
AWS
re:Invent
NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

STG202

Better, faster, and lower-cost storage: Optimizing Amazon S3

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AWS

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Torc Robotics

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Agenda

Operating storage at scale

Insights into Amazon S3

Optimizing cost for various data access patterns

Achieving high performance with Amazon S3

How Torc Robotics manages petabytes of data

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Compliance records

Analytics

Geospatial or lunar imagery

Internet of Things (IoT) sensor data

Medical images and records

Data lakes

Customer call-center records

Media master files

Digital record preservation

Mobile sync and storage

Home video recordings

Origin storage for CDN

Seismic and reservoir simulation data

Pharmaceutical study data

Durable backups

DNA sequences

Surveillance video/closed-circuit television

ML training data

Media assets

Financial transaction records

Website hosting

Log files

Meteorological and environmental research

User-generated content

Autonomous vehicle data

Oil and gas topography

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Industry-leading scalability, durability, and availability



- Exabytes stored across many millions of drives
- Amazon S3 holds more than 280 trillion objects and averages over 100 million requests per second
- 235+ distributed microservices in 3 or more Availability Zones per Region

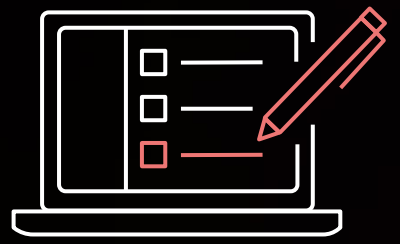
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Data is growing **faster than ever**

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Pillars of cost optimization

1



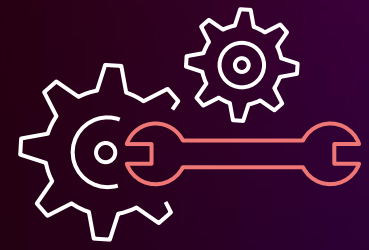
Define your workload requirements

2



Understand your storage and develop insights

3

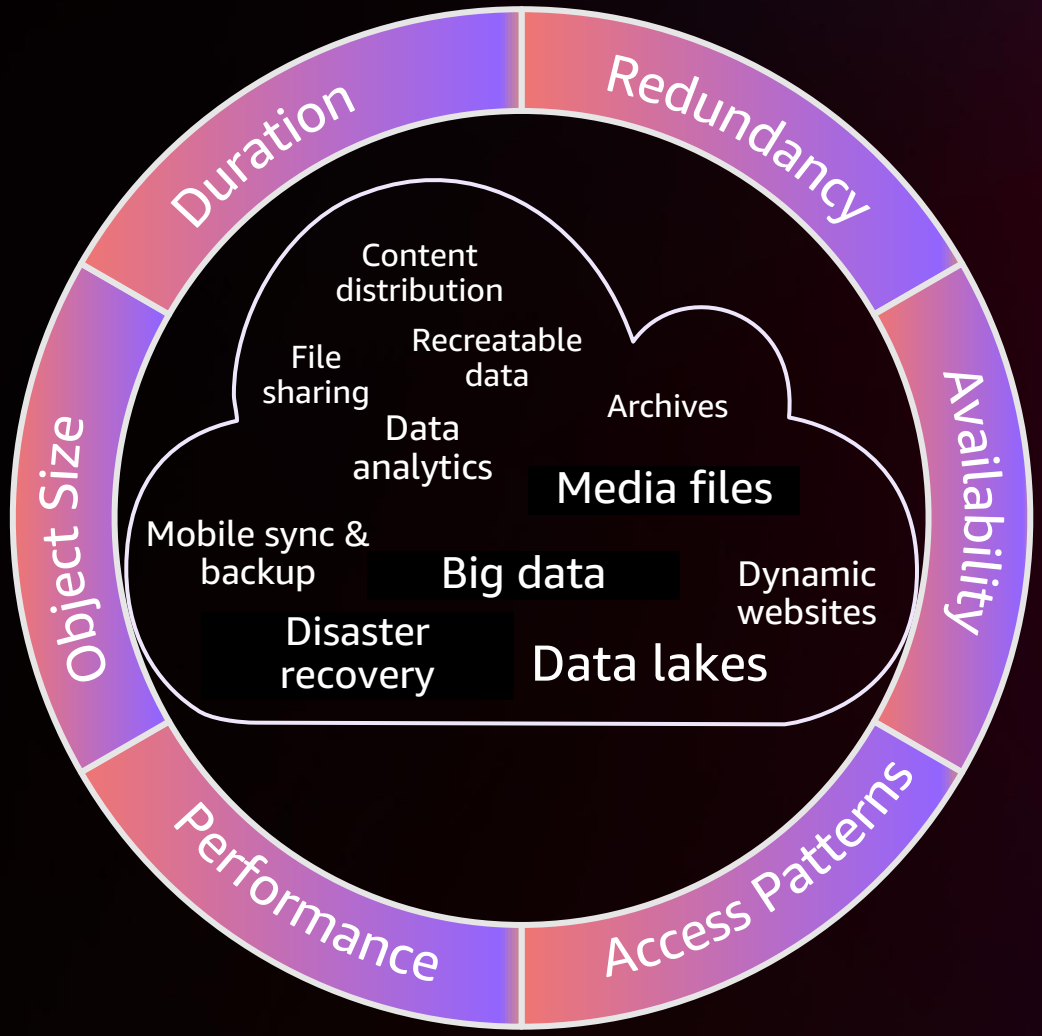


Optimize and measure

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Define your workload requirements

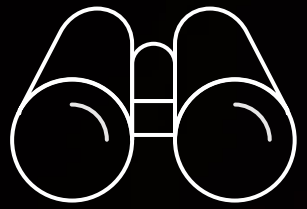


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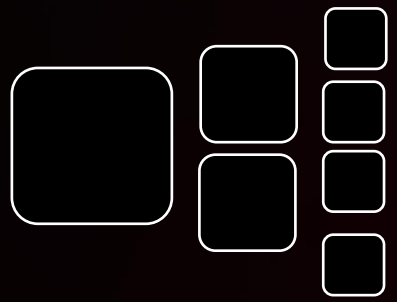
If you can't see it,
you can't change it

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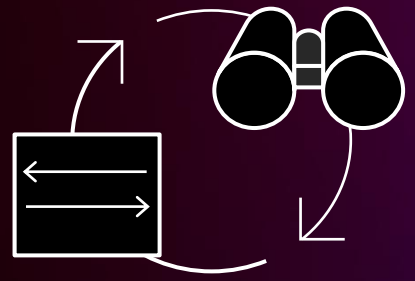
What did customers ask for?



Organization-wide visibility into usage



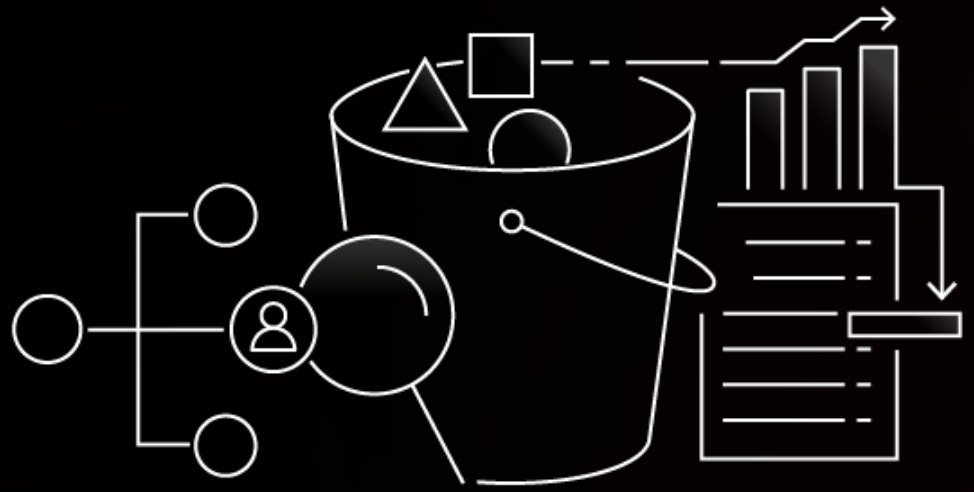
Drill down to gain understanding of usage



Take action on the insights developed

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Analyze your storage with S3 Storage Lens



Free and paid versions available

1. Interactive dashboard experience in the S3 console – free to all customers
2. Organization-wide visibility
3. Drill-down by Region, storage class, bucket, and prefix
4. Multiple ways to access Storage Lens data
5. Granular usage & activity metrics

New *Now includes 34 additional metrics (more than double the existing metrics count!)*

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S3 Storage Lens added 34 new metrics

Cost optimization



"How do I optimize my storage spend?"

Data protection



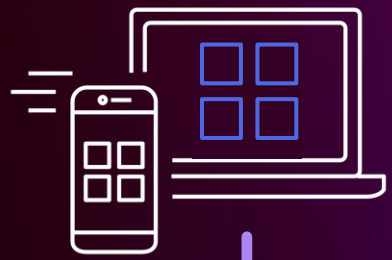
"How do I prevent accidental deletes and overwrites?"

Performance



"Am I seeing a rise in 403 authorization errors?"

Access control



"How do I audit my buckets to ensure ACLs are disabled?"

