are examples of solutions that aim to meet specific needs and requirements of the organization.

Hybrid cloud providers: Hybrid cloud providers that offer an integrated public and private cloud services let the systems configuration and workload portability to become much more effortless with synchronization and connection of data and

a unified experience. They help companies in the transition to the hybrid cloud model by balancing their security, compliance, and performance needs. Some of these solutions include VMware Cloud Foundation, Google Anthos, Azure Arc, and AWS Outposts, to mention just a few.

Multi-cloud providers: Multi-cloud providers are businesses with scope to manage assets from various vendors all at once without even having a choice. This is by creating multi-cloud platforms using various cloud providers to solve the problem. Also, their cloud solutions offer security features; migration facilities for workload; and platforms for cloud management. Each the market players include CloudCheckr, RightScale and CloudHealth from VMware for example. They guarantee and increase the flexibility, efficiency and cost aspect under the instances of multi-cloud scenarios.

f. Challenges and risks of cloud computing

Cloud computing enables massive scalability which result in cost-effectiveness, flexibility, but the risk and security concerns still exist. Cyberattacks, cybercrime and data privacy are growing at the Internet of things. Sensitive data may be exposed by poor access controls on security settings, flatware service and resource corruption. On one hand, users should make sure that the data are safe, sensitive applications and access controls are contained. On the other hand, the cloud providers will be responsible for the security of the infrastructure.

In this regard, exact data protection laws, e.g., GDPR, HIPAA, and PCI DSS, should be implemented by those companies which process and store data in the cloud highways. As a result of data privacy, encryption, and legal obligations that have to be in place, this can be more complicated. Local rules must be understood because the positioning of data centers by cloud providers overseas creates important and international data architecture questions. The businesses tie-up with cloud can be disrupted in their normal operations and specific downtime and revenue which may result due to cloud errors might be witnessed. Thus, availability and reliability epitomize as critical factors in this context. Having them in place is necessary to decrease this risk level. On the other hand, shared resources in a public cloud will possibly be the cause of inaccurate performance such as latency and inerratic response.

However, businesses that heavily depend on just one cloud provider may be susceptible to additional lock-in problems. These events make it hard for these companies to move their workloads or to change their provider. Similarly, human error and software defects cost people and the infrastructure likewise can cause recovery. Effective cost control and the prevention of low-vision costs demands consistent use of cost management. It is mandatory that companies increase the sophistication level of the security persisted by their cloud services, perform frequent audits, put the data under public eye, set clear compliance rules, draw contingency plans, follow up on performance and economize the expenses, to address this issue. It is imperative that IT teams, security specialists, compliance officers, and cloud providers work together to tackle the constantly changing risks and challenges that come with cloud computing.

5. METHODOLOGY

a. Analysis of the Existing Systems

Before developing this cloud-based file-sharing system, several existing file-sharing systems were studied to identify their strengths and limitations. These existing systems include:

1. **Dropbox**: A popular file-sharing and storage platform that offers seamless synchronization across multiple devices. It leverages cloud infrastructure to allow users to store and access files from anywhere. However, it has limitations in terms of customization for businesses and the high costs associated with scaling beyond a certain limit.

2. **Google Drive**: Google Drive offers vast cloud storage integrated with Google's suite of productivity tools. While effective for individual users and small teams, it lacks fine-grained access controls for more complex collaboration scenarios in larger enterprises.

3. **WeTransfer**: A simple and user-friendly file-sharing service that allows users to send large files without creating an account. It offers limited security features, such as password protection, and is not ideal for long-term file storage.

4. **Microsoft OneDrive**: A robust solution integrated with Microsoft Office 365. OneDrive offers strong collaboration features but suffers from complexity in integration with non-Microsoft services and has high licensing costs for enterprise use.

Each of these systems has proven successful in their respective areas but shares common limitations:

i. **Scalability limitations**: Many systems impose file size or storage limitations.

ii. **Cost concerns**: As storage needs grow, subscription costs can become prohibitively expensive.

iii. **Customization constraints**: These platforms often provide limited flexibility in tailoring the system to unique organizational needs.

iv. **Security**: Many lack advanced security controls for data protection in high-sensitivity environments.

