Data transfer, synchronisation and sharing

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Efficient Data Management

- Data is the lifeblood of research (or any modern business).
- Having data is not enough; it needs to be organized, and be accessible.
- The ability to seamlessly transfer, synchronize, and share data is crucial.

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A clear opportunity presented by STFC "foundational" infrastructure: Ceph S3 object storage as the common backend

ceph

- To support our data transfer, synchronization, and sharing needs, we've selected Ceph S3 Object Store as the foundational storage backend.
- Ceph is an open-source, highly scalable object storage solution that enables us to manage large volumes of data with flexibility and resilience
- Why Ceph S3?
  - Scalable
  - Cost-efficient
  - STFC have an expertise in it

References: https://docs.ceph.com/en/latest/start/

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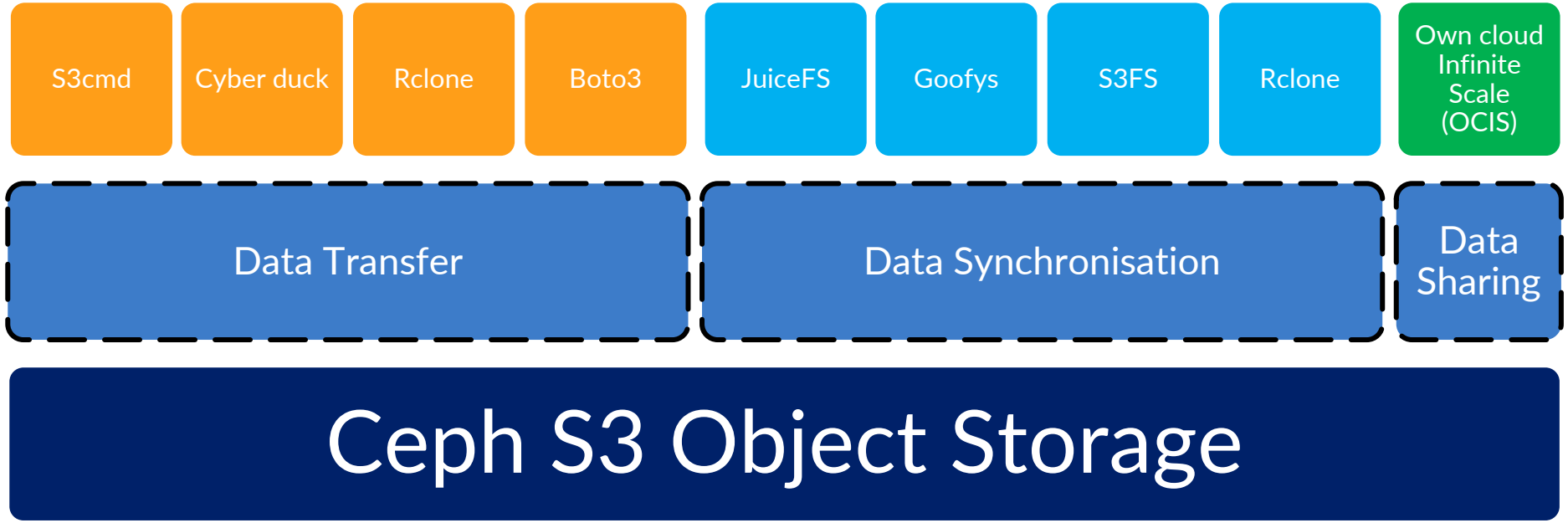
Overview of technology trials and use cases



Purpose of Experiments Each tool was assessed to understand its strengths and limitations in handling data workflows, including:

- **Data Transfer**: Efficiently moving large datasets between storage systems.
- **Data Synchronization**: Keeping data in sync across distributed locations or multiple devices.
- **Data Sharing**: Facilitating collaboration and secure data access for users across our network

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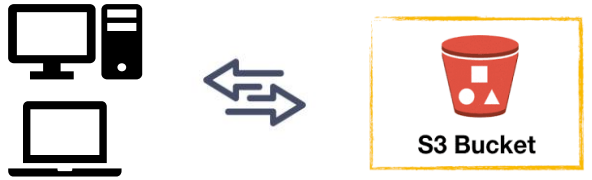
Data Transfer

Challenge:

Efficient transfer of large volume of files and objects between different locations and systems.