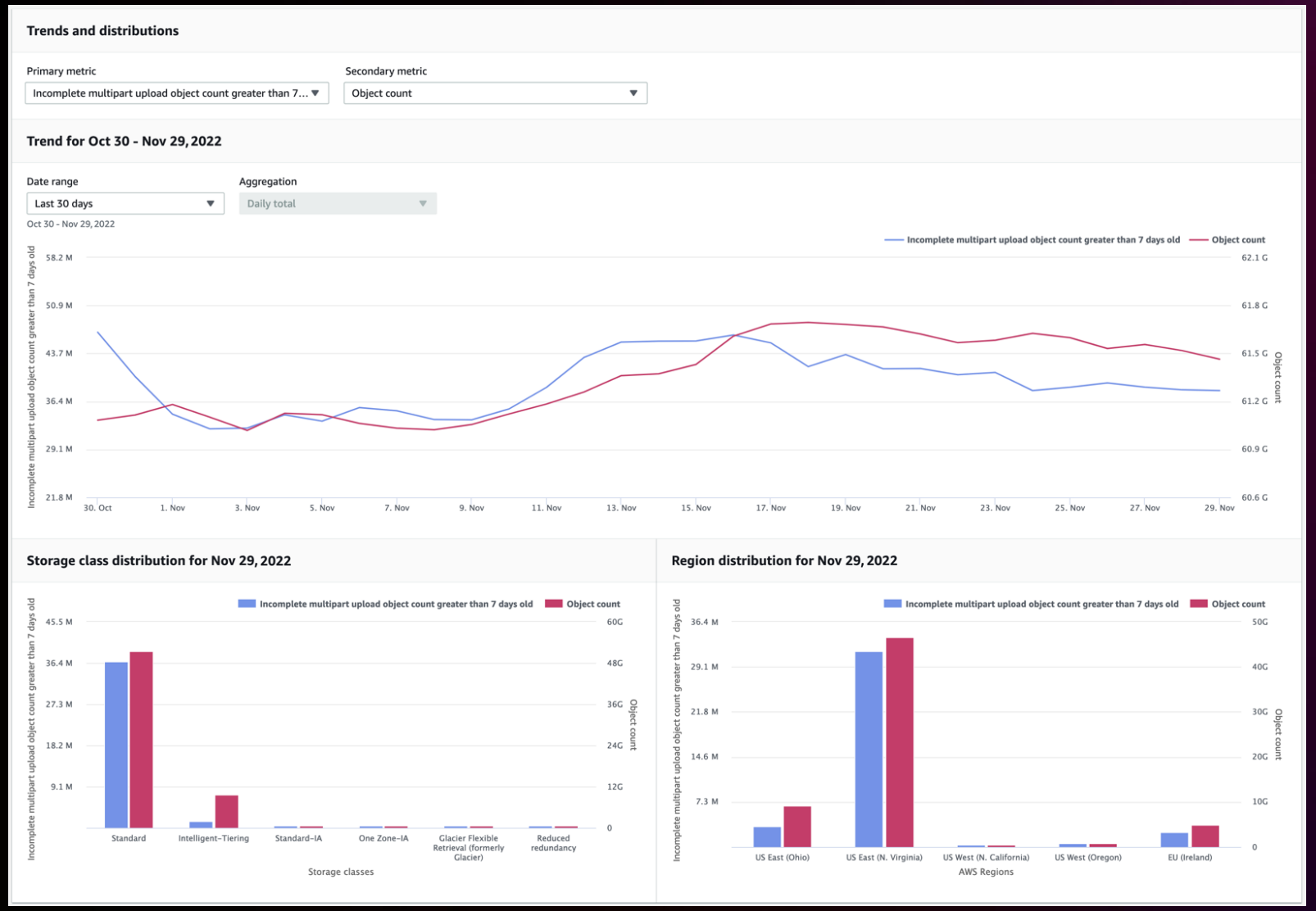
New metrics

- S3 Lifecycle rule count metrics
- Versioning metrics
- Status code metrics
- Object ownership metrics

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Discover incomplete multipart uploads



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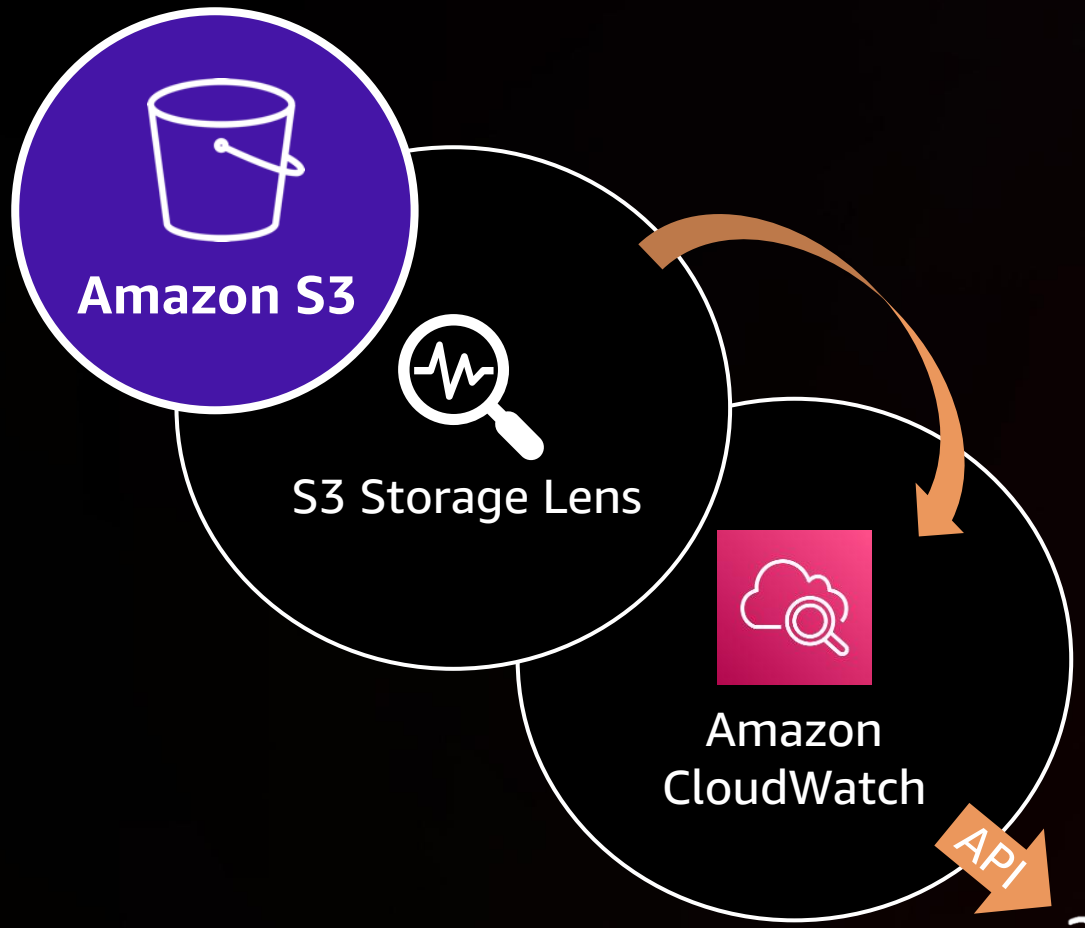
90%+ of buckets are versioned due to business requirements

Archived petabytes of noncurrent versioned data to save costs

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Publishing metrics to Amazon CloudWatch



Unlock capabilities of CloudWatch for S3 Storage Lens metrics

- Centralized, cross-service dashboards
- Alarms and triggered actions
- Anomaly detection

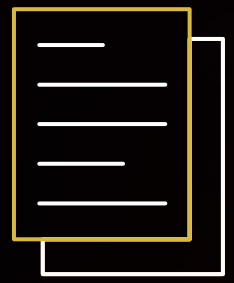
Access metrics via CloudWatch API

- Connect AWS observability partners

aws partner network

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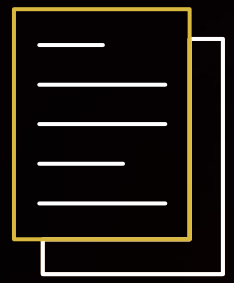
S3 Inventory for object-level analysis



S3 Inventory report

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S3 Inventory for object-level analysis



S3 Inventory report





Amazon Athena

```
SELECT key FROM your_table_name WHERE is_latest = ‘FALSE’ and size >= ‘10240’
```

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Patterns of cost optimization



1. Data with known or predictable access patterns

2. Data with unknown or changing access patterns

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Patterns of cost optimization