The system in this project seeks to overcome these limitations by leveraging **Amazon EC2** to provide an efficient, scalable, and cost-effective file-sharing platform with better control over security and customization.

b. Proposed Methodology

The proposed methodology for the design and implementation of a scalable cloud-based file-sharing system using **Amazon EC2** follows a structured approach based on the **System Development Life Cycle (SDLC)**, combined with **cloud computing principles** and **agile development techniques**. The focus is on scalability, security, cost-efficiency, and user experience. The following key phases constitute the proposed methodology:

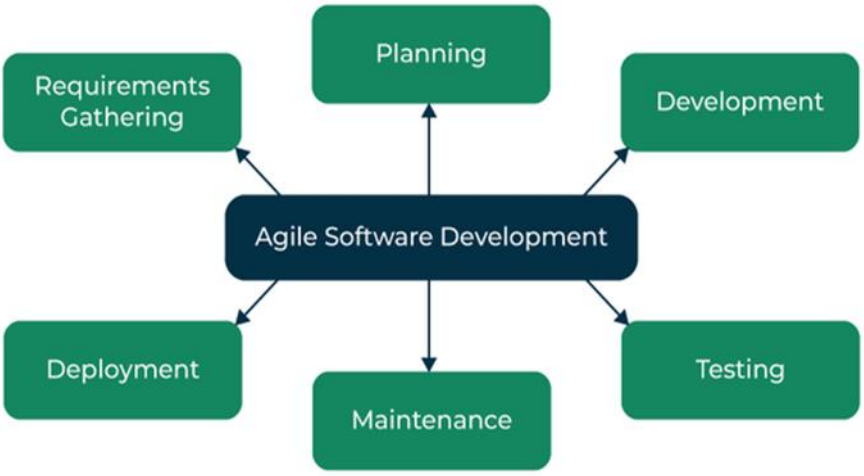

Fig 1: Proposed Organogram Chat of the System

c. Requirement Analysis

The first phase involves gathering and analyzing system requirements. This phase is crucial to ensure that the system is designed to meet the needs of its users while leveraging the full capabilities of Amazon EC2 for scalability and flexibility.

- **User Needs Assessment**: Surveys, interviews, and questionnaires are used to understand users' needs for file sharing, including file size, security, and collaboration requirements. Different user personas (e.g., individual users, small businesses, enterprises) are taken into consideration.

- **Functional and Non-Functional Requirements**: Based on the assessment, both functional (e.g., file upload, download, sharing, version control) and non-functional requirements (e.g., scalability, security, performance, usability) are identified and documented.

d. System Architecture Design

The architecture of the cloud-based file-sharing system revolves around **Amazon EC2** as the core infrastructure provider. The system architecture is designed to be scalable, secure, and user-friendly. components of the architecture include:

1. **Amazon EC2 Instances**: EC2 is used to host the file-sharing server, manage user requests, and handle computational tasks. It provides the scalability needed for growing file-sharing demands by adjusting compute capacity based on user traffic.

2. **Amazon S3**: Simple Storage Service (S3) is used to store files uploaded by users. S3 is chosen for its cost-efficiency, durability, and ability to handle large volumes of data.

3. **Elastic Load Balancer (ELB)**: To distribute traffic evenly among EC2 instances and ensure the system remains responsive under heavy load, ELB is employed. This ensures high availability and resilience.

4. **Amazon RDS**: Relational Database Service (RDS) is used to manage metadata such as user accounts, file details, permissions, and file versioning.

5. **User Authentication & Access Control**: **OAuth 2.0** is used for secure authentication, with fine-grained access control to ensure that users have appropriate permissions for file access and sharing.

6. **Data Encryption**: Files are encrypted both in transit (using SSL/TLS) and at rest using Amazon KMS (Key Management Service), providing robust security.

e. System Design

This chapter depicts the systems design and unified modeling language (UML). Several UML diagrams were adopted over the course of the development process such as Data Flow Diagram.

