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EBS Volume Backup Automation using AWS Lambda, Event Bridge, and SNS

Eshwar Nidadavolu
Student, CBIT University, Hyderabad, Telangana
enidadavolu@gmail.com

Abstract: *With the growing reliance on cloud computing, ensuring data security, availability, and reliable backup mechanisms has become essential. Amazon Elastic Block Store (EBS) volumes store critical data for EC2 instances, making them vulnerable to risks such as accidental deletion, system failures, or cyber threats if not properly backed up. This project presents an automated solution for EBS volume backup using AWS Lambda, Amazon EventBridge, and Amazon Simple Notification Service (SNS).*

The system automatically identifies in-use EBS volumes across AWS regions and creates snapshots at scheduled intervals using EventBridge triggers. A Python-based Lambda function, integrated with the AWS SDK (Boto3), performs the snapshot operations efficiently. Additionally, SNS is used to send real-time email notifications, ensuring visibility and monitoring of the backup process.

This serverless approach eliminates manual effort, reduces human errors, and ensures consistent backup execution. Overall, the solution enhances data protection, improves disaster recovery readiness, and demonstrates the effectiveness of automation in managing cloud infrastructure..

Keywords: AWS, Amazon EC2, Elastic Block Store (EBS), Snapshot Automation, AWS Lambda, Amazon EventBridge, Amazon SNS, Cloud Computing, Serverless Architecture, Data Backup, Disaster Recovery, Automation

I. INTRODUCTION

The rapid growth of cloud computing has transformed the way organizations store, manage, and process data. Cloud platforms such as Amazon Web Services (AWS) provide scalable and reliable infrastructure that supports a wide range of applications. Among these services, Amazon Elastic Compute Cloud (EC2) and Elastic Block Store (EBS) play a crucial role in hosting and storing application data. EBS volumes are widely used as persistent storage devices attached to EC2 instances, making them essential for maintaining system performance and data integrity.

However, as the reliance on cloud-based storage increases, so does the need for effective data protection strategies. Data stored in EBS volumes is susceptible to various risks, including accidental deletion, system failures, hardware issues, and potential cyber threats. In the absence of a proper backup mechanism, such incidents can lead to significant data loss and operational disruptions. Traditionally, backup processes are performed manually, which is time-consuming, inconsistent, and prone to human error.

To address these challenges, automation has become a key requirement in modern cloud environments. AWS provides serverless services such as AWS Lambda, Amazon EventBridge, and Amazon Simple Notification Service (SNS), which can be integrated to automate repetitive tasks efficiently. By leveraging these services, it is possible to build a robust and scalable system that performs regular backups without manual intervention.

This project focuses on designing and implementing an automated solution for EBS volume backups. The system uses AWS Lambda to create snapshots of in-use volumes, EventBridge to schedule and trigger the backup process, and SNS to send real-time notifications to users. This approach ensures consistent backup execution, reduces operational overhead, and enhances disaster recovery capabilities. Overall, the project demonstrates how serverless architecture can be effectively utilized to improve data reliability and streamline cloud infrastructure management.

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PROBLEM DEFINATION

As a cloud computing continues to expand, organizations increasingly rely on Amazon EC2 instances and EBS volumes to store critical application and business data. However, many systems still depend on manual or inconsistent backup processes, which introduces significant risks. Manual backups are time-consuming, require continuous monitoring, and are prone to human error, often resulting in missed or irregular backups.

In addition, unexpected events such as system failures, accidental deletion of volumes, or security incidents can lead to permanent data loss if recent backups are not available. Managing backups across multiple AWS regions further increases complexity and operational overhead. Moreover, the lack of real-time monitoring and notification mechanisms makes it difficult for administrators to verify whether backups have been successfully completed.

II. LITERATURE SURVEY

Automating cloud backup processes has become an important area of focus in modern cloud infrastructure management, particularly for services like Amazon Elastic Block Store (EBS) that store critical application data. Several industry implementations and research studies have explored the use of AWS serverless services to improve backup reliability and reduce manual effort.

AWS documentation on EBS snapshot management highlights that snapshots are the primary mechanism for backing up EBS volumes and can be automated using event-driven services. It emphasizes that integrating AWS Lambda with scheduling services like Amazon EventBridge enables periodic and consistent snapshot creation without manual intervention. This approach ensures that backups are created regularly and can be used for disaster recovery when needed.

Practical implementations of EBS backup automation using AWS Lambda demonstrate that serverless functions can dynamically identify active volumes and create snapshots across multiple regions. These implementations show that automation reduces the chances of missed backups and minimizes operational overhead. Additionally, the use of Amazon SNS for notifications provides real-time feedback, allowing administrators to monitor backup success and quickly respond to failures.

Research on automated cloud backup systems also highlights the importance of scheduling and monitoring mechanisms. Event-driven architectures using cron-based triggers have been widely adopted to ensure that backup processes run at defined intervals. Such systems improve consistency and reliability compared to manual or semi-automated approaches.

Another important aspect discussed in recent studies is scalability. Serverless solutions using Lambda automatically scale based on workload, making them suitable for environments with multiple EBS volumes across different regions. This ensures that the backup system can handle increasing data volumes without requiring infrastructure changes.

Overall, existing studies and implementations confirm that combining AWS Lambda, EventBridge, and SNS provides an efficient and scalable solution for automating EBS volume backups. These approaches enhance data protection, ensure consistent backup execution, and reduce human dependency. This project builds upon these concepts by implementing a multi-region automated backup system with real-time notifications, focusing on simplicity, reliability, and practical deployment.

Research Gap

- Most existing solutions focus only on single-region backup, not multi-region environments[1].
- Limited discussion on real-time notification systems for backup status monitoring[2].
- Lack of focus on dynamic handling of EBS volumes (new or deleted volumes)[3].
- Limited emphasis on scalability in large cloud environments[4].
- Lack of unified serverless architecture combining Lambda, EventBridge, and SNS[5].
- Minimal focus on simplified deployment and practical implementation[6].
- Limited real-world examples of end-to-end automated backup systems[7].

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Scope

The primary scope of this project is to design and implement an automated system for creating backups of Amazon EBS volumes using AWS serverless services. The system focuses on improving data protection and ensuring reliable backup mechanisms within cloud environments.

- Automates the creation of EBS snapshots for in-use EC2 volumes.
- Supports multi-region backup, ensuring coverage across AWS regions.
- Uses EventBridge scheduling to perform backups at regular intervals.
- Integrates AWS Lambda for executing backup logic without manual intervention.
- Provides real-time notifications using Amazon SNS for monitoring backup status.
- Reduces human effort and operational complexity through automation.
- Enhances data recovery capabilities in case of system failure or data loss.
- Demonstrates the use of serverless architecture for cloud automation tasks.

The project is mainly limited to snapshot creation and notification mechanisms and does not include advanced features such as automated snapshot deletion, cost optimization policies, or graphical monitoring dashboards, which can be considered for future enhancements.

Objective

1. To automate the creation of EBS volume snapshots in AWS.
2. To implement scheduled backups using Amazon EventBridge.
3. To use AWS Lambda for executing backup operations without manual intervention.
4. To provide real-time notifications using Amazon SNS after snapshot creation.
5. To reduce human effort and minimize errors in the backup process.
6. To improve data protection and disaster recovery capabilities.
7. To develop a scalable and serverless backup solution.
8. To demonstrate practical implementation of cloud automation using AWS services.

Assumption

It is assumed that the user has an active AWS account with all required services enabled and properly configured. The project assumes that EC2 instances and their associated EBS volumes are already created and in use within the AWS environment. It is also assumed that the user has basic knowledge of AWS services such as Lambda, EC2, IAM, and EventBridge. Proper IAM roles and permissions are expected to be assigned to the Lambda function to allow access to EC2 resources and snapshot creation. Additionally, it is assumed that the SNS email subscription is confirmed so that notifications can be received successfully. The EventBridge rule is assumed to be correctly configured for scheduling the backup process. Finally, it is assumed that sufficient AWS resources and service limits are available, and that snapshots are securely stored within the AWS infrastructure.

Dependencies

The successful implementation of this project depends on the availability and proper configuration of various AWS services and resources. The system relies on AWS Lambda for executing the backup logic and requires the AWS SDK (Boto3) for interacting with EC2 and EBS services. It depends on Amazon EventBridge to schedule and trigger the Lambda function at defined intervals. Amazon SNS is required for sending email notifications regarding backup status, and it must be properly configured with confirmed subscriptions. The project also depends on correct IAM roles and permissions to allow Lambda to access EC2 resources and create snapshots. Additionally, the presence of active EC2 instances with attached EBS volumes is necessary for backup operations. The effectiveness of the system also depends on stable network connectivity and adherence to AWS service limits and quotas.

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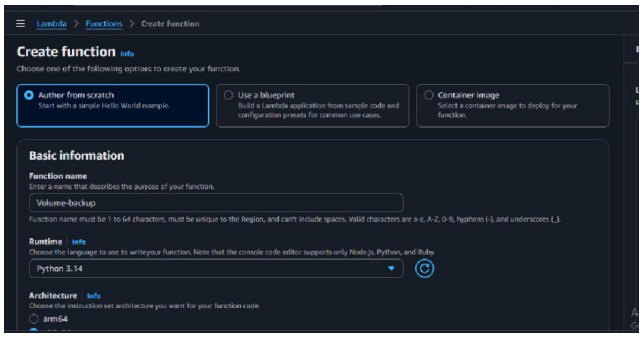
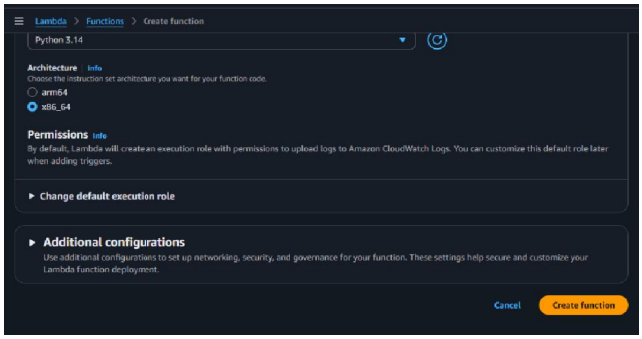
Proposed Methodology

1. The proposed system is designed to automate the process of creating backups of Amazon EBS volumes using a serverless architecture. The methodology follows an event-driven approach where AWS Lambda, Amazon EventBridge, and Amazon SNS are integrated to perform scheduled backup operations efficiently.
2. The process begins with the identification of all available AWS regions using the AWS SDK (Boto3). For each region, the system scans and retrieves all EBS volumes that are currently in an "in-use" state and attached to EC2 instances. Once the volumes are identified, the Lambda function initiates the creation of snapshots for each volume. These snapshots act as backups and are stored securely within AWS.
3. To ensure regular and automated execution, Amazon EventBridge is configured with a scheduling rule (cron or rate expression) that triggers the Lambda function at predefined intervals. This eliminates the need for manual intervention and ensures consistency in backup operations.
4. After the snapshot creation process is completed, Amazon SNS is used to send real-time email notifications to the user. These notifications include details such as snapshot ID, region, and execution status, allowing administrators to monitor the system effectively.
5. The entire workflow operates in a serverless environment, which provides scalability, cost-efficiency, and high availability. By combining scheduling, execution, and notification into a single integrated system, the proposed methodology ensures reliable backup management and improved disaster recovery capabilities.

Results



Step 1 (Creating a Lambda Function)



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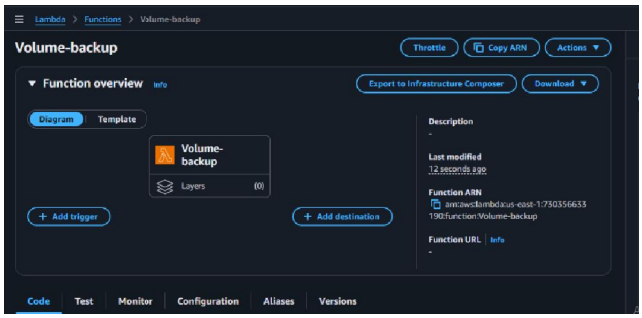
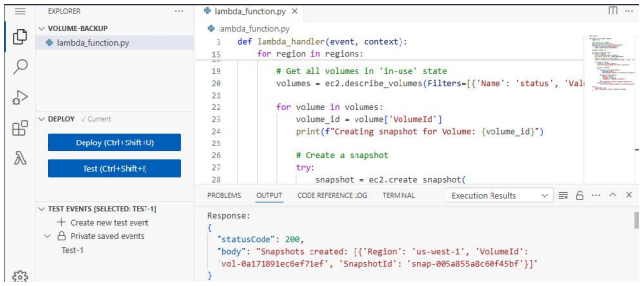
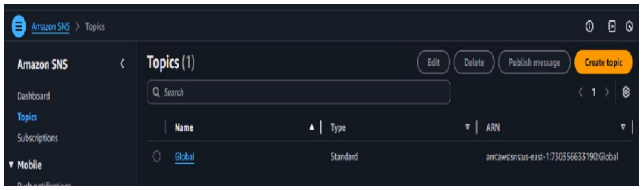


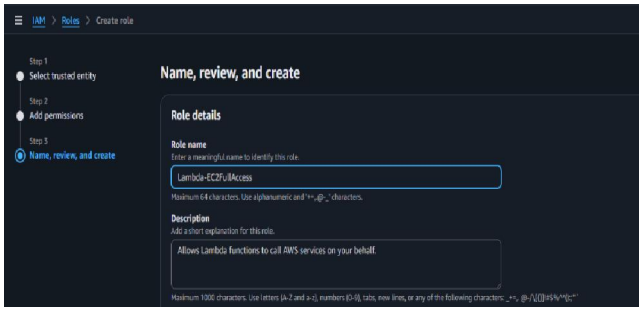
Step 2 (Add Code for Creating EBS Snapshot)



Step 3 (Create SNS Topic for Email Notification)



Step 4 (Attach Permissions to Lambda Role)



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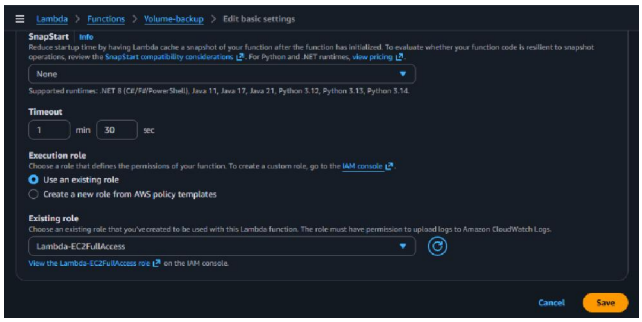
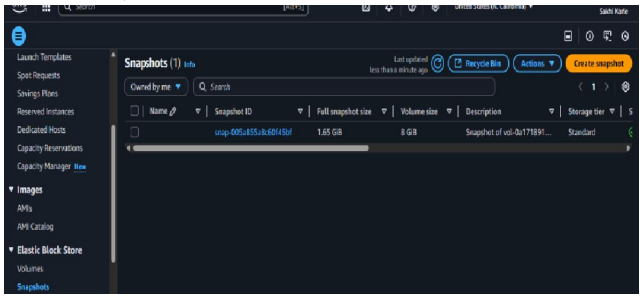
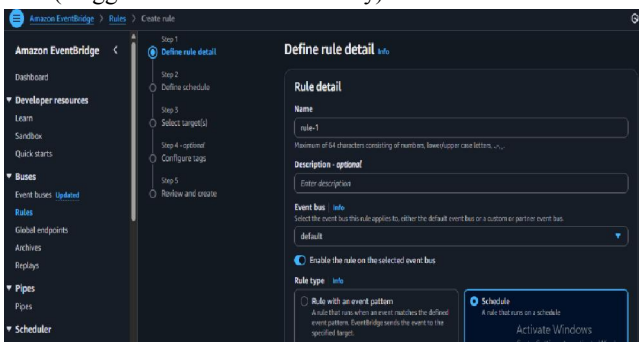
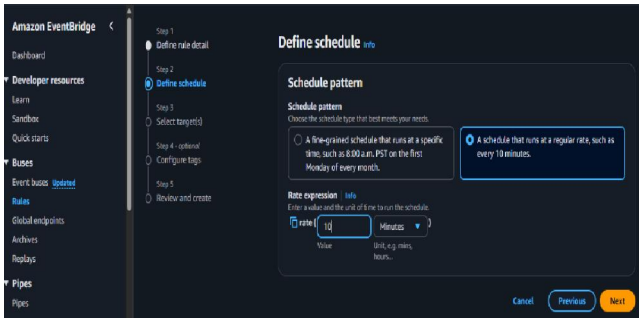


Step 5 (Verify Snapshot in EC2 Console)



Step 6 (Create EventBridge Rule (Trigger Lambda Automatically)





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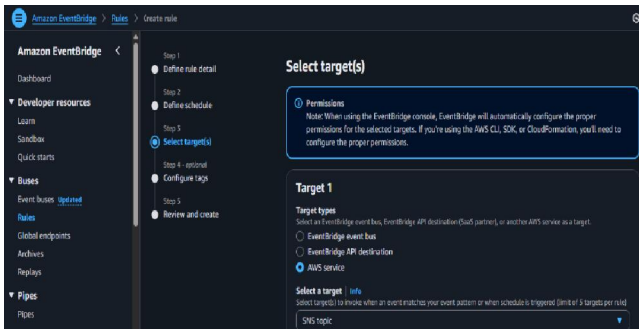
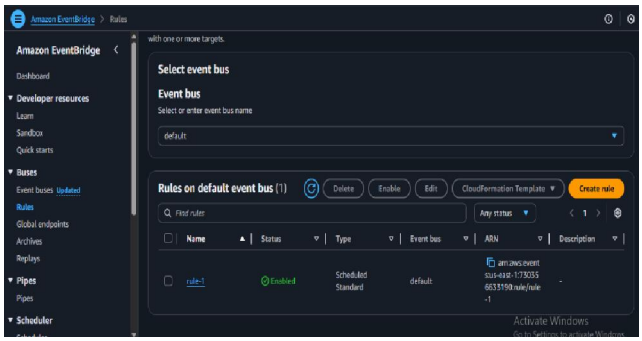
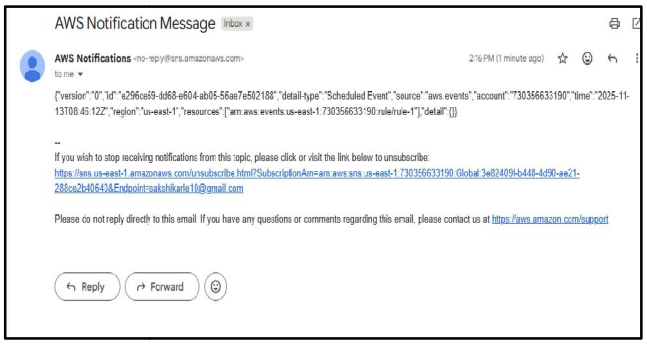




Step 7 (Check SNS Email Notification)



III. CONCLUSION

In this project, an automated solution for EBS volume backup was successfully designed and implemented using AWS serverless services. The system utilizes AWS Lambda to create snapshots of in-use EBS volumes, Amazon EventBridge to schedule and trigger the backup process, and Amazon SNS to provide real-time notifications. This integration ensures that backups are performed consistently without requiring manual intervention.

The proposed approach significantly reduces human effort and minimizes the risk of errors associated with manual backup processes. It enhances data protection by ensuring that up-to-date backups are always available, thereby improving disaster recovery capabilities. Additionally, the use of serverless architecture makes the system scalable, cost-efficient, and easy to manage.

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Overall, this project demonstrates the effectiveness of cloud automation in managing critical infrastructure tasks. By combining scheduling, execution, and monitoring into a single workflow, the system provides a reliable and practical solution for EBS backup management in modern cloud environments.

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