1. Data with known or predictable access patterns

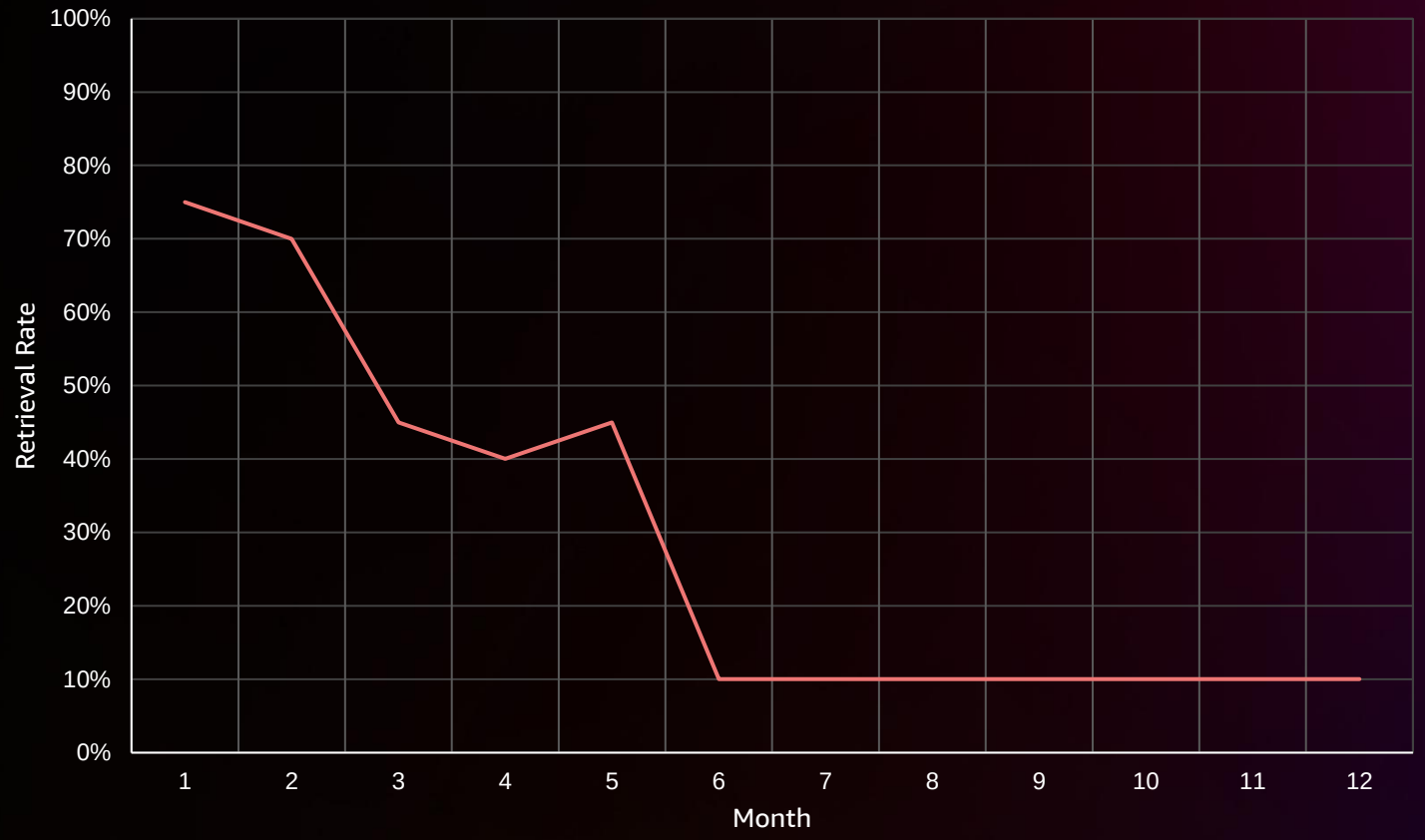
2. Data with unknown or changing access patterns

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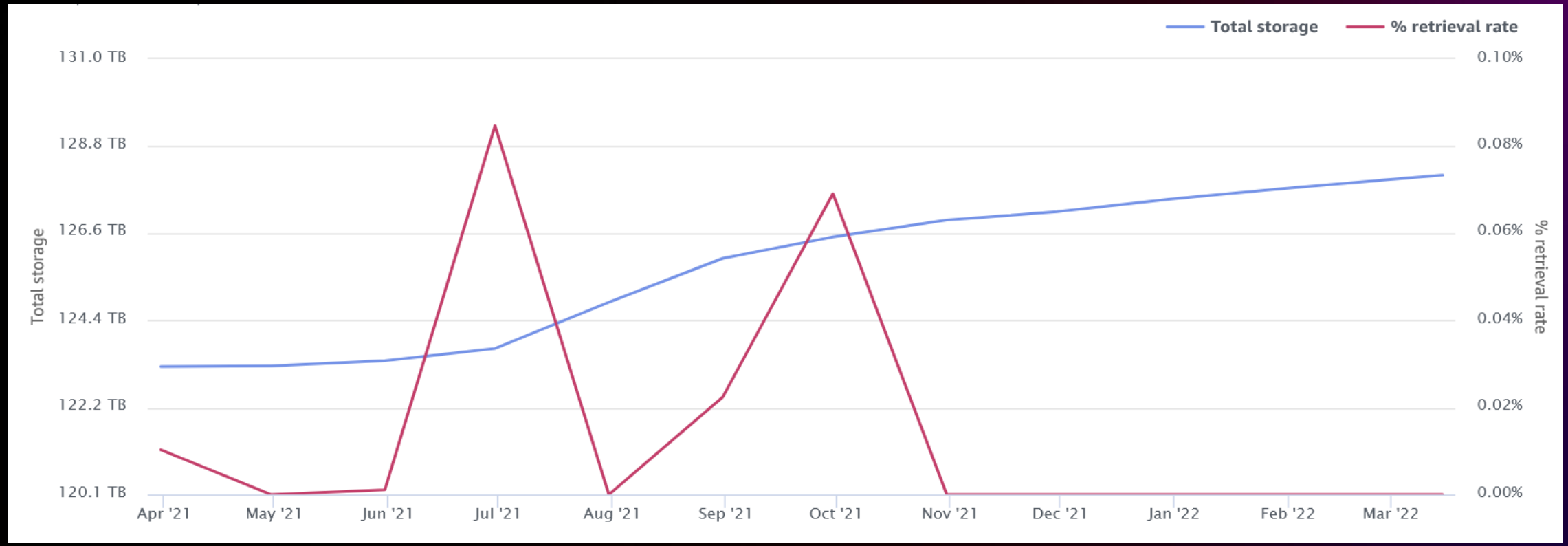
Patterns of cost optimization

Data with known or predictable access patterns



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Workloads with predictable patterns often have low retrieval rates for long periods of time after becoming rarely accessed



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Medical Research Environment v2.0.556

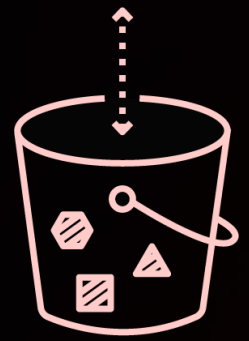




Optimizing data with known access patterns



S3 Standard



S3 Standard-IA



S3 Glacier
Instant Retrieval



S3 Glacier
Flexible Retrieval

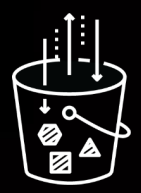


S3 Glacier
Deep Archive

aws

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Optimizing data with known access patterns



S3 Standard

Frequently accessed data

- Milliseconds access
- No retrieval charge



S3 Standard-IA

Infrequently accessed data

- Milliseconds access
- Per-GB retrieval charge



S3 Glacier Instant Retrieval

Rarely accessed data

- Milliseconds access
- Per-GB retrieval charge



S3 Glacier Flexible Retrieval

Archive data

- Minutes to hours
- Free bulk retrievals



S3 Glacier Deep Archive

Long term archive data

- Retrieval in hours

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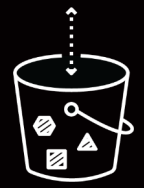
Optimizing data with known access patterns



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S3 Standard-IA

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S3 Glacier Instant Retrieval

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S3 Standard-IA

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S3 Glacier Deep Archive

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Optimizing data with known access patterns



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S3 Glacier Flexible Retrieval

Archive data

- Minutes to hours
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S3 Glacier Deep Archive

Long term archive data

- Retrieval in hours

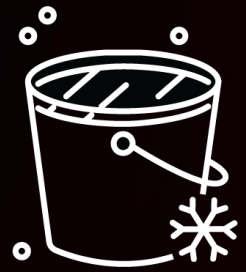
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Amazon S3 Glacier storage classes



S3 Glacier
Instant Retrieval



S3 Glacier
Flexible Retrieval



S3 Glacier
Deep Archive

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Snap saved millions of dollars and customer memories



Snap saved millions of dollars and customer memories

363 million daily Snapchatters store content indefinitely

2 exabytes of data, or 1.5 trillion media files stored on Amazon S3



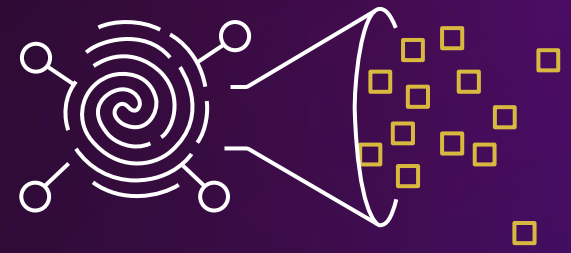
Selecting the right storage class



Frequency of access



Duration of storage

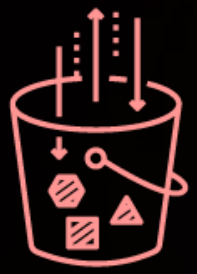


Performance

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Fine tune your Lifecycle policies



S3 Standard



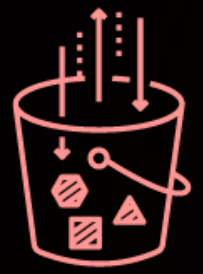
S3 Glacier
Instant Retrieval



S3 Glacier
Deep Archive

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Fine tune your Lifecycle policies



S3 Standard

90 days



S3 Glacier
Instant Retrieval

365 days



S3 Glacier
Deep Archive

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Majority of data has **unknown access patterns**

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Patterns of cost optimization