Data Transferring Tools:

S3cmd: A cross-platform command-line tool	**CyberDuck**: : A user-friendly graphical file transfer application	**Boto3**: A powerful Python SDK	**rclone**: A cross-platform command-line tool

s3cmd

Cyberduck

Boto 3

RCLONE

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Data Synchronisation

Challenge:

Maintaining synchronization and data consistency across multiple locations and devices

File Systems and Data Synchronization Tools:

JuiceFS: A POSIX-compatible distributed file system	**Goofys**: A high-performance FUSE-based file system	**s3fs**: A FUSE file system	**rclone**: rclone can also be used as a powerful data synchronization tool

JuiceFS

s3fs

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Data Sharing

Challenge:

Enabling effective and secure data sharing among teams, departments, and even external partners.

Data Sharing Platform

Own Cloud Infinite Scale (OCIS)

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Why OCIS?

Scalability

- Integration with Ceph S3
- Efficient Data Handling

Collaborative Workspaces

- Dynamic Quotas
- Permission Settings

Security

- Role-Based Access Control (RBAC)

Multi-Platform Compatibility

API Access & Custom Workflow Integration

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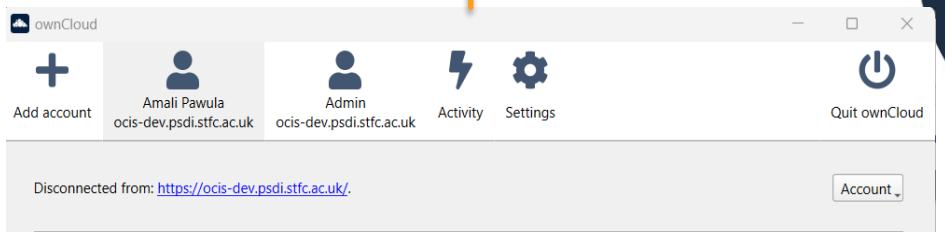
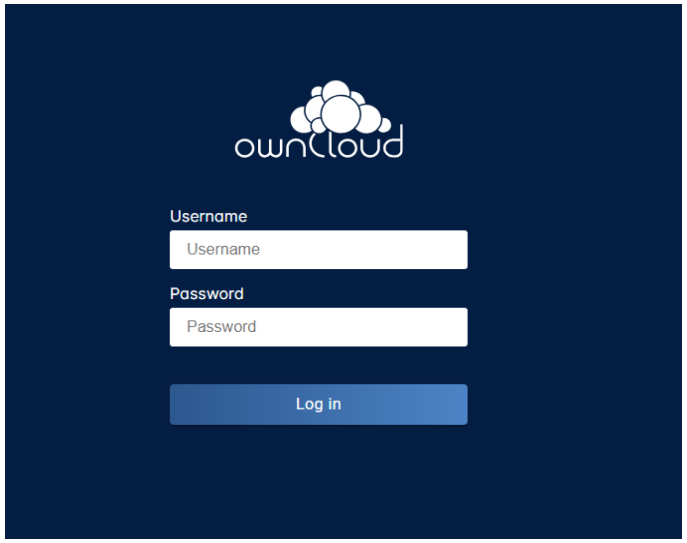
Access Your Data Your Way

ownCloud Infinite Scale



Own Cloud Desktop Client (Windows)



