CERNBox

Community Distribution for Analysis Facilities

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On behalf of the CERNBox team

Contents

- Cloud Sync&Share Storages at CERN and beyond

- The Technology

- Community and Outlook:
Storage and Sync&Share for Analysis Facilities

CERN's cloud collaboration storage platform

- **1 TB** for every user, up to **10 TB** on demand
- **Built purely with open-source components**
  - **ownCloud for "Dropbox" use-case**
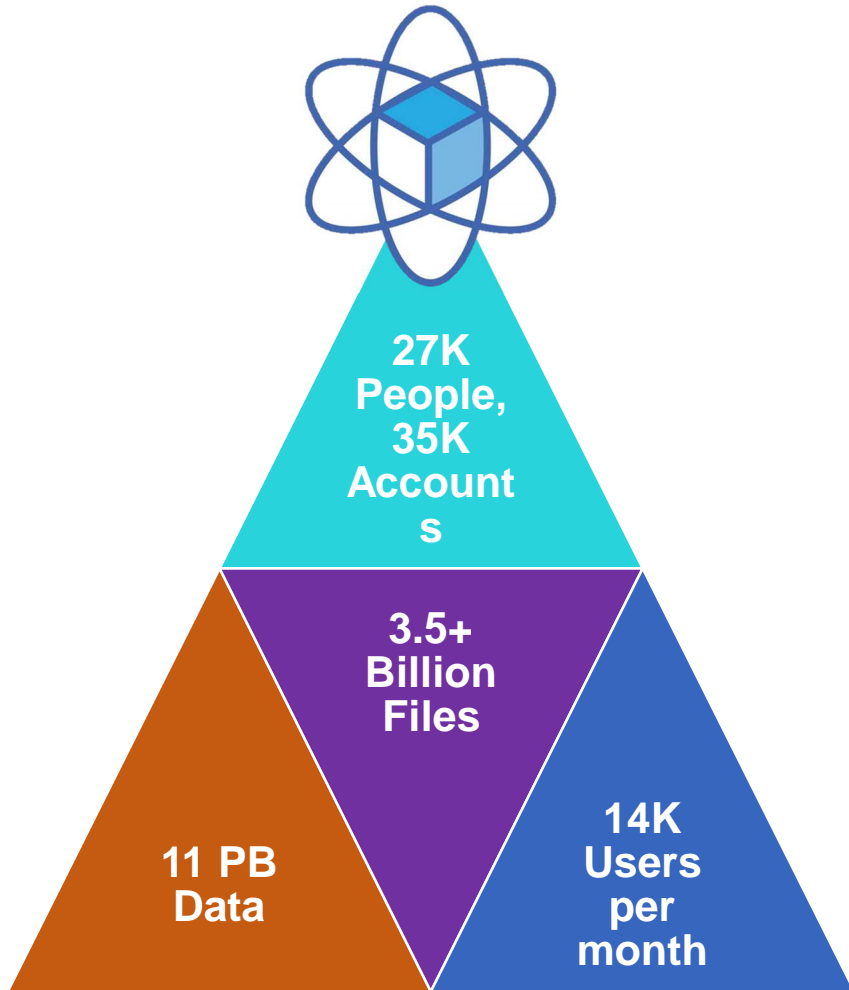 - **EOS and Ceph for storage**

- **Data safely stored on CERN premises**
- **Security policies to keep data safe and confidential**

Usage and Features in a nutshell

27K People, 35K Accounts

3.5+ Billion Files

11 PB Data

14K Users per month

Provides storage and sync for users

Users have control over access permissions, sharing links, and can collaborate in real-time

Versioning and File History

Security and Authentication (KRB, OIDC, tokens)

Robust backup in two computer centres

Integration with CERN baseline services (auth, groups, mail)

Scientific Computing: integration tier for multiple scientific platforms (Jupyter Notebooks, computing farms, HPC clusters, ...)