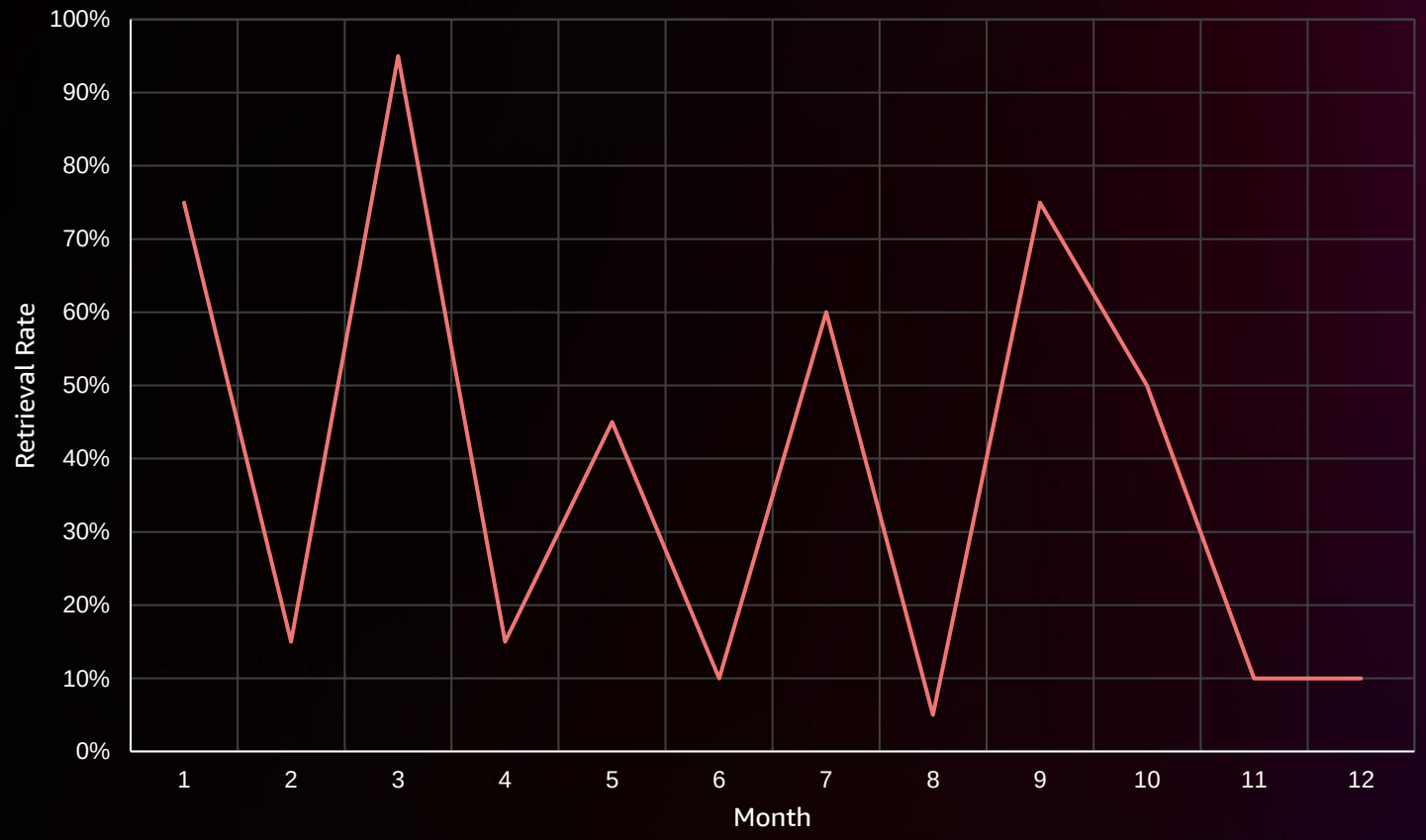
1. Data with known or predictable access patterns

2. Data with unknown or changing access patterns

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Patterns of cost optimization

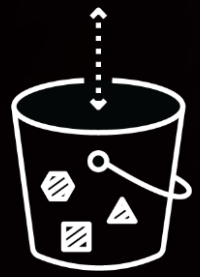
Data with unknown or changing access patterns



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S3 Standard



S3 Standard-IA



S3 Glacier
Instant Retrieval



S3 Glacier
Flexible Retrieval



S3 Glacier
Deep Archive

Frequent

Infrequent

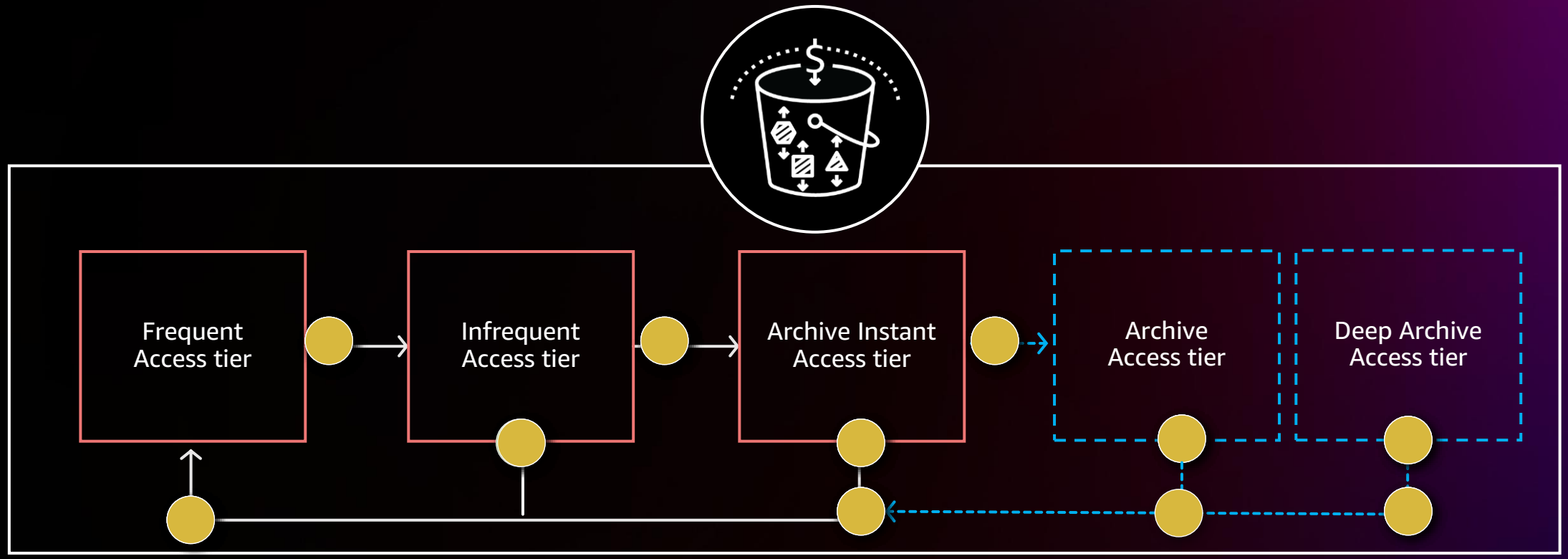
Archive Instant

Archive

Deep Archive

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Automatically optimize each & every object

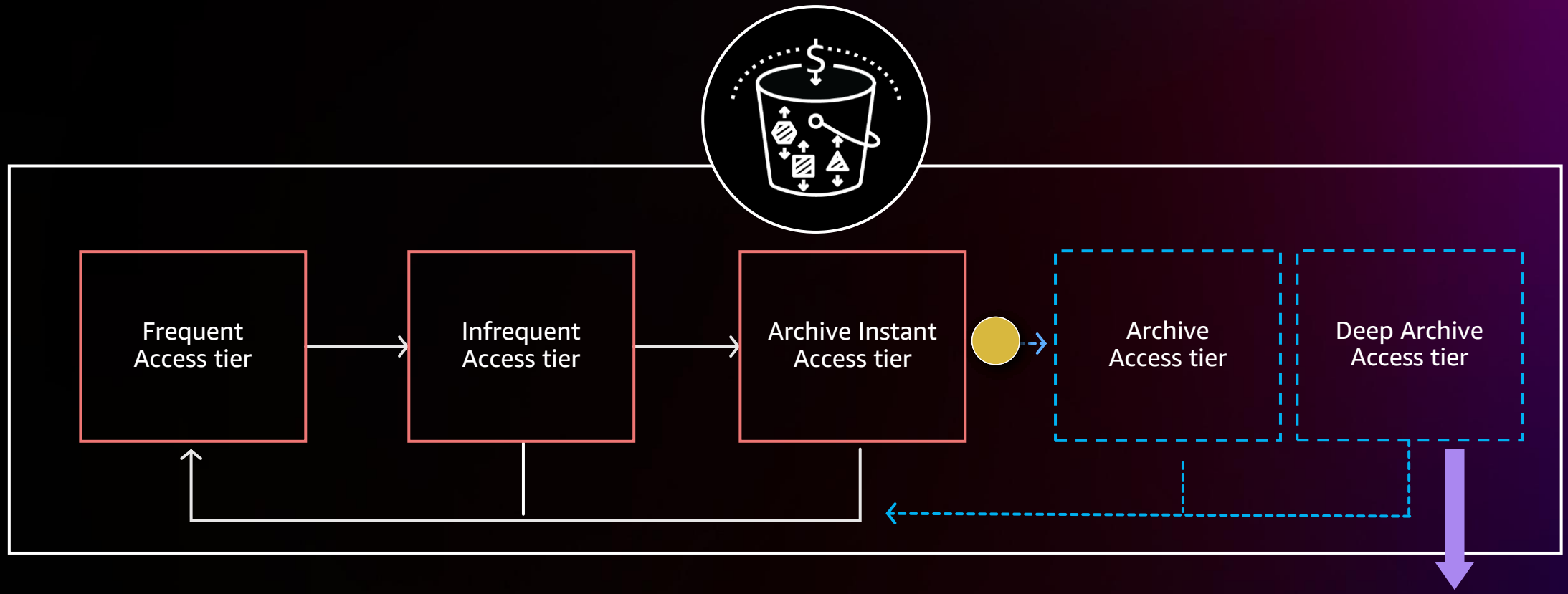


Milliseconds access (automatic)

Minutes to hours (optional)

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Use Event Notifications to track objects moved to the asynchronous archive tiers



Amazon SQS

Amazon SNS

AWS Lambda

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Regain **20-50%** of sprint time