Web User Interface : https://ocis-dev.psdi.stfc.ac.uk/

OCIS - Application Programming Interface

WebDAV Support

RCLONE

Easily connect with rclone for flexible file management

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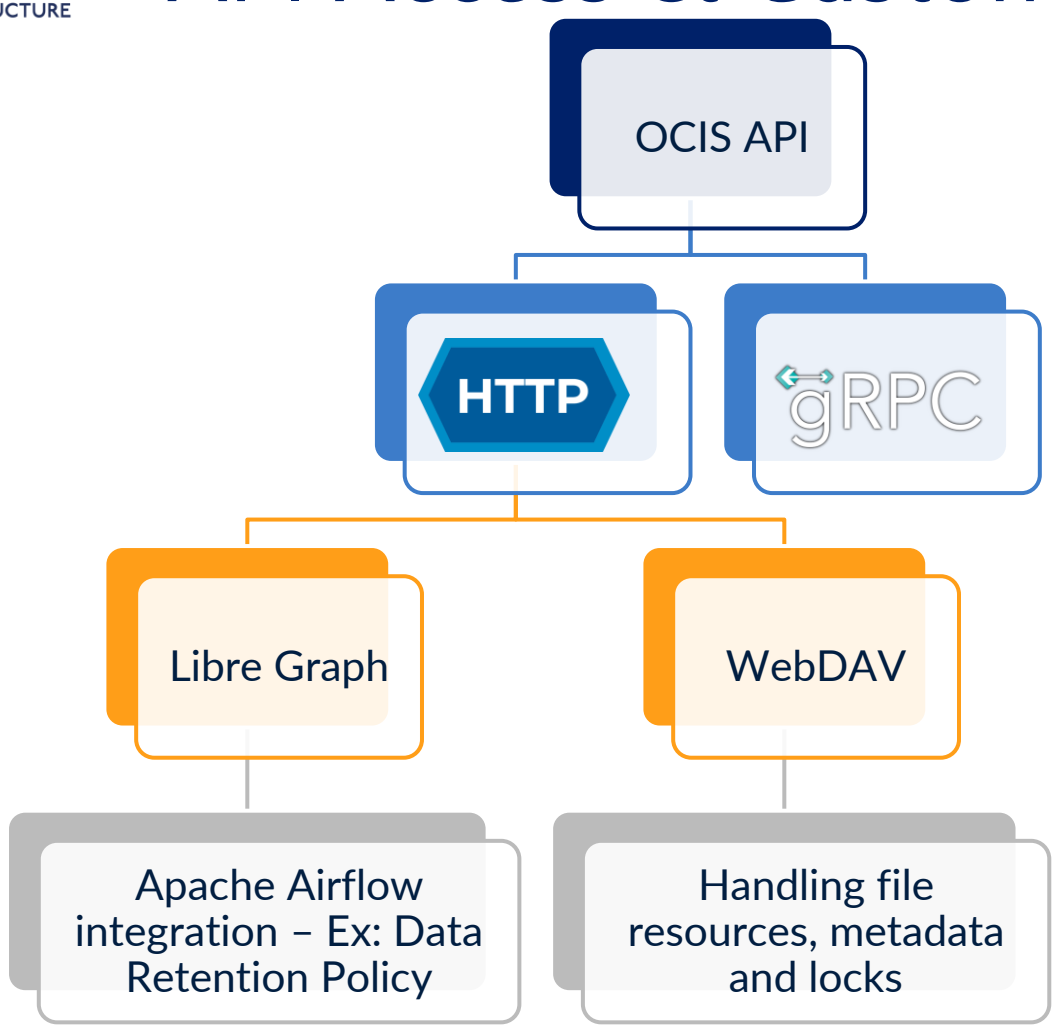
API Access & Custom Workflows



POSTMAN

curl://

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Data transfer, synchronisation and sharing solution can be combined with workflows solution for defining (and operating) data policies

Implemented	*As the data transfer, synchronisation and sharing solution administrator, I want to define and operate data retention policy*
Pending implementation	*As the data transfer, synchronisation and sharing solution administrator, I want to define and operate data release policy*
Pending implementation	*As the data transfer, synchronisation and sharing solution administrator, I want to define and operate data indexing policy*