A Cloud Storage for Scientific Computing

- **Usage spanning the whole Organization**
  - Physics, Engineering, Administration
  - **420K** public links, **160K** shares, **1.3K** project areas

- **A great diversity of use-cases and workflows**
  - Generating tens of thousands of different file *types*
  - Most represented: sources (all together), images, ROOT files
  - A large fraction of files are machine-generated

- **Combined FUSE + cloud access very popular**
  - About **1.9K** unique users access the storage via FUSE daily
  - **40-45%** of them also use cloud (offline sync or web) access at the same time
  - Storage throughput dominated by FUSE traffic from Batch farm (**70%** of total I/O)

CERNBox all counts - NS
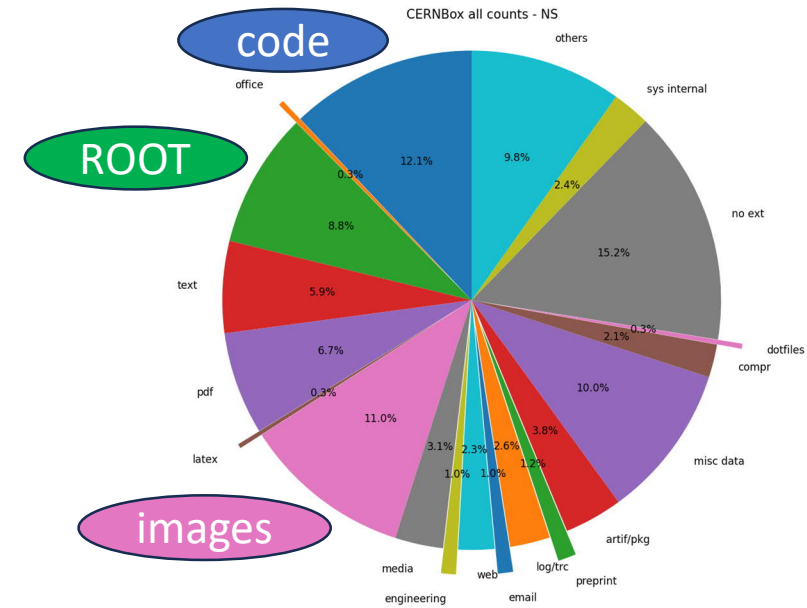
World-wide usage on a single day (Tue Feb 27ᵗʰ)
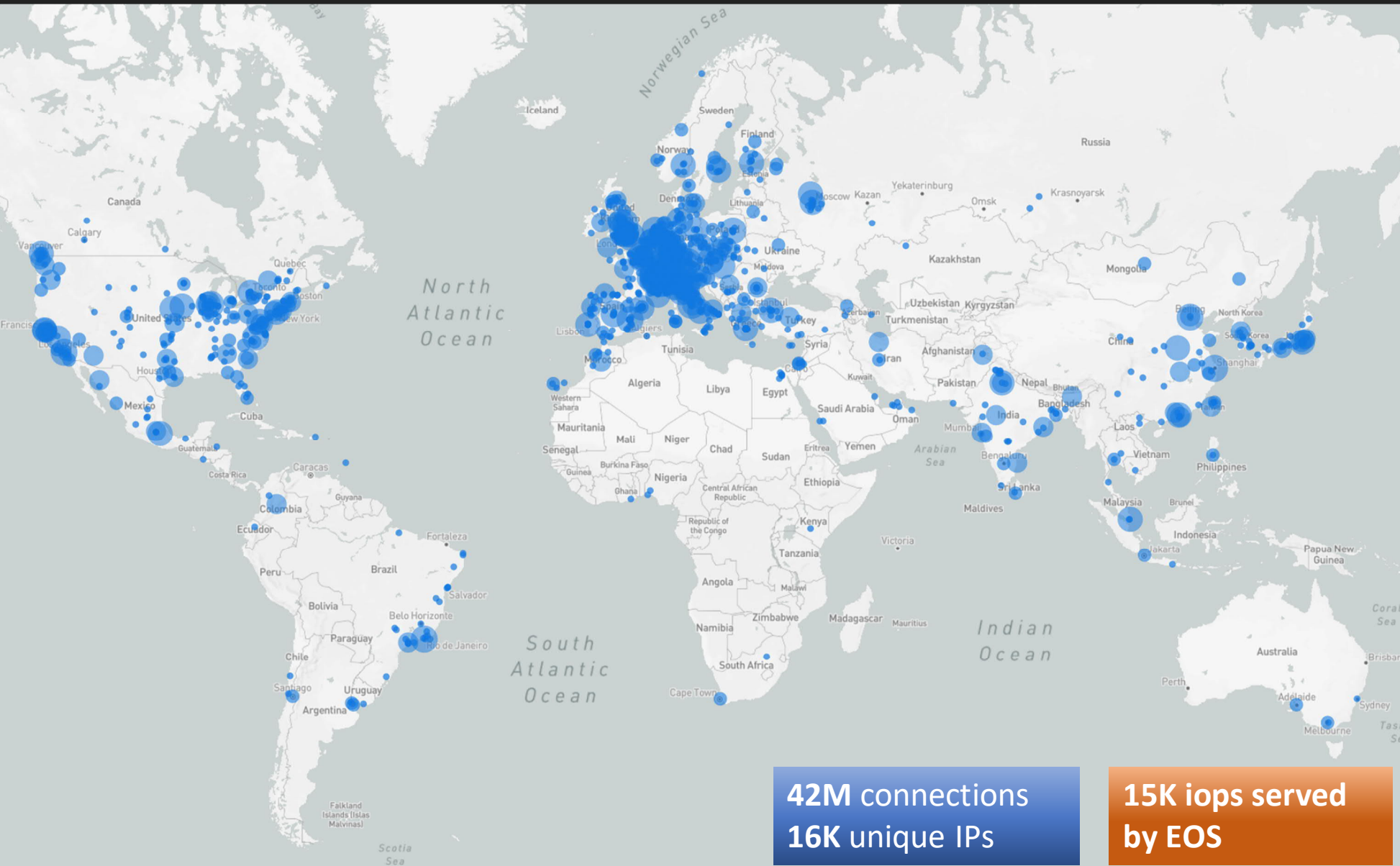
89 COUNTRIES   1467 CITIES