Cost savings of up to **60%**

Elastically scale **petabytes** of data

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$750 million

in cost savings

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Getting started with **Amazon S3 Intelligent-Tiering** as your default storage class



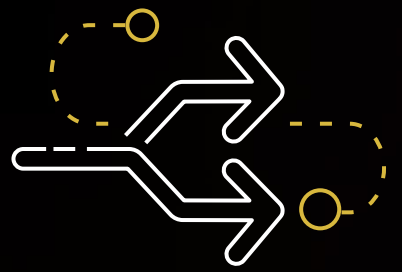
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Scaling to tens of millions of requests per second

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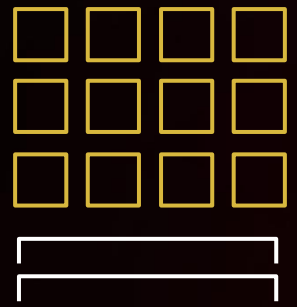
Pillars of performance optimization

1



Organizing the S3 key namespace

2



Use horizontal scaling

3



Monitor and retry

aws

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Prefix design for scale

3,500

PUT/COPY/POST/DELETE



5,500

GET/HEAD

per prefix

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Designing prefixes for “bursty” workloads



/daily-uploads/20211006/CAR01/drive-data
/daily-uploads/20211006/CAR02/drive-data
/daily-uploads/20211006/CAR07/drive-data
/daily-uploads/20211006/CAR05/drive-data
/daily-uploads/20211006/CAR01/drive-data
/daily-uploads/20211006/CAR02/drive-data
/daily-uploads/20211006/CAR07/drive-data
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Designing prefixes for “bursty” workloads

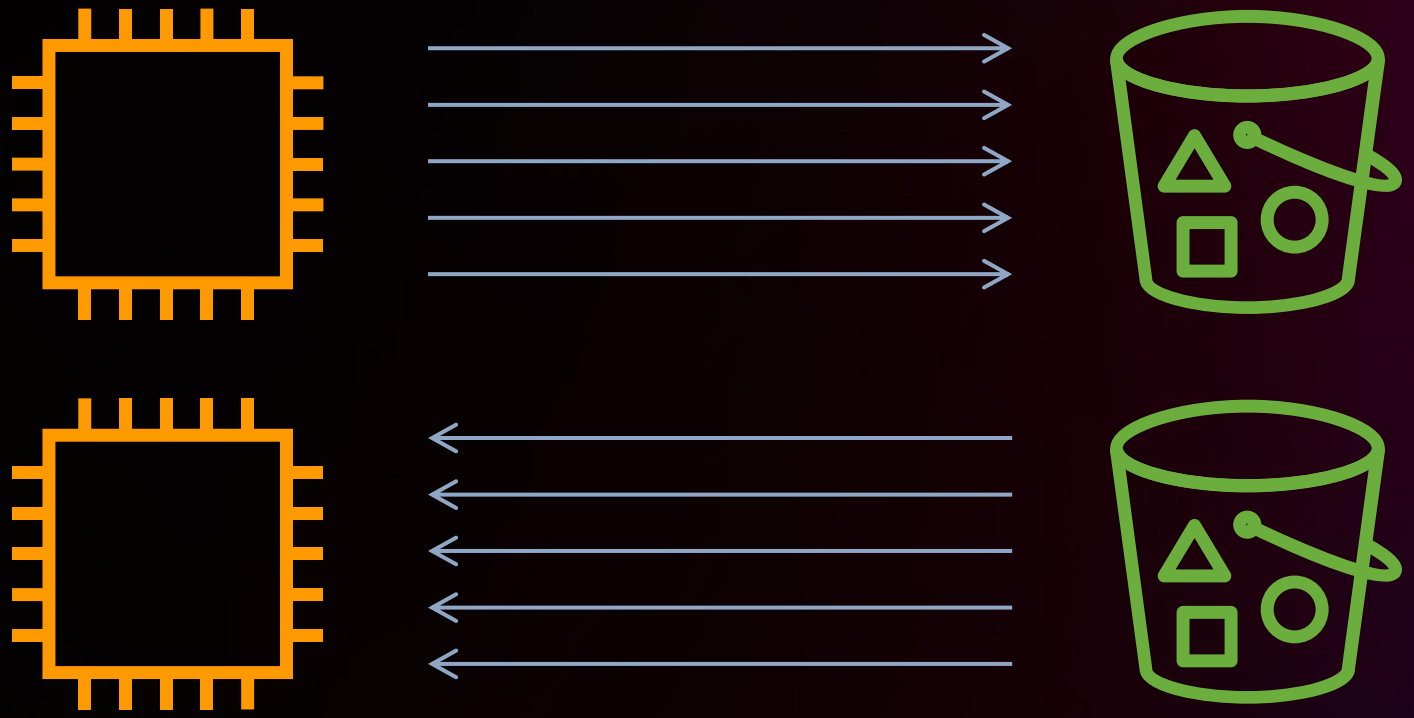


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/daily-uploads/ef/20211006/CAR05/drive-data
/daily-uploads/fd/20211006/CAR01/drive-data
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/daily-uploads/01/20211006/CAR07/drive-data

Add entropy to the start of the prefix

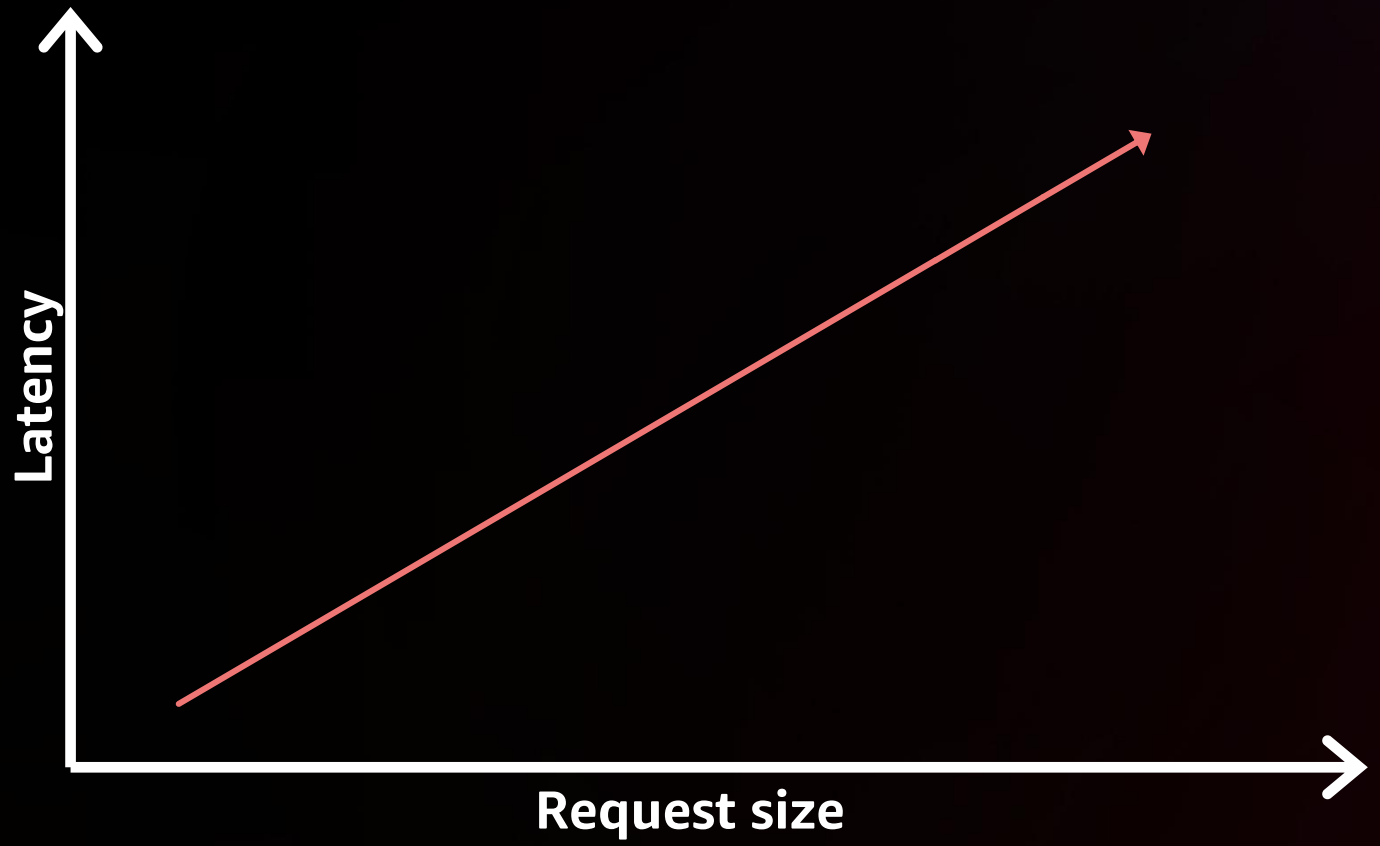
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Horizontal scaling is key to maximizing performance



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Parallelization of individual operations



- Use multipart upload to parallelize large objects when uploading
- Use byte-range fetches to parallelize large objects when retrieving data

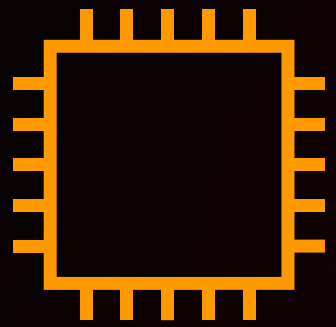
Parallelize large object uploads and downloads to reduce latency and improve throughput

