# CSCI 5902 Advanced Cloud Architecting (Summer 2023)

# Assignment 1 : Storage

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1. **What are the main challenges that Silver Screen Studios faces with their current on-premises storage solution, and how can a cloud-based storage solution address these challenges?**

   The main challenges that Silver Screen Studios faces with their current on-premises storage solution include:

   - **Difficulty to manage and scalability:** The task of managing and expanding Silver Screen Studios' current infrastructure, which houses a significant library of video content, is becoming progressively challenging due to the constrained capacity and scalability of their on-premises storage systems.
   - **Redundancy:** The occurrence of hardware failures poses a substantial risk to Silver Screen Studios, as it can lead to detrimental data loss. On-premises storage solutions lacking built-in redundancy mechanisms increase the probability of both data loss and potential financial repercussions.
   - **Limited data transfer speed:** On premises storage can result in lower transfer speed when dealing with large video file transfers.
   - **More upfront cost:** The cost involved to setup on premises storage servers are more and there is additional cost for maintenance, electricity etc. This could be expensive over time if the hardware's require updates or change.
   - **Growing storage needs:** With the growing data, it might require the storage to scale. The existing on premises storage is difficult to scale considering the future requirements.

   The cloud based solution can address the challenges by providing the following benefits:

   - **Scalability:** AWS provide a scalable storage solution that can effectively address the expanding storage requirements of Silver Screen Studios. Cloud storage enables them to effortlessly adjust their storage capacity to match the demand, allowing them to seamlessly accommodate their video content without concerns of insufficient space.
   - **High-speed data transfer:** AWS storage services provide rapid data transfer capabilities, enabling teams to swiftly access and transfer large video files. Silver Screen Studios can take advantage of AWS services specifically designed to enhance data transfer, resulting in reduced latency, and enhanced operational efficiency.
   - **Redundancy:** AWS storage solutions incorporate inherent redundancy mechanisms to safeguard data against hardware failures. AWS provides a range of redundancy choices, such as data replication across multiple

availability zones, guaranteeing the preservation of stored content with exceptional availability and durability.

- **Cost-effectiveness:** AWS storage operates on a pay-as-you-go model, enabling businesses to pay only for the storage they use. This eliminates the need for large upfront costs associated with purchasing and maintaining on-premises storage infrastructure. Additionally, AWS offers various storage classes with different pricing tiers, allowing organizations to optimize costs based on their data access frequency and performance requirements.
- **Future data growth:** Designed for seamless scalability, AWS storage solutions effortlessly accommodate increasing storage requirements. Silver Screen Studios can effortlessly expand their storage capacity without the need for substantial infrastructure modifications, alleviating the workload on their IT team and presenting a cost-effective solution for future growth.

2. **How would you determine the appropriate storage service(s) for Silver Screen Studios to use in their cloud-based storage solution, considering factors such as scalability, performance, and cost-effectiveness?**

   To determine the appropriate storage service(s) for Silver Screen Studios' cloud-based storage solution, several factors need to be considered, including scalability, performance, and cost-effectiveness.

   - **Scalability:** We need to look for AWS storage services that offer easy scalability, such as Amazon S3 (Simple Storage Service) or Amazon EBS (Elastic Block Store), which can seamlessly expand storage capacity as required. Amazon S3 is highly scalable and you only pay for what you use, you can start small and grow your application as you wish, with no compromise on performance or reliability.

     Amazon S3 offers remarkable flexibility, allowing you to store any form and quantity of data based on your needs. Whether you require frequent access to the data or use it sparingly for critical disaster recovery purposes, Amazon S3 can accommodate both scenarios. Whether you're developing a straightforward FTP application or a complex web application like Amazon.com, Amazon S3 eliminates the need for you to invest time in devising data storage solutions, enabling you to prioritize innovation instead.

   - **Performance:** After considering factors such as data transfer speeds, I/O operations per second (IOPS), and latency, AWS storage services like Amazon S3, Amazon EBS can be used. EBS provides low-latency, high-IOPS block storage that can be attached to EC2 instances for video processing or editing tasks. For lower latency we can also use cross-replication in different region, that also helps with higher availability. We also need to consider services that offer content delivery networks (CDNs) or edge caching can improve performance by reducing latency for distributed access.

- **Cost-effectiveness:** By exploring cost optimization features provided by AWS storage services, we can say Amazon S3 Intelligent-Tiering automatically moves data between different storage tiers based on access patterns, optimizing costs by placing frequently accessed data in lower-cost tiers. We can also compare the pricing for the storage and pick the one that fits our requirements and try to optimize our architecture with the help of AWS Trusted Advisor, that can help with real time optimization of resources or services. We can also use Amazon S3 Analytics, to get automated analysis and visualization of Amazon S3 storage patterns to help us decide when to shift data to a different storage class.