Copy URL   New Map

🇨🇭 Switzerland	7540 IPs
🇫🇷 France	1819 IPs
🇺🇸 United States	1277 IPs
🇮🇹 Italy	917 IPs
🇬🇧 United Kingdom	763 IPs
🇩🇪 Germany	760 IPs
🇪🇸 Spain	316 IPs

42M connections
16K unique IPs

15K iops served by EOS

Generated at https://ipinfo.io

The Cloud Sync&Share Storage (CS3) Community

- An active community, **significant intersection with HEP sites**

- Sites survey updated in March 2024
  - **32** sites running an EFSS
  - **500K+** users in Education & Research

- Meet up at the CS3 Workshop, this year hosted at CERN as part of TechWeekStorage24
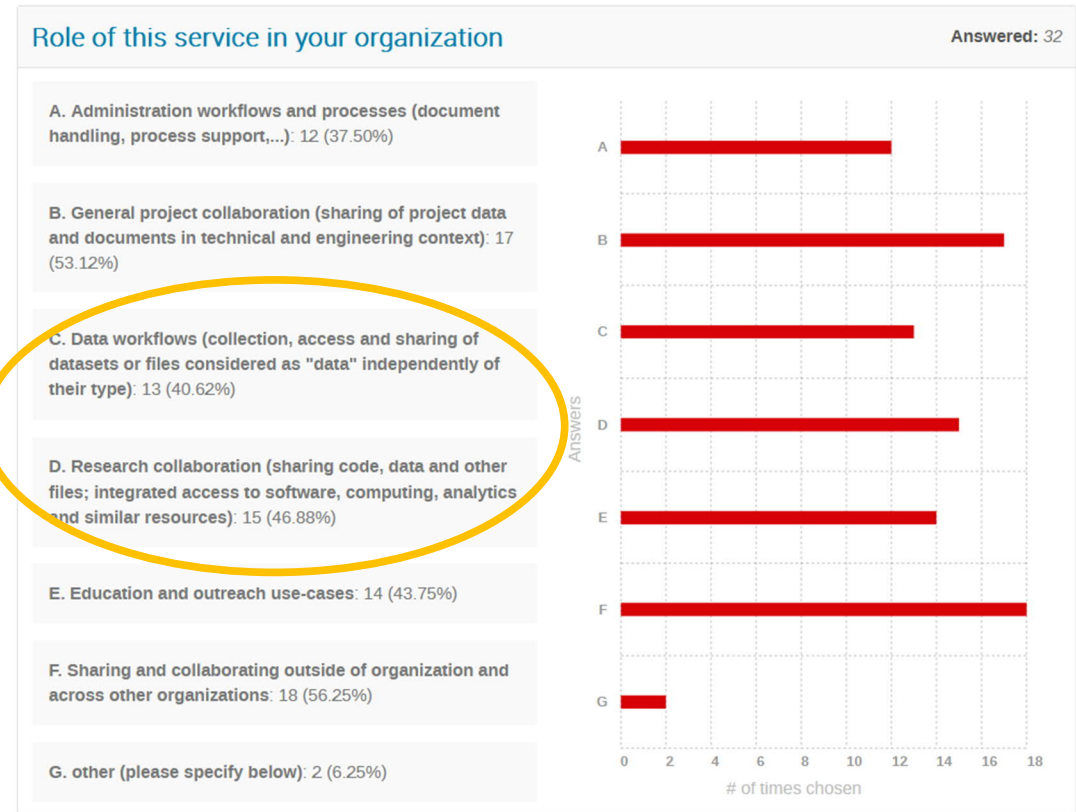