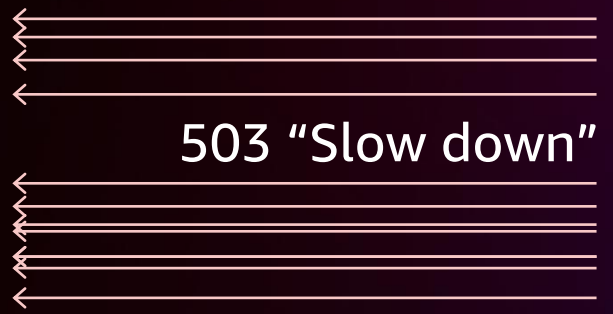
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Measuring 503 slowdown errors

503 Slow Down typically indicates that the number of requests to your S3 bucket is very high, exceeding the request rates

- Amazon CloudWatch metrics
- S3 Storage Lens advanced metrics
- Server access logs







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Hundreds of thousands
of data lakes are built on S3

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TORC ROBOTICS

One Mission:
Saving Lives



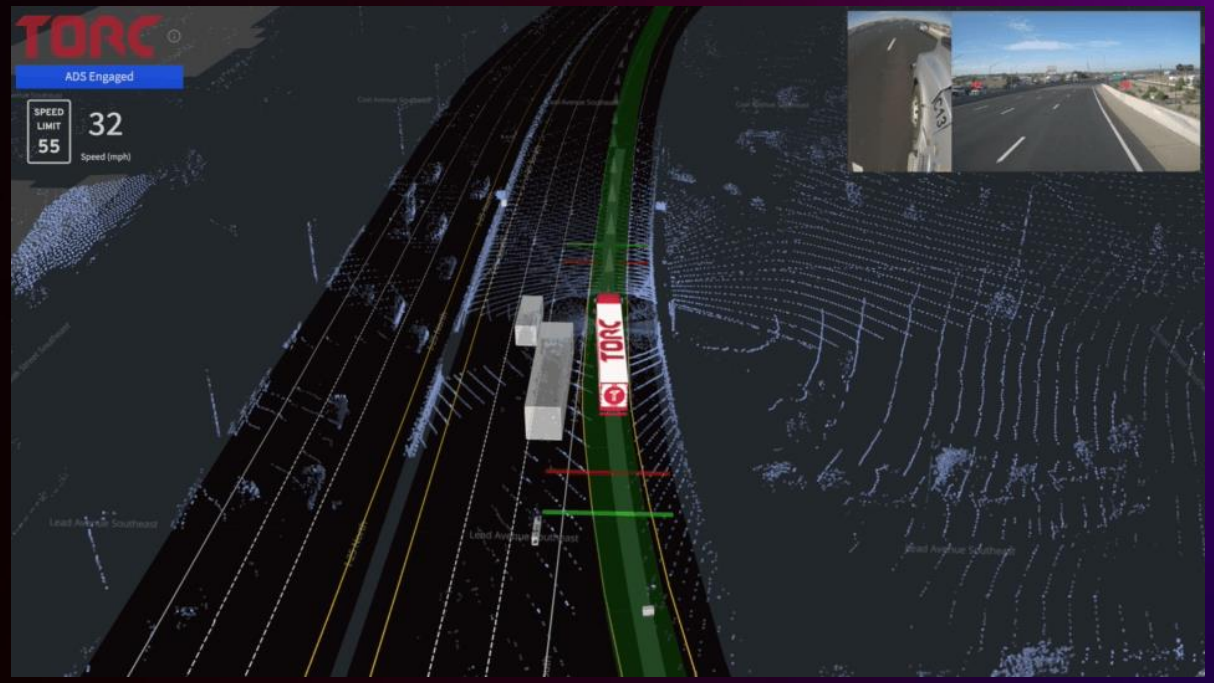
Deliver critical goods:
$800 billion industry transports 72.5% of all US goods, including food and medicine

Reduce environmental impact:
29% of US greenhouse gases emitted by transportation

Improve safety:
415,000 truck crashes/year

Trucks collect multiple terabytes per hour

- Data recorded in binary compressed format
- 99.8% of the data are images and point clouds
- Some data needs to be kept forever

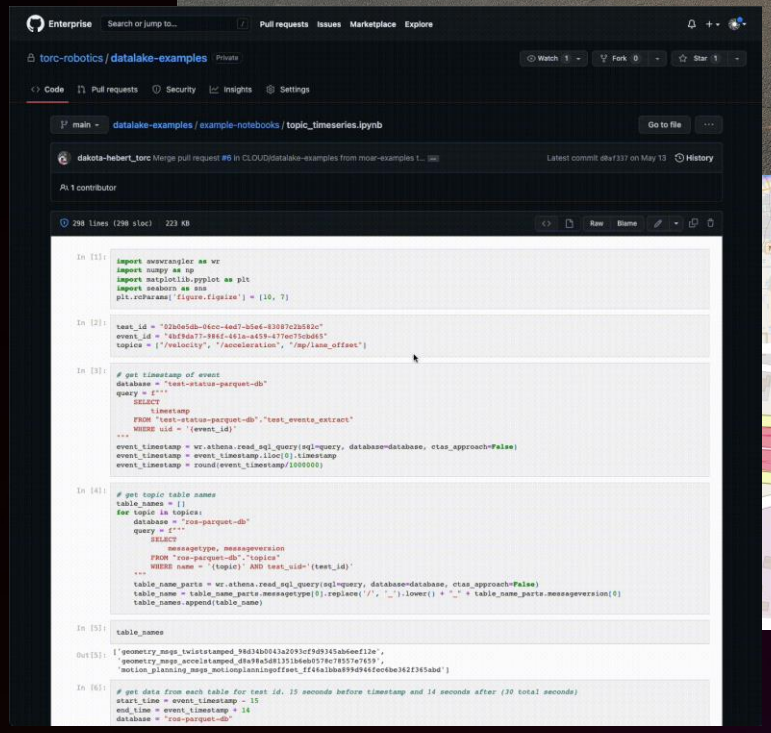


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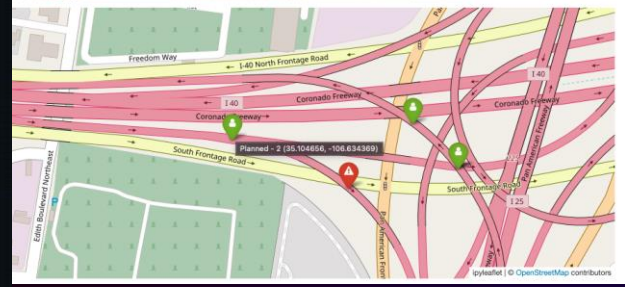
Support multiple access patterns

- Forensics
- Fleet ops and reporting
- Algorithm KPIs
- ML training data
- Ad hoc querying