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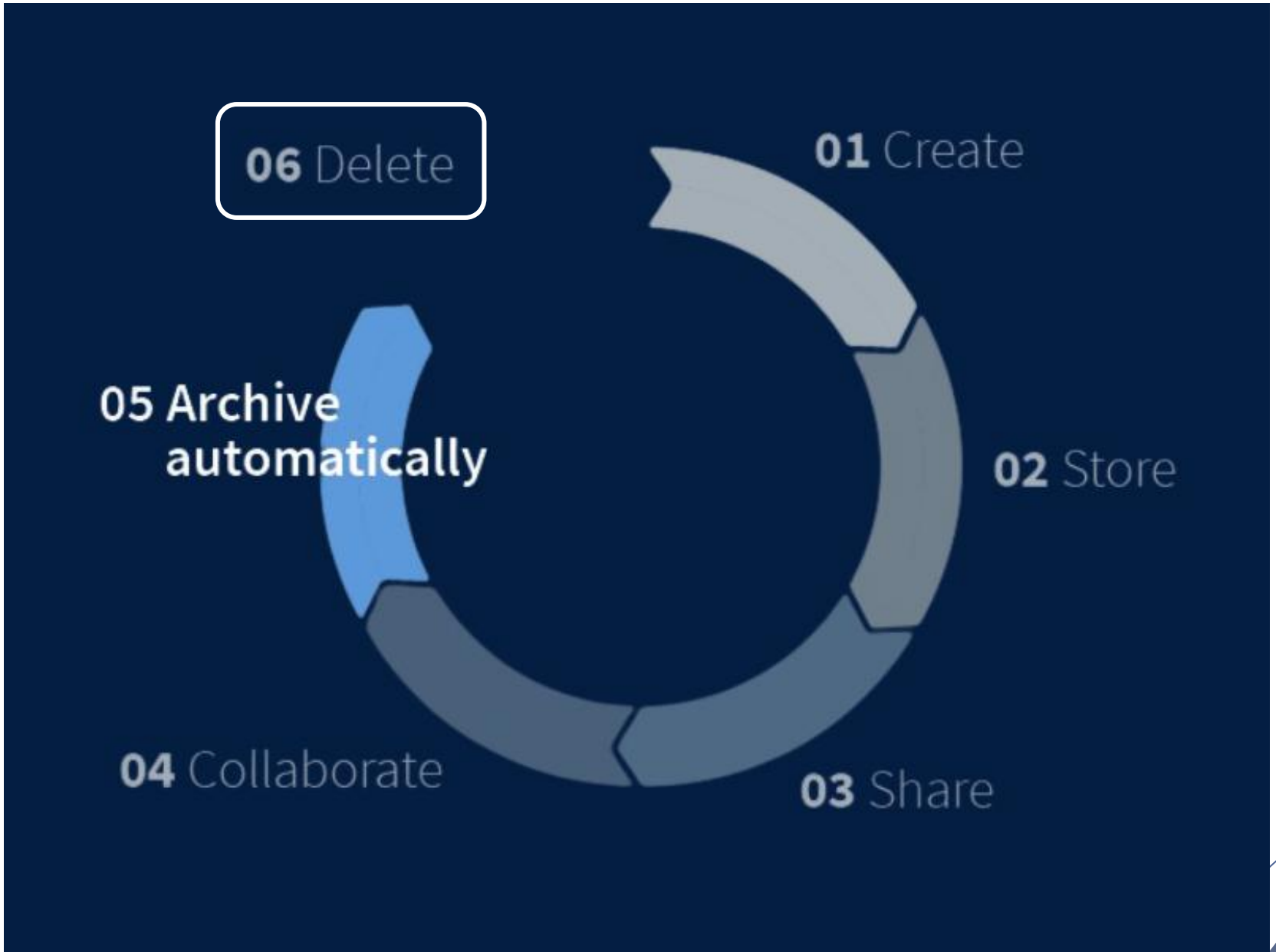
Data Lifecycle Management