From https://cs3map.ethz.ch

Usage of CS3 Services in the Community

- Survey run at the CS3 Workshop 2024

- **Significant interest in Data workflows and Scientific Computing at large**
  - More than Administration workflows, corresponding to pure Dropbox-like use-cases
  - Collaboration across other organizations even more important

- Integration of Sync&Share with platforms such as JupyterHub increasingly popular

Role of this service in your organization — Answered: 32

A. Administration workflows and processes (document handling, process support,...): 12 (37.50%)

B. General project collaboration (sharing of project data and documents in technical and engineering context): 17 (53.12%)

C. Data workflows (collection, access and sharing of datasets or files considered as "data" independently of their type): 13 (40.62%)

D. Research collaboration (sharing code, data and other files; integrated access to software, computing, analytics and similar resources): 15 (46.88%)

E. Education and outreach use-cases: 14 (43.75%)

F. Sharing and collaborating outside of organization and across other organizations: 18 (56.25%)

G. other (please specify below): 2 (6.25%)

The Technology

The Technology

- Architecture paradigm: **microservices**

- Multiple components and daemons, each responsible for (a simple) part of the service, easing horizontal scalability
  - Most parts are distributed, metadata is kept on the storage and partly cached on a MySQL database
  - Technologies of choice: Vue.js, Golang and Python, Protobuf
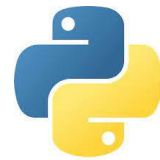
The Technology: protocols and APIs

- **Reva** : the backend, written in Go
  - Public API available at https://github.com/cs3org/cs3apis, in collaboration with ownCloud
  - Provides **HTTP** and **gRPC** services, including federation (OpenCloudMesh), WLCG-based TPC, ...

- Web frontend co-developed with ownCloud
  - Part of their new product oCIS
    - Currently on a fork, aim is to converge in the coming weeks
  - Mix of **WebDAV** and HTTP REST APIs

- (Branded) Sync clients provided by ownCloud
  - Fully based on **WebDAV**

- Storage: EOS offers **XRootD, HTTP, gRPC, FUSE**; CephFS offers native library
  - Reva interacts with EOS via XRootD, soon via gRPC+HTTP

- Satellite components, probes, etc. written in Python and Go
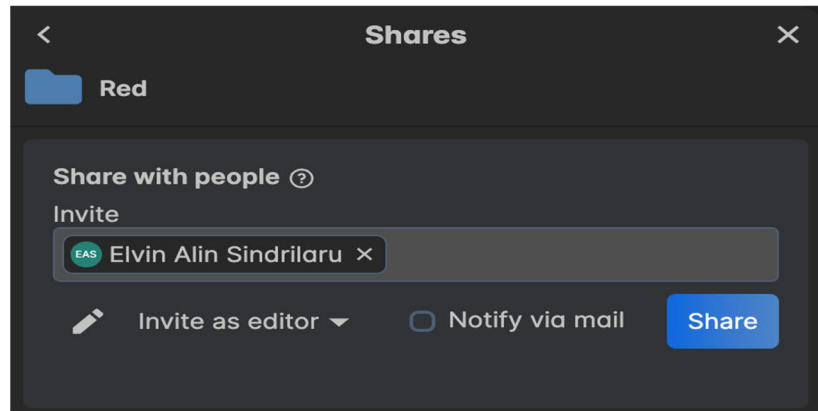
/eos/project/m/ml-for-hep/my_great_gpt/dataset.h5

0d4d04eb-d081-41a9-92cd-8b49c540d08c!df62cd7f-538d-4b15-8fb3-b046ee6bbe77$630dea7f-f2b1-4971-82fa-63a8eb005dc1

What makes CERNBox different?