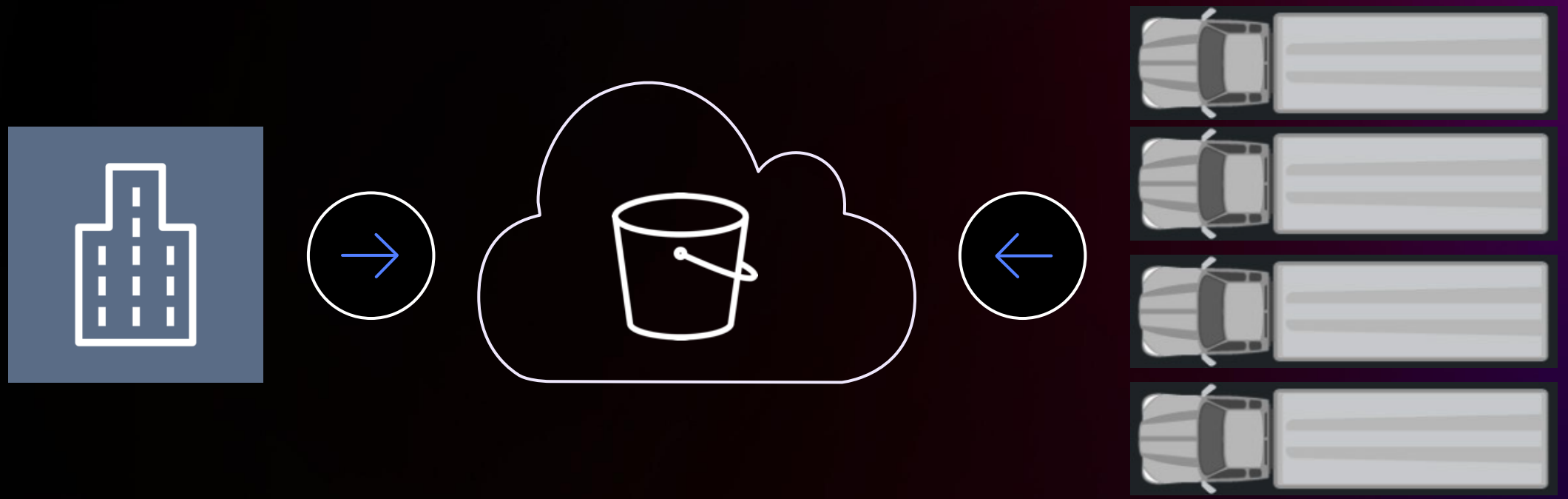






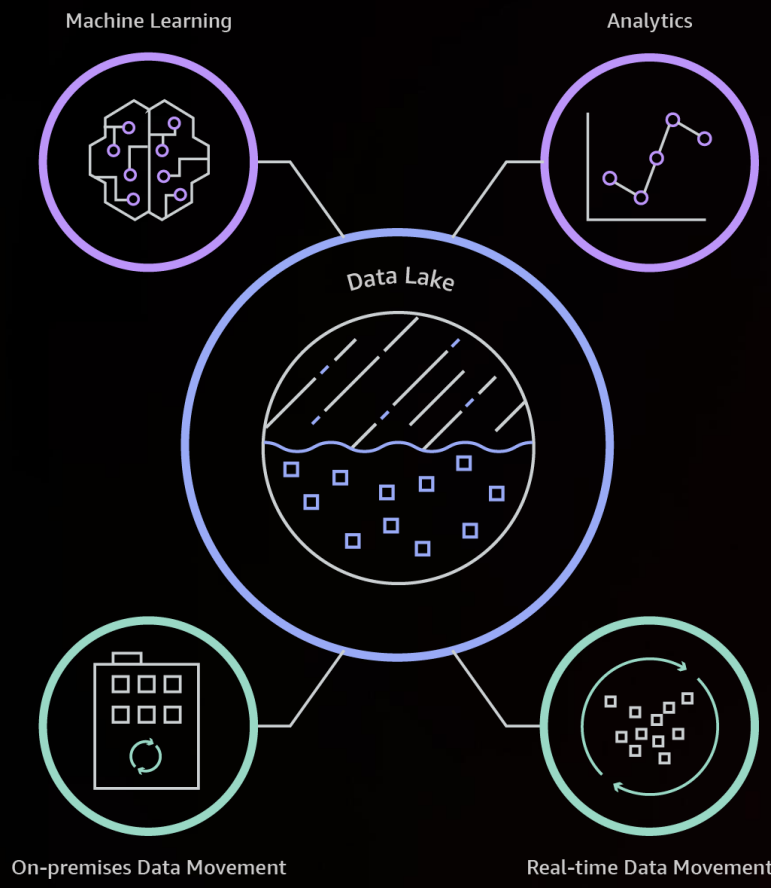
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Migrated on-premises workloads to Amazon S3



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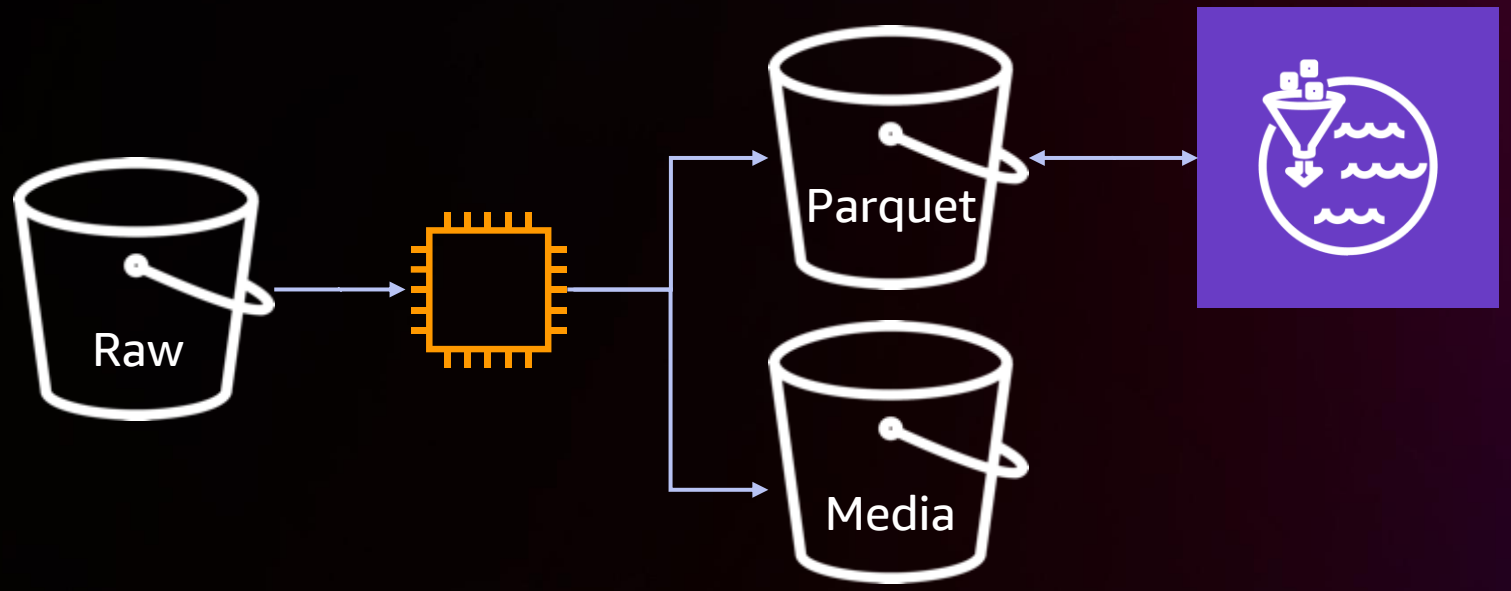
Data lakes on Amazon S3 enable new capabilities



- Efficiently look at specific threads of data across tests
- Combine and share data (operational reporting)
- Data enrichment (KPIs)
- Create and update ML datasets

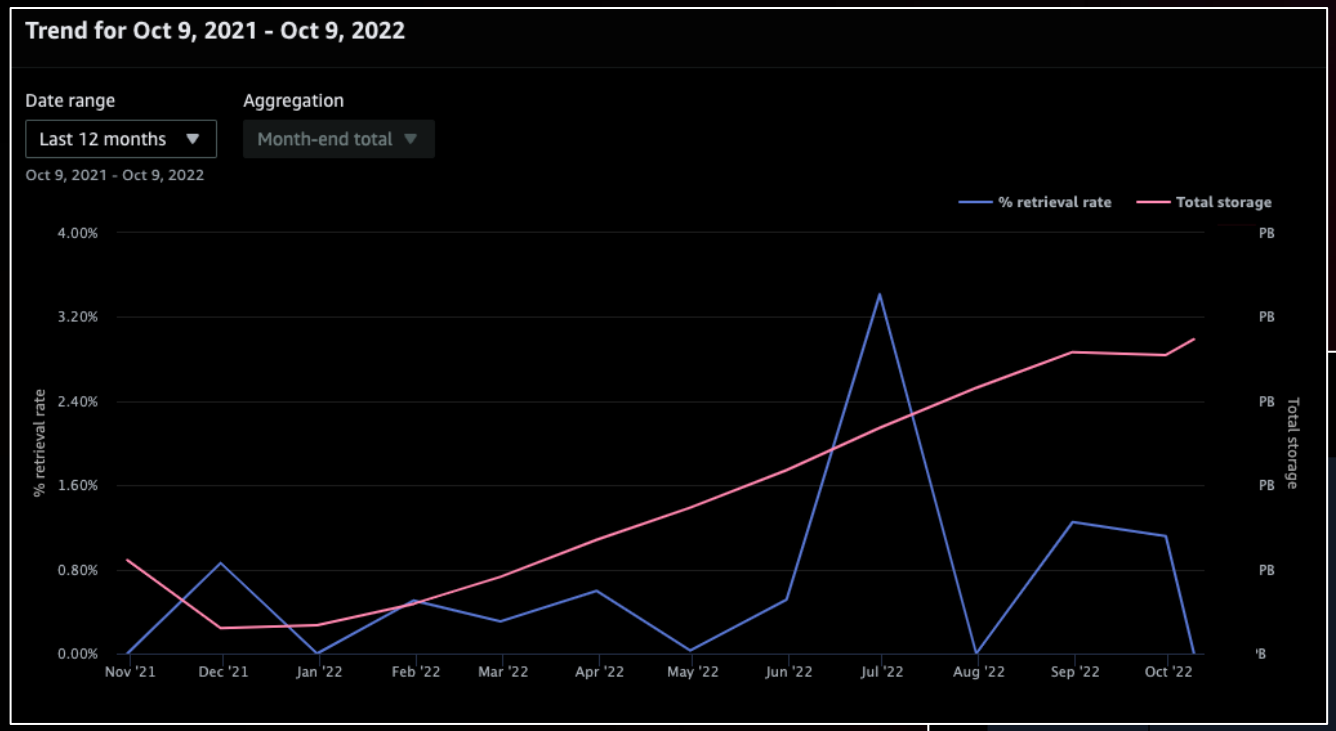
aws
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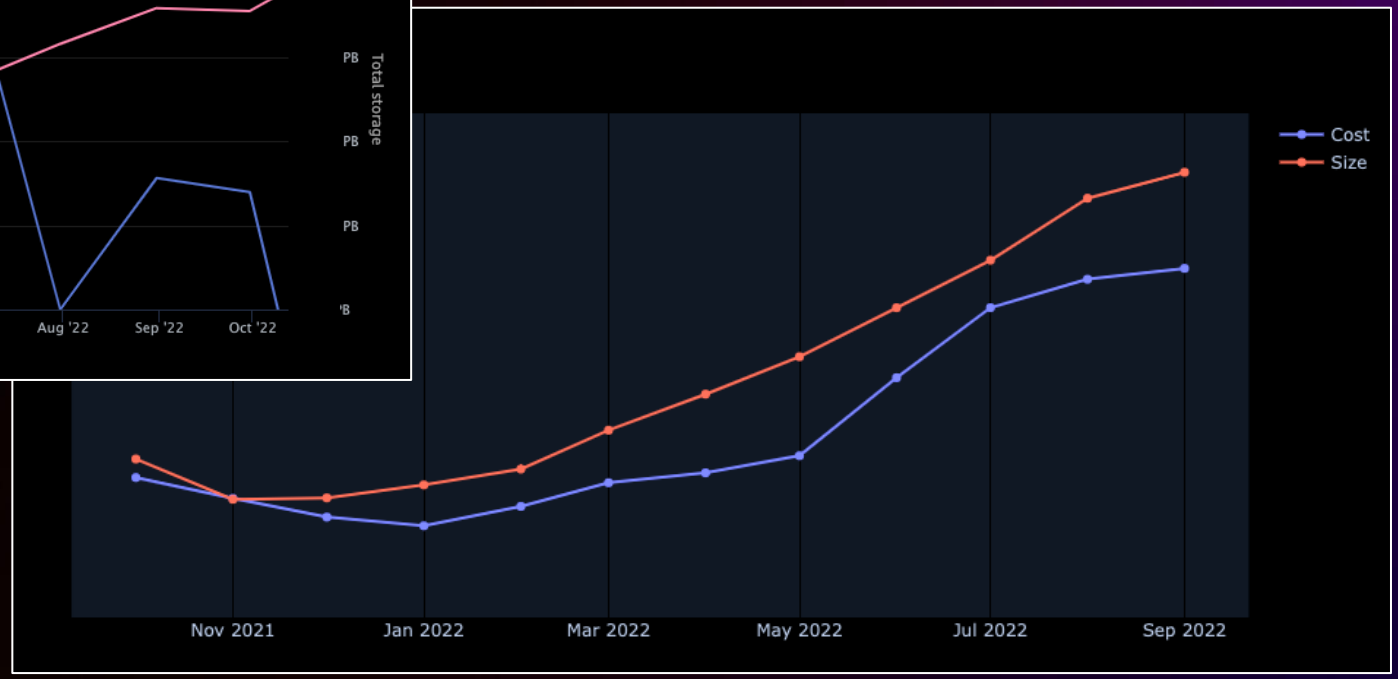
Simplified setup