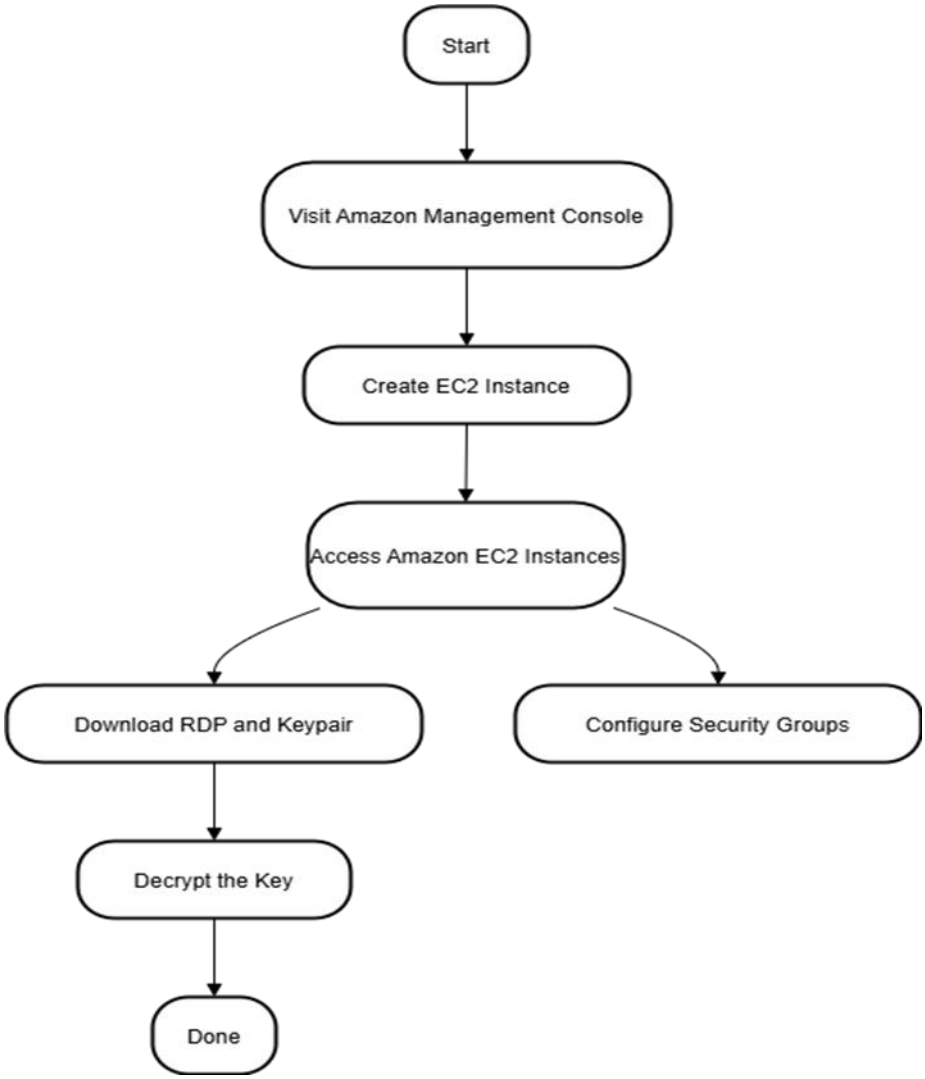

Fig 2 Design model of the system

6. RESULT AND DISCUSSION

a. System Requirements

Functional Requirements

i. User Authentication: The system must authenticate users to ensure secure access.

ii. File Upload and Storage: Users should be able to upload files, which are stored securely in S3.

iii. File Sharing: Users must be able to share files via secure links or permissions.

iv. File Retrieval: Users should retrieve stored files quickly and efficiently.

v. Scalability: The system should handle varying loads without performance degradation.

vi. Access Logging: Maintain logs for file uploads, downloads, and sharing activities for auditing.

Non-Functional Requirements

i. Scalability: The system must scale dynamically with user demand.

ii. Security: Ensure data integrity, confidentiality, and secure access.

iii. Availability: Ensure uptime with minimal downtime.

iv. Performance: Ensure fast file uploads and retrieval.

v. Cost Efficiency: Optimize AWS resource utilization to minimize operational costs.

b. System Implementation

Login AWS

To log in, enter your registered email address and case-sensitive password in the respective fields, ensuring accuracy. Click the login button to authenticate securely. If you forget your password, use the *Forgot Password* link to reset it via email. For security, all credentials are encrypted, and HTTPS protects communication.