- Storage is exposed transparently & it's directly accessible and mountable
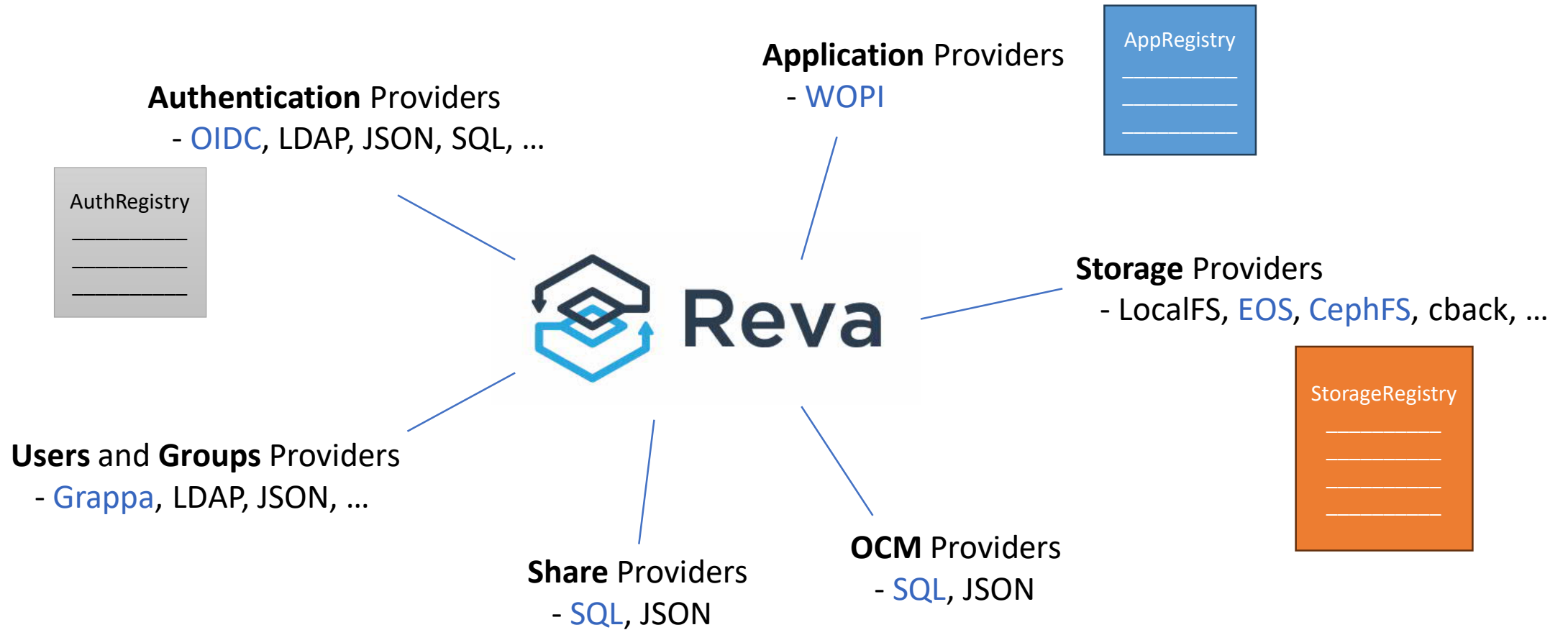 - This allows convergence of access via multiple access methods

- As a corollary, namespace metadata lives in the storage
  - Setting metadata on files from Web or mobile/desktop applications is reflected on the storage

Zooming into Reva

Authentication Providers
- OIDC, LDAP, JSON, SQL, …

AuthRegistry
_____
_____
_____

Application Providers
- WOPI

AppRegistry
_____
_____
_____

Storage Providers
- LocalFS, EOS, CephFS, cback, …

StorageRegistry
_____
_____
_____
_____

Users and **Groups** Providers
- Grappa, LDAP, JSON, …

Share Providers
- SQL, JSON

OCM Providers
- SQL, JSON

- The storage plays a crucial role in supporting all cloud storage use-cases

Feature	EOS	CephFS
Rich ACLs for users&groups, authenticated shares	✔	✔
Atomic uploads for sync clients	✔	✔
Automatic file **versioning**	✔	✖
Recycle bin	✔	⚠ WORK IN PROGRESS
File **locking** (support for web apps)	✔	⚠ WORK IN PROGRESS
Mounted filesystem access, "near-POSIX" interface	✔	✔✔