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Optimizing cost with S3 Intelligent-Tiering





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Optimizing performance

Problem:

- Bursty request rates during uploads to Amazon S3

```
<test_uuid>/<data_stream_name>/<original_key>_<timestamp>.<ext>
```

- Our PUT object costs accounted for 8% of our cost

Solution: Bundled media into tar files

Effects:

- Reduced PUTs by 99% and eliminated throttling
- Incurred some time cost in extraction process

aws

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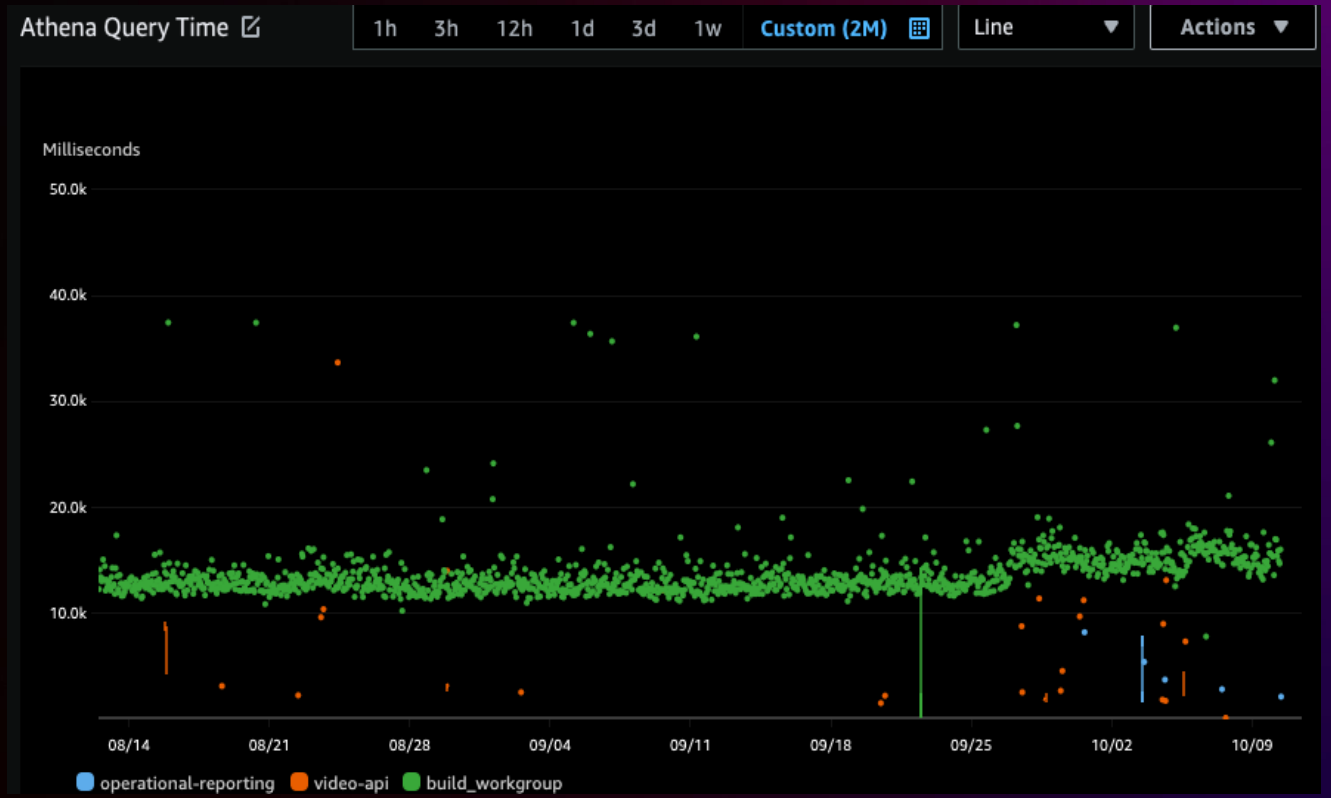
Amazon Athena query performance

S3 prefixes determine partition schema for tables

Choose prefixes based on the most common query conditions

Setting partition indexes reduced query times by up to 40%

Observe <20s query times when using partitions



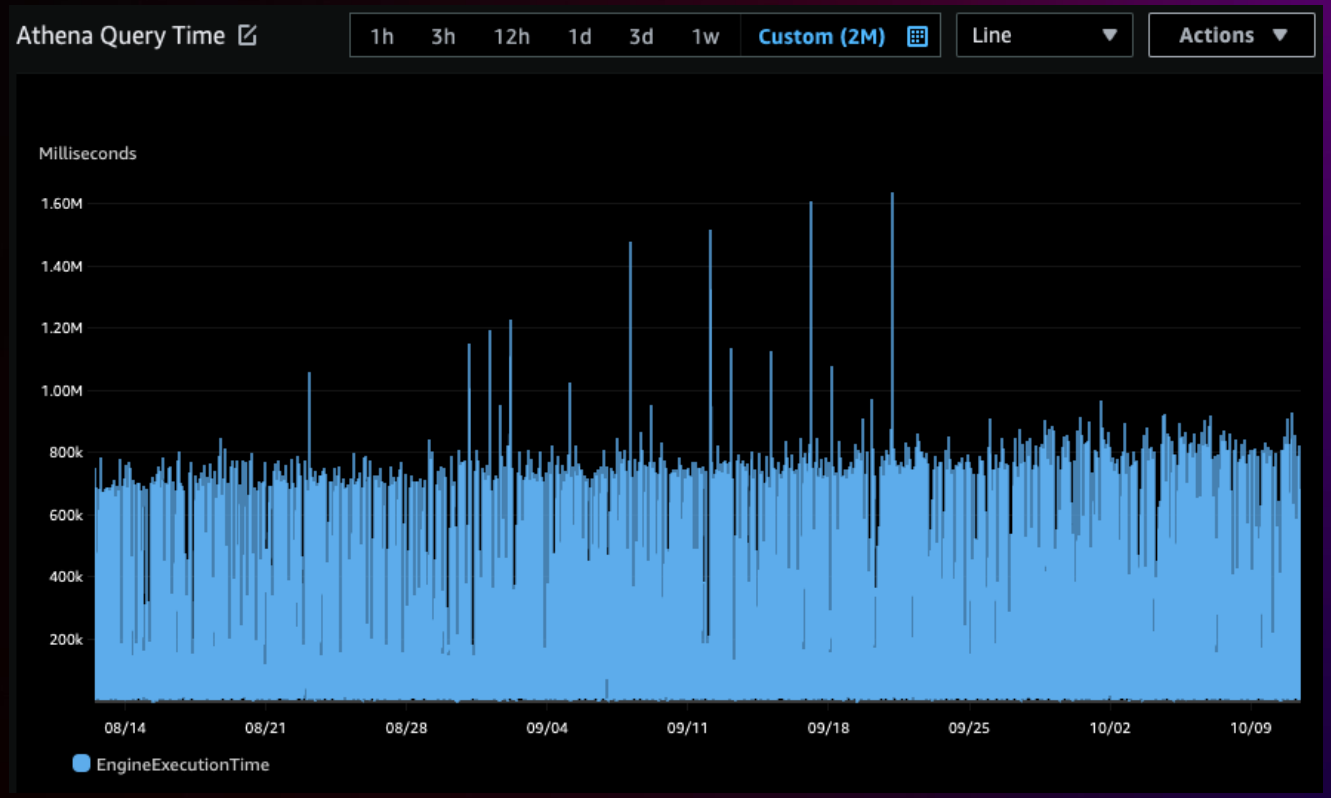
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Amazon Athena query performance

Observe 1-12m query times for common full table operations

Complex queries can be much longer (<30 mins)

Vehicle data database contains >300B rows



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Amazon Athena query performance

No performance impact from SSE

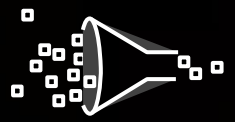


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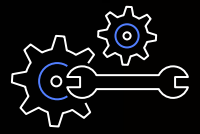
Putting it all together



Monitor and manage data with Amazon S3 tools



Optimize storage with purpose-built storage classes



Achieve high performance with Amazon S3

aws

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Thank you!

Christoph Bartenstein

Andrew Kutsy

Zane Reynolds



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