General Home, Media & Project spaces

CERNBox

33K User Accounts

indico
CDS
zenodo
AV
restic

ROOT
Data Analysis Framework

Microsoft 365

diagrams.net

CodiMD

30K clients lxplus lxbatch

physics analysis xrd

Windows

Data Analysis & Physics Infra

WLCG

indico
restic

~26PB Physics Data worldwide

150K+ clients worldwide

Backups Prevessin Zone

$HOME lxplus lxbatch

General Infrastructure & Services

OPENSHIFT

EP-ESE

puppet

openstack.

CERN Tape Archive

GitLab

HPC

Sync/Share	WebApps		fusex			Samba	DFS		DPM	CVM FS		AFS	FILER			Ceph FS

EOS File Store

S3 RBD

CEPH Object Store

Contents

- The Project

- The Technology

- The Service

- Future Prospects

What is CERNBox?

CERN's cloud collaboration storage platform

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