Reva provides the rest:

✓ Desktop/Mobile sync clients

✓ Non-authenticated shares

✓ Hooks for web apps (from text editors to Jupyter and external services)

Community and Outlook

A growing interest

- Building on the CS3 Community, and on the HEP Community at large
  - [BoF event at CHEP 2023](#) gathered significant interest

- First in-person Meet the Team Event @ CERN TechWeekStorage24
  - With KIT, IN2P3, SURF, LBL, PIC, RAL-STFC representatives, among others

- What can we offer?
  A CERN-agnostic CERNBox setup + consultancy

- What do we aim for?
  A self-supporting community (cf. EOS), to address together
  common issues, and contribute to the development
  of drivers (e.g. CephFS) or specific capabilities
 - A plugin system is already in place for Reva

Joining the Community

- **Please get in touch!**

- Send a mail to reva-community@cern.ch to join the mailing list

- Reva server repository: https://github.com/cs3org/reva
  - Discussion page https://github.com/cs3org/reva/discussions recently launched

- CERNBox repository: https://github.com/cernbox

- IN2P3 prototype with CephFS (*courtesy Michel Jouvin*):
  upstream ownCloud client over Reva + direct access to underlying filesystem
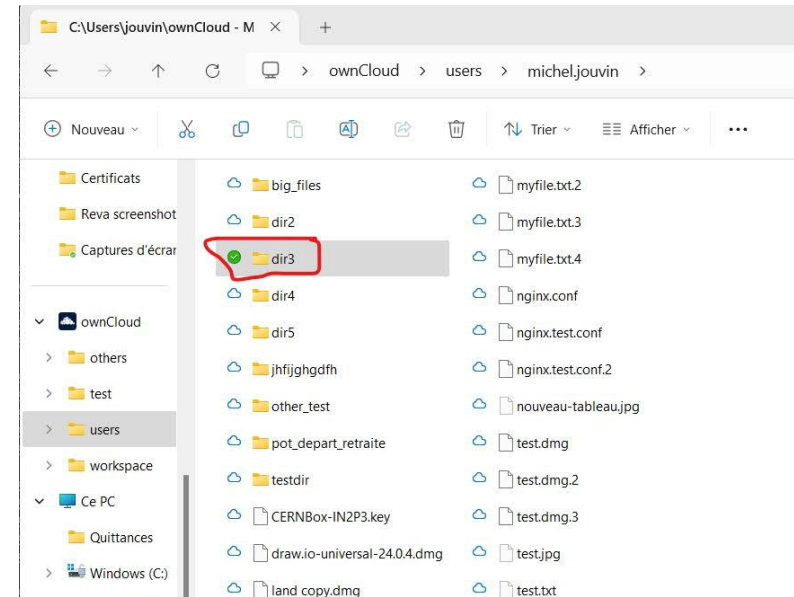
Outlook: which Storage for Analysis Facilities

- High-performant storage is key for the high-throughput computing needed at HEP Analysis Facilities
  - See also [talk by A. Sciabà on Friday](#)
  - Mountable storage for interactive use-cases

- High Performance I/O for HEP @ Compute & Accelerator Forum ([last week](#)!): ROOT's `RNTuple` being promoted to replace `TTree` for optimized storage and I/O
  - => The heavy lifting remains with the underlying storage
  - EOS is being evolved, in coordination with ROOT and xrootd developers