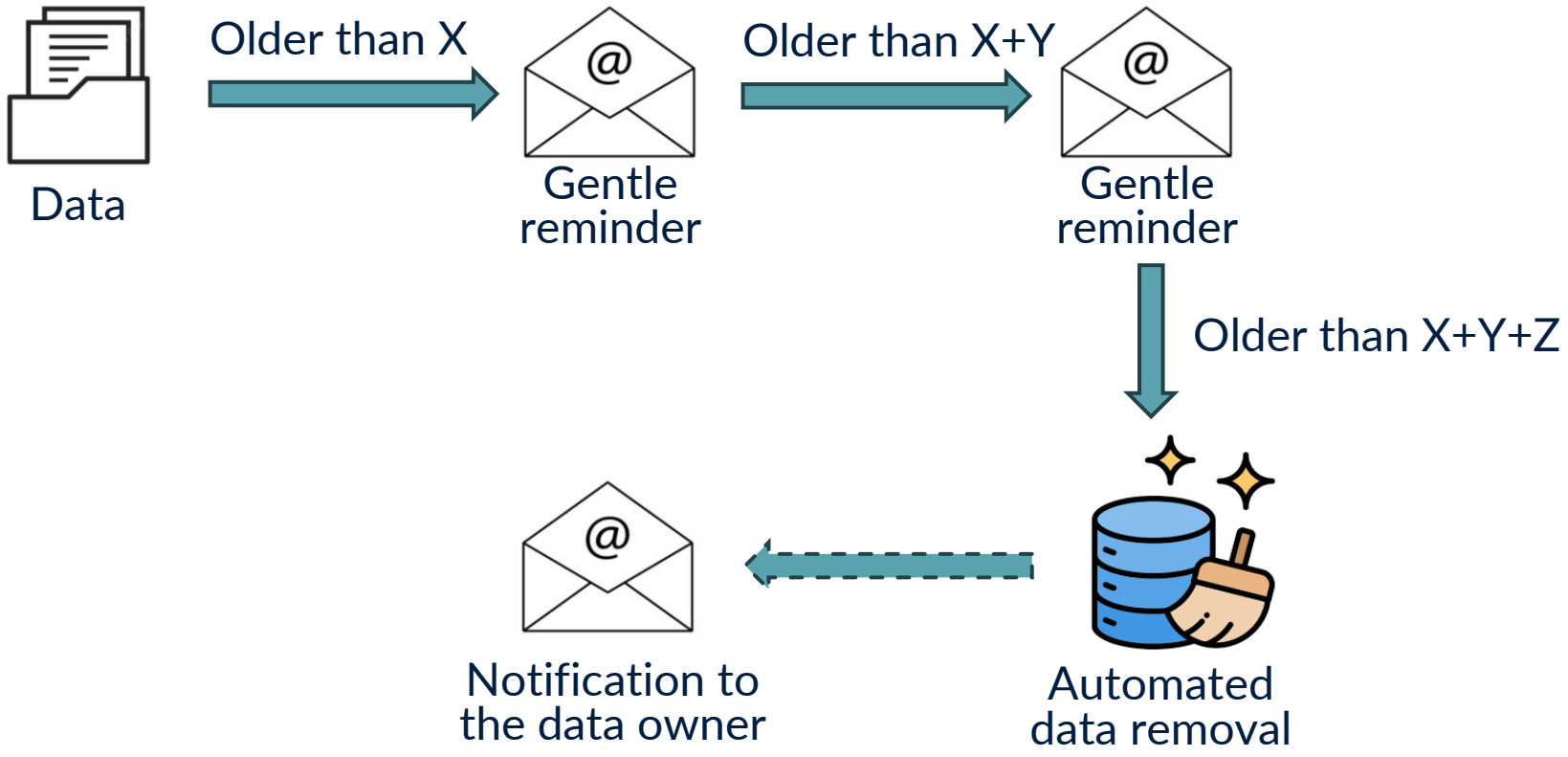


Simple data retention policy

Proof of concept: https://github.com/PSDI-UK/ocis-data-retention-policy-poc

Scheduled actions: Apache Airflow

API: WebDAV



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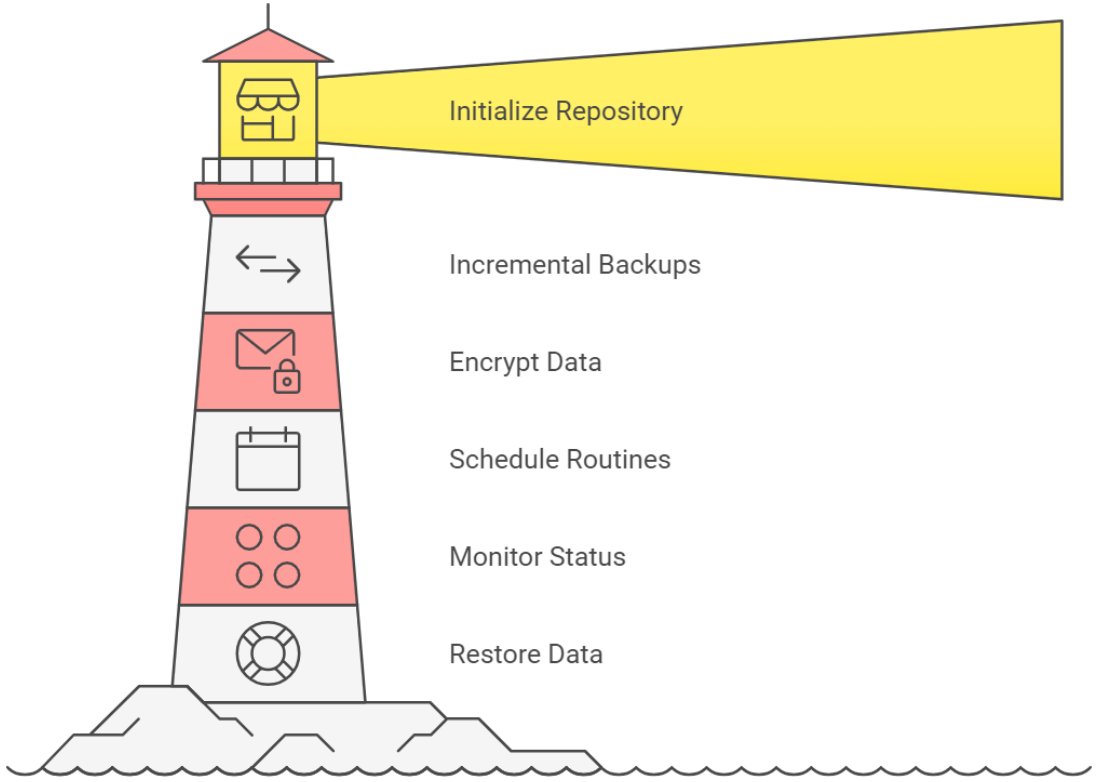
Ensuring Data Integrity with Backup and Restore