Once we have a brief idea of the storage services we would be using, we can get an estimate pricing using the AWS pricing calculator. It gives us transparent pricing per service or a group of services to analyse the architecture cost.

3. **What strategies would you recommend to optimize the transfer speed of large video files between teams, and what AWS storage services and features would you utilize to achieve this?**

AWS S3 Transfer Acceleration can be used to optimize the transfer speed of large video files between teams. It is a feature provided by AWS S3 that enables faster file upload and download by leveraging the AWS Edge Network. It can speed up content transfers to and from Amazon S3 by as much as 50-500% [1]. Since Silver Screen has multiple offices around the world, this would optimize the transfer speed of large files between teams.

There are a few strategies and AWS services features and services we can use to optimize the transfer speed of files:

- **AWS S3 Transfer Acceleration:** We can use it as it uses optimized network paths and AWS Edge Network to speed up the data transfer to and from S3, especially for large files over long distance.
- **Multipart uploads:** Breaking the files into multiple parts and uploading them in parallel can improve transfer speed and resiliency.
- **AWS Direct Connect:** We can create a private network connection between your on-premises environment and the AWS region using AWS Direct Connect if your teams have dedicated network connections to AWS. Faster and more dependable data transfers may result from this.
- **S3 Transfer Accelerator with CloudFront:** We can use a CDN (Content Delivery Network) Amazon CloudFront, that will help cache the content in the region close to the teams and will improve download speed and helps reduce load on origin S3 bucket.
- **S3 Intelligent Tiering:** If the files are accessed frequently, then we can consider using it as it moves data between different storage classes based on the access pattern and reducing latency for frequently accessed files.

- **Regional Buckets:** Select a region for our S3 bucket creation that is physically closer to the teams doing file transfers. This may aid in lowering network latency and enhancing transfer rates.

We can greatly increase the transfer speed of large video files between teams, lower latency, and minimise expenses by combining these techniques and making use of AWS S3 Transfer Acceleration.

4. **What specific AWS features and services would you implement to ensure the reliability and availability of Silver Screen Studio's storage solution, and what mechanisms would you use to monitor and maintain these features?**

We can use Amazon S3 Cross-Region replication, that enables the replication of data across different regions, serving as a precautionary measure against data loss caused by unforeseen events or disasters. By spreading data across multiple regions globally, it can enhance both latency and availability, ensuring efficient service delivery with minimal delays. Implementing AWS Disaster Recovery services such as AWS Backup and AWS CloudEndure further strengthens data protection and enables swift recovery in the face of disruptions or disasters. AWS also offers service level agreements (SLAs) for its storage services, assuring customers of the service's high availability and durability.

The performance and health of storage services are actively monitored by AWS CloudWatch, which enables the early identification and correction of any possible problems. It can be used to monitor application performance, perform root cause analysis, optimize resources proactively and validate impacts [2].

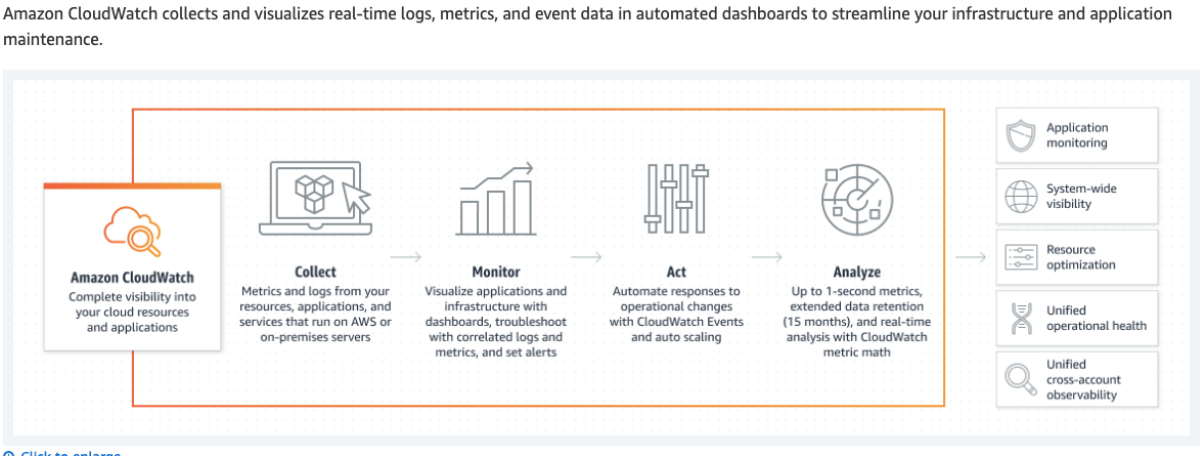


**Fig 4.1** : Amazon Cloud Watch use case and working [2].

5. **How would you ensure that Silver Screen Studios' video content remains secure and compliant with industry regulations while being stored in the cloud, and what specific security measures and AWS services would you recommend?**
Below are the security measures and AWS services recommended for keeping the content secure and compliant with industry regulations while stored in cloud:

- **Encryption at Rest**: To protect the data from unauthorized access, we can encrypt the data at server side using AES 256-bit, S3 managed keys. The objects are encrypted before they are written to the disk. Server-side encryption protects data at rest. All new object uploads to Amazon S3 buckets are encrypted by default with server-side encryption with Amazon S3 managed keys (SSE-S3). [3].
- **Encryption in Transit**: For data transfer between Silver Screen Studio's applications and AWS services, enable SSL/TLS encryption. This can be done by encrypting network traffic using the HTTPS or SSL/TLS protocols.
- **IAM policies/Access Control:** We can restrict access to the video content using roles and permissions. Only the authorized persons can access the video contents.
- **Version Control:** We can also enable version control to protect against data loss. This can help us with recovery of data in case of data loss.
- **Compliance:** Leverage AWS Artifact to access compliance reports and relevant industry certifications. AWS Artifact is a central resource for compliance-related information that matters to the company and it provides on-demand access to security and compliance reports from AWS [4]. Also, in order to meet the compliance requirements we might need to have a copy of our data in more than one region and cross-replication can help achieve this.
- **Logging and Auditing:** Enable AWS CloudTrail to log data access and updates as well as capture API activities. This assists with forensic investigation, auditing, and keeping an eye out for any unauthorised access attempts.
- **Bucket Policies:** We can also add bucket policies to define access to specific object or buckets.

6. **What backup and archiving strategies would you recommend to manage the lifecycle of Silver Screen Studio's video content, and what AWS services would you use to implement these strategies?**

   The following strategies can be implemented for backup and archiving:
   - **Lifecycle Policies:** Lifecycle policies can be used to automatically archive data that must be kept for long-term storage or compliance requirements. We can configure a rule to move things to the "Glacier" or "Glacier Deep Archive" storage classes after a predetermined time. This transfers the data to a cheaper storage tier that is better suited for archival needs.
   - **Automated Backups:** AWS Backup is a cost-effective, fully managed, policy-based service that simplifies data protection at scale. This ensures that data is protected and can be restored in case of accidental deletion or data corruption [5].
   - **Archieving:** AWS Glacier offers a reasonably priced archiving option for less often accessed video content that has to be stored for the long term. Glacier is appropriate for archival needs because it enables data retrieval in a matter of hours or days.
   - **Versioning:** We can also enable version control to protect against data loss. This can help us with recovery of data in case of data loss. This also maintains

a history records of the video contents that are being added, modified or deleted.

7. **How would you balance the need to meet Silver Screen Studios' storage requirements with cost-effectiveness, and what specific cost optimization strategies and tools would you recommend?**

   To balance the need to meet Silver Screen Studio's storage requirements with cost-effectiveness, several cost optimization strategies and tools can be recommended:

   - **Lifecycle Policies:** To automatically move data across storage classes or remove expired objects, we can implement lifecycle policies. We can reduce storage expenses while still maintaining compliance and retention standards by migrating rarely used data to lower-cost storage tiers or deleting superfluous data.
   - **Data compression and removal of duplicate data:** We can apply compression techniques to reduce the storage space requirements and avoid adding duplicate objects in the storage class to minimize costs.
   - **Reserve Instances:** If the requirement has predictable or consistent storage usage then we can consider using reserved instances, that will provide significant savings in a long run.
   - **Cost Monitoring:** For expense tracking and analysis, we can use AWS expense Explorer and AWS Budgets. To spot expense spikes, examine usage trends, and improve expenditure, set up cost alerts and frequently monitor cost reports.
   - **Selection of storage class:** Evaluate the usage patterns and specific needs of various video content. Select the suitable storage class for each data type, taking into account the characteristics of the content and opt for the "S3 Standard" storage class for frequently accessed data, while less accessed or archival content can be placed in the "S3 Glacier" or "S3 Glacier Deep Archive" storage classes. This approach ensures cost-effectiveness by aligning storage options with the frequency of access and the required retrieval time.
   - **Optimization:** AWS Trusted Advisor can be used for getting real time identification of potential areas of optimization[6].
   - **Alerts:** AWS Budgets can be used to set custom budgets that trigger alerts when cost or usage exceed (or are forecasted to exceed) a budgeted amount. Budgets can be set based on tags and accounts as well as resource types[6].
   - **AWS Cost Explorer:** Cost explorer is a tool provided by AWS can help us configure a cost estimate that fits the company's needs with AWS products and services [7].

**References:**


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