- Ongoing discussions about Analysis Facilities in HEP…
CERNBox and its ecosystem, including **SWAN**, is a proven implementation for a **Cloud Storage underlying an Analysis Facility**
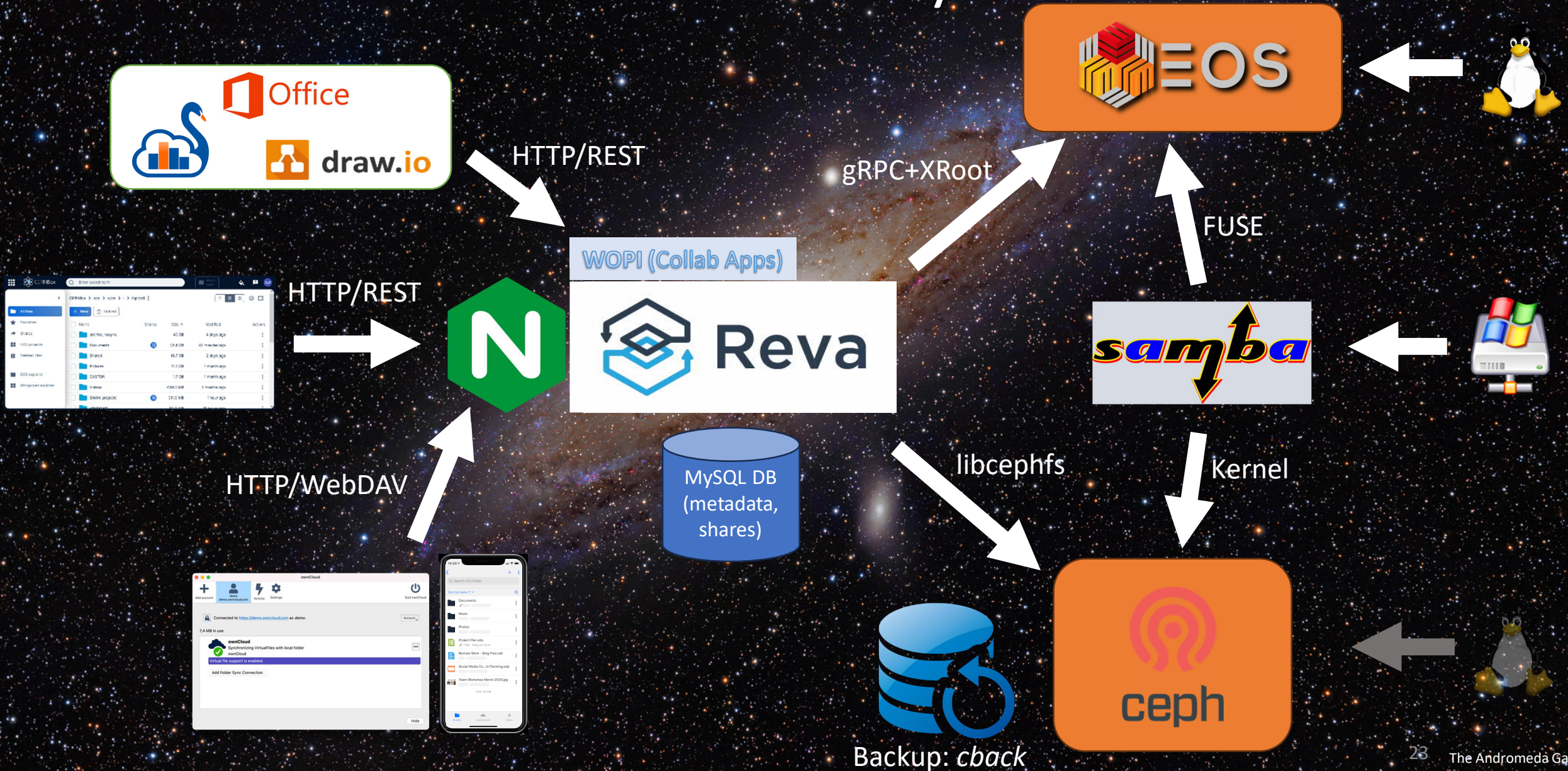
BACKUP SLIDES

Reva CephFS resources

- Reva CephFS community deployment forum:
  https://github.com/cs3org/reva/discussions/4610

- Reva CephFS deployment documentation (online soon):
  https://reva.link/docs/tutorials/cephfs-tutorial

Architecture: The CERNBox Galaxy

HTTP/REST

HTTP/REST

HTTP/WebDAV

WOPI (Collab Apps)

Reva

MySQL DB (metadata, shares)

gRPC+XRoot

FUSE

libcephfs

Kernel

Backup: *cback*

EOS

samba

ceph

23

The Andromeda Galaxy. Source: Wikimedia

CERNBox Applications

- Long track of apps integrated in CERNBox

- For Research / Data Science
  - SWAN, Apache Spark (via FUSE mount!)
  - ROOT viewer

- For productivity
  - Microsoft Office 365 Online
  - Collabora, CodiMD, Onlyoffice
  - Draw.io

- For Engineering
  - CAD viewer