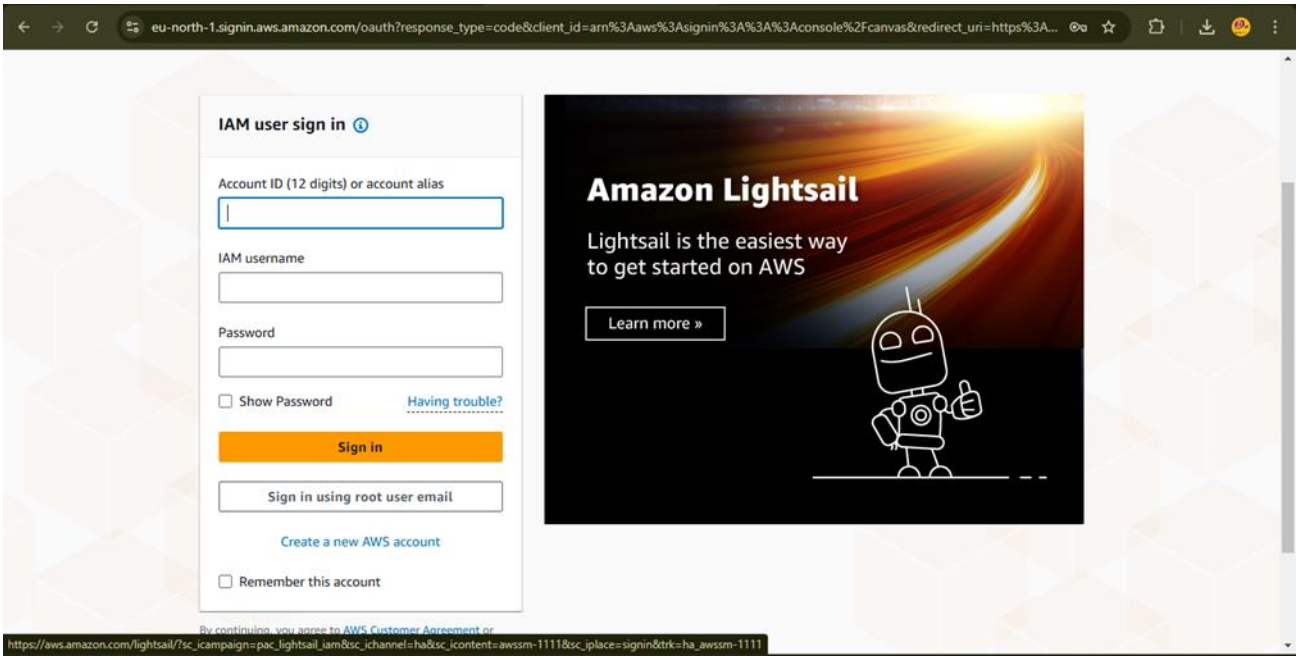

Fig.3 login page

Console Home

The dashboard provides centralized access for efficient management of your cloud infrastructure.