RESTIC : Backups Done Right

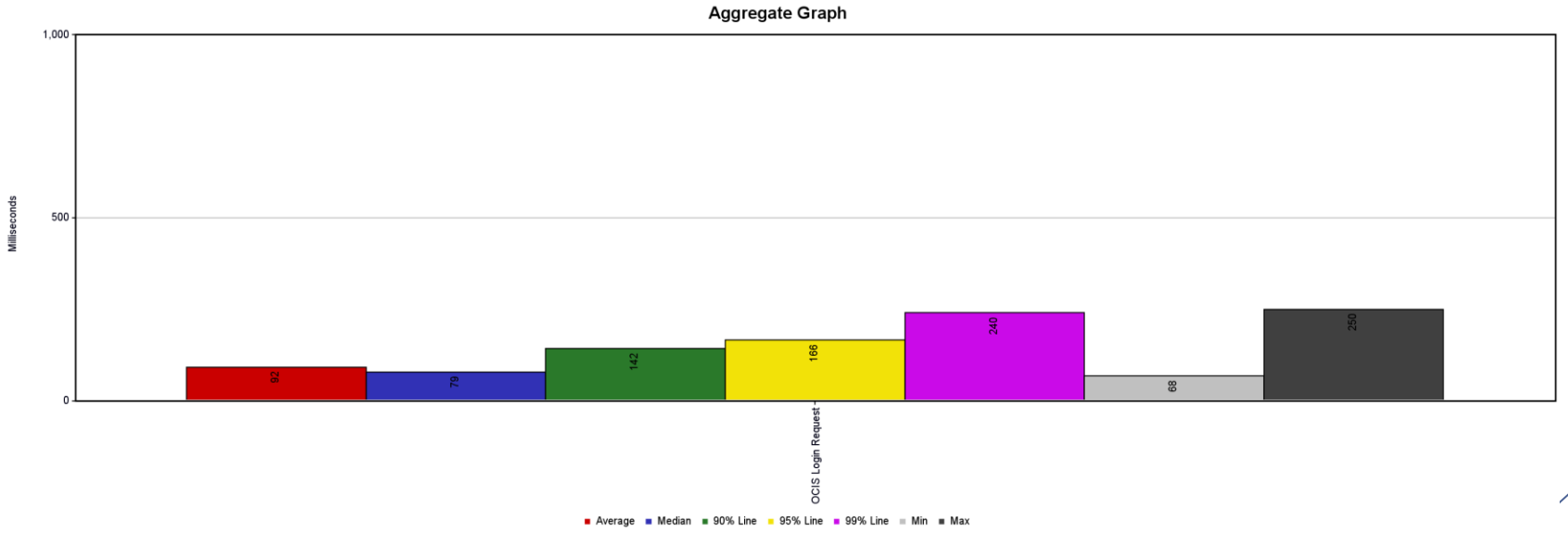
- Restic is a powerful, open-source data backup and restore tool that we've integrated into our Ceph S3 object store
- Restic offers several key advantages:
  - Incremental Backups
  - Cross-Platform Compatibility
  - Encryption and Security
  - Ceph S3 Integration