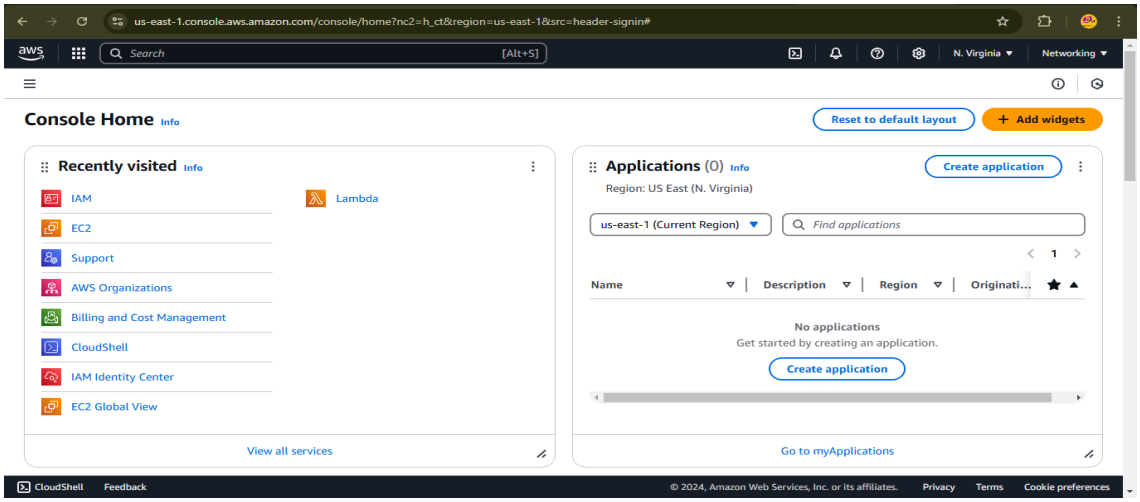

Fig. 4 Dashboard page

Open the EC2

To manage your virtual servers, click on EC2 from the Console Home or search for it in the navigation bar. In the EC2 dashboard, locate the Instances section to view all running and stopped instances, along with details like instance type, status, and public IP addresses. To manage security credentials, go to the Key Pairs section under the Network & Security tab, where you can create, view, or download key pairs used for securely accessing your EC2 instances. The dashboard simplifies the process of managing instances and security configurations.

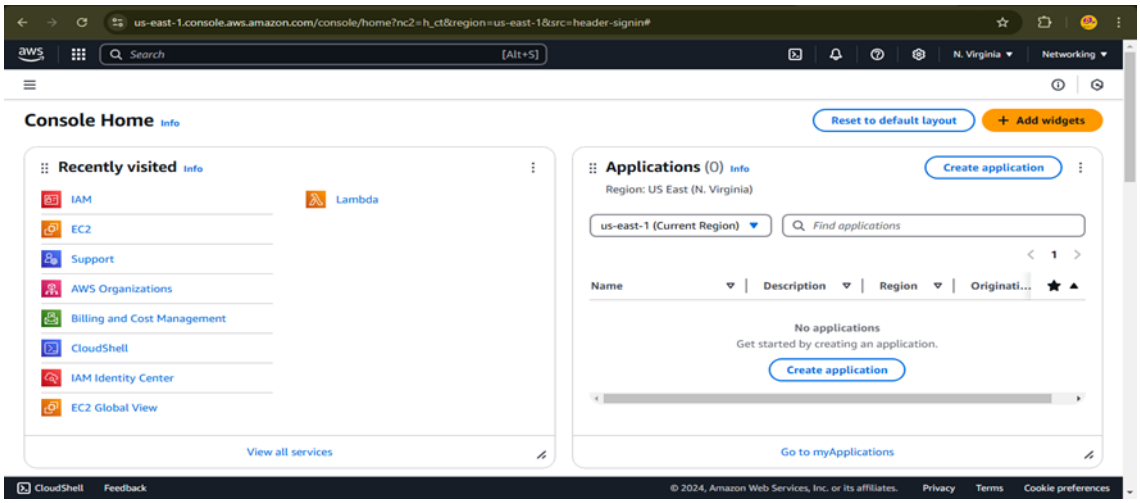

Fig. 4.3 Instance Section EC2

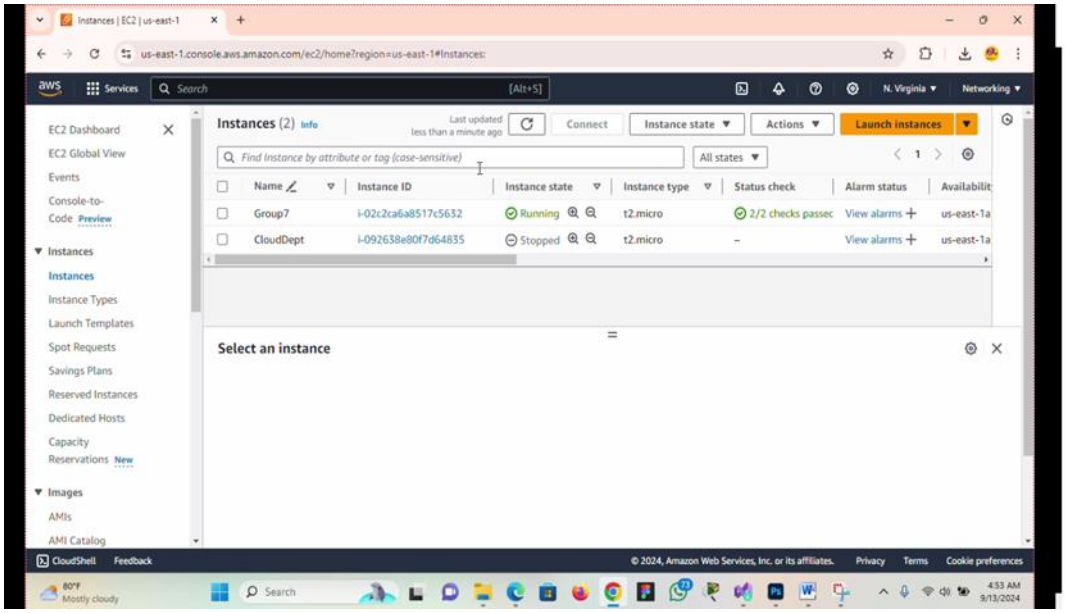

Fig 5: Launch Instance Page

Download the RDP and Key-pair

After locating the **Instances** in the EC2 dashboard, select an instance and start it. Wait patiently for the instance to fully initialize before proceeding. Once it's ready, click on **Connect** to download the RDP (Remote Desktop Protocol) file. After downloading the RDP file, upload the previously downloaded Key Pair to decrypt the file and establish a secure connection to the instance.

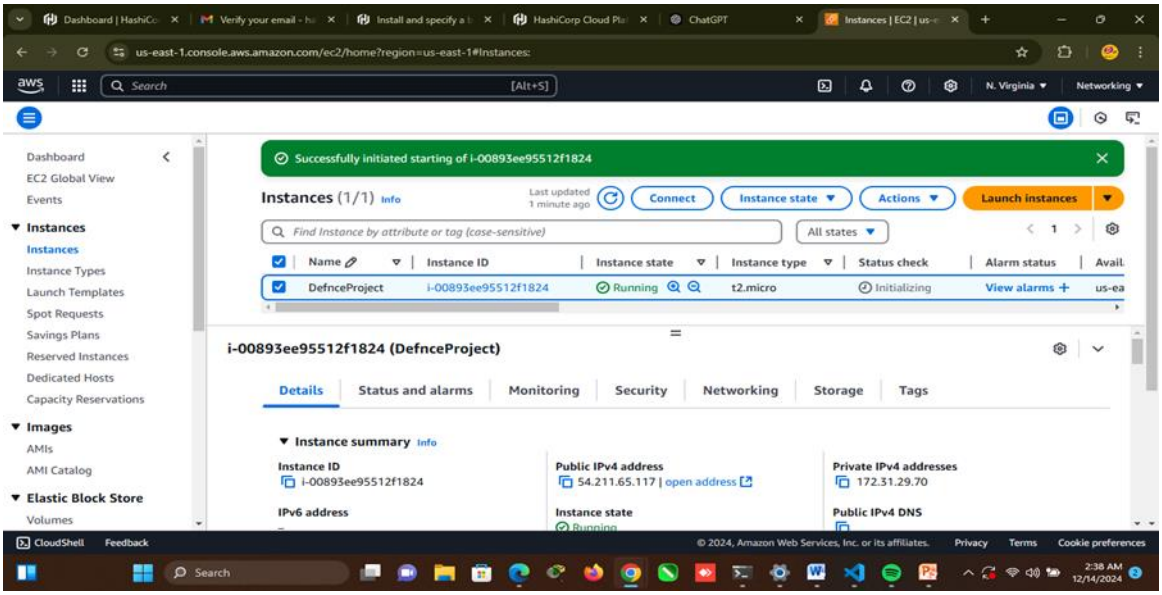

Fig. 6 Instance Running Section

Download RDP

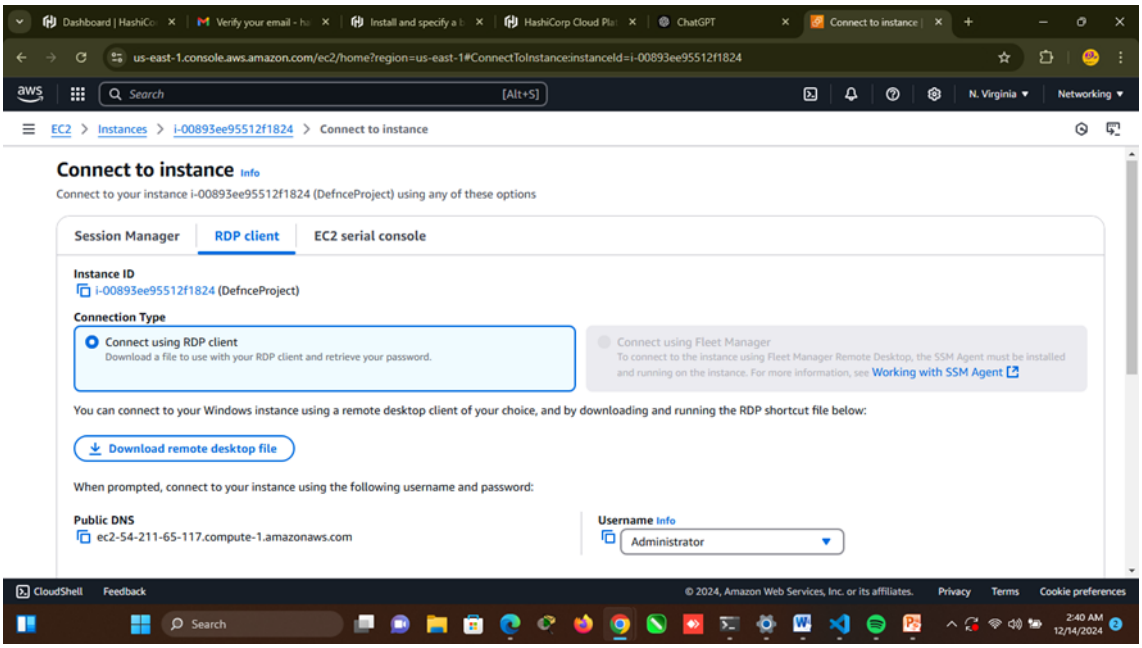

Fig. 7Connect RDP Instance Section

Get Windows Password

Upload the key-pair you download earlier and decrypt it

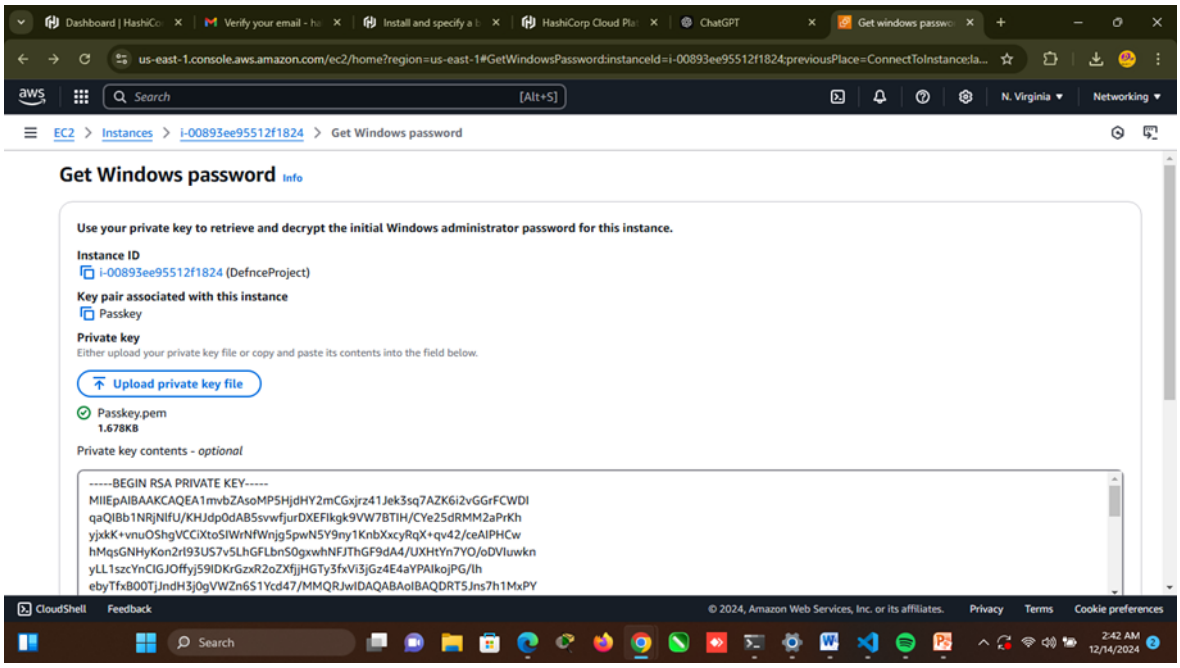

Fig. 8. Decrypting Section

Connecting the RDP

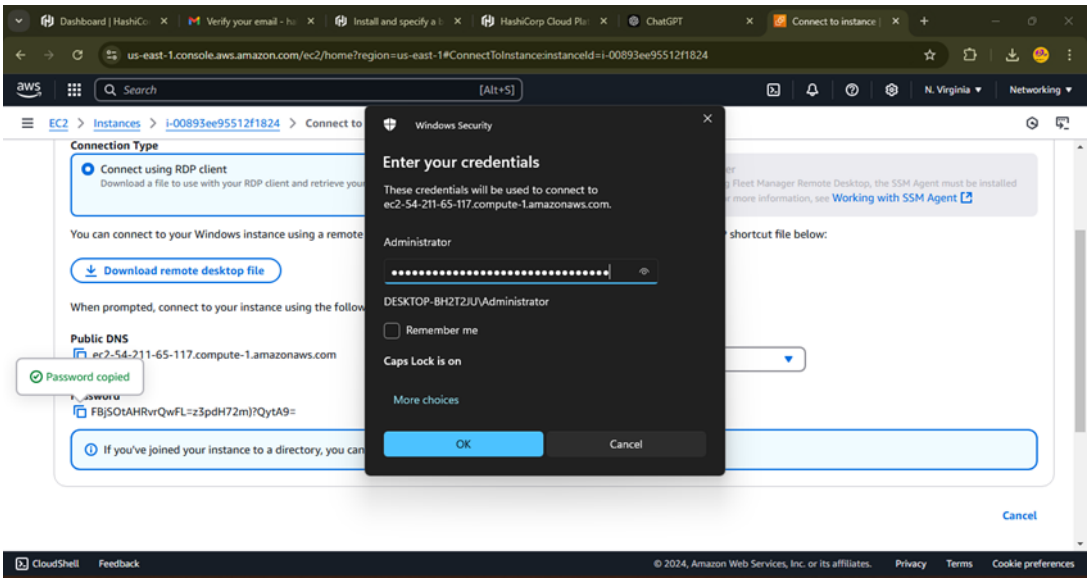

Fig.9. Password

The RDP will be connected and the password decrypted earlier will be input into the password section because the Admin user has been created on the cloud already.

Fig. 10. Instances Environment

Remote Desktop Publish Environment

In the RDP environment, files can be saved and seamlessly shared between the virtual environment and your physical system. Once the file is saved in the RDP session, you can close the connection. The file will automatically be stored in the cloud, ensuring it remains accessible for future use. This allows for secure and efficient file management, with the flexibility to retrieve the saved files anytime from the cloud storage.

7. CONCLUSION

This research focused on the design and implementation of a scalable cloud-based file-sharing system leveraging Amazon Elastic Compute Cloud (EC2) and Amazon Simple Storage Service (S3). The system was built to provide users with a secure, efficient, and accessible platform for uploading, sharing, and retrieving files. Key features include user authentication, file encryption, dynamic scalability, and secure sharing via pre-signed URLs. The system architecture utilized a multi-tier design with EC2 for processing, S3 for storage, and additional AWS services for monitoring and load balancing. Successful testing confirmed the system's reliability, scalability, and cost-efficiency, making it a viable solution for modern cloud-based file management needs.

The implementation of this cloud-based file-sharing system demonstrates the capabilities of AWS services in delivering a robust, scalable, and secure solution for file management. By integrating EC2, S3, and other AWS resources, the system achieves high performance and adaptability to varying user demands. The use of advanced security features, including encryption and access controls, ensures data confidentiality and integrity. This solution effectively meets the requirements of a reliable cloud infrastructure, providing a user-friendly and cost-efficient platform for individuals and organizations to manage their files.

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