Load Testing Results for OCIS

Ref: https://jmeter.apache.org/

Aggregate Report for Login Request with 100 concurrent users – GET HTTP Request

Label	# Samples	Average	Median	90% Line	95% Line	99% Line	Min	Max	Error %	Throughput	Received KB/sec	Sent KB/sec
OCIS Login Request	100	78	70	105	125	169	62	179	0.00%	48.87586	69.16	24.1
TOTAL	100	78	70	105	125	169	62	179	0.00%	48.87586	69.16	24.1



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More Results..

Aggregate Report for File Uploading (500mb)Request with 100 concurrent users – PUT HTTP Request

Label	# Samples	Average	Median	90% Line	95% Line	99% Line	Min	Max	Error %	Throughput	Received KB/sec	Sent KB/sec
OCIS File Upload Request	100	290	281	414	441	461	162	463	0.00%	19.33862	12.35	7.88
TOTAL	100	290	281	414	441	461	162	463	0.00%	19.33862	12.35	7.88

Aggregate Report for File Downloading Request with 100 concurrent users – GET HTTP Request

Label	# Samples	Average	Median	90% Line	95% Line	99% Line	Min	Max	Error %	Throughput	Received KB/sec	Sent KB/sec
OCIS File Download Request	100	307	289	425	508	582	168	595	0.00%	30.75977	29.83	9.22
TOTAL	100	307	289	425	508	582	168	595	0.00%	30.75977	29.83	9.22

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Current status summary

- Functionally complete prototype of a data transfer, synchronisation and sharing solution is developed
- Capitalizes on a mature, scalable and cost-efficient STFC object store
- Includes Web UI, desktop UIs, machine interface, data transfer and data backup tools
- OCIS installed via Helm with GitHub Repository managed configuration
- Initial load testing is performed, simulating up to 100 concurrent users
- A few file systems built on top of object store were tested, which can be valuable add-ons
- The data transfer, synchronisation and sharing solution can be paired with the indexing solution (pending demonstration) and machine-actionable policies (already demonstrated)

Next steps

- PD ▶ Collect expressions of interest for user testing, from pathfinders in the first place. Define and run a structured user testing exercise
- PD ▶ Review operational maturity when PSDI Helpdesk function or / and PSDI IT Service Management roles are established
- MPD ▶ Implement more data policies in addition to one demonstrated
- ▶ Introduce integrations with other solutions, notably with indexing
- ▶ Consider publishing a comprehensive technical report

PD = Project Dependency that cannot be resolved by the WP3 / Vasily's team only

MPD = Mild Project Dependency, where consultation with the project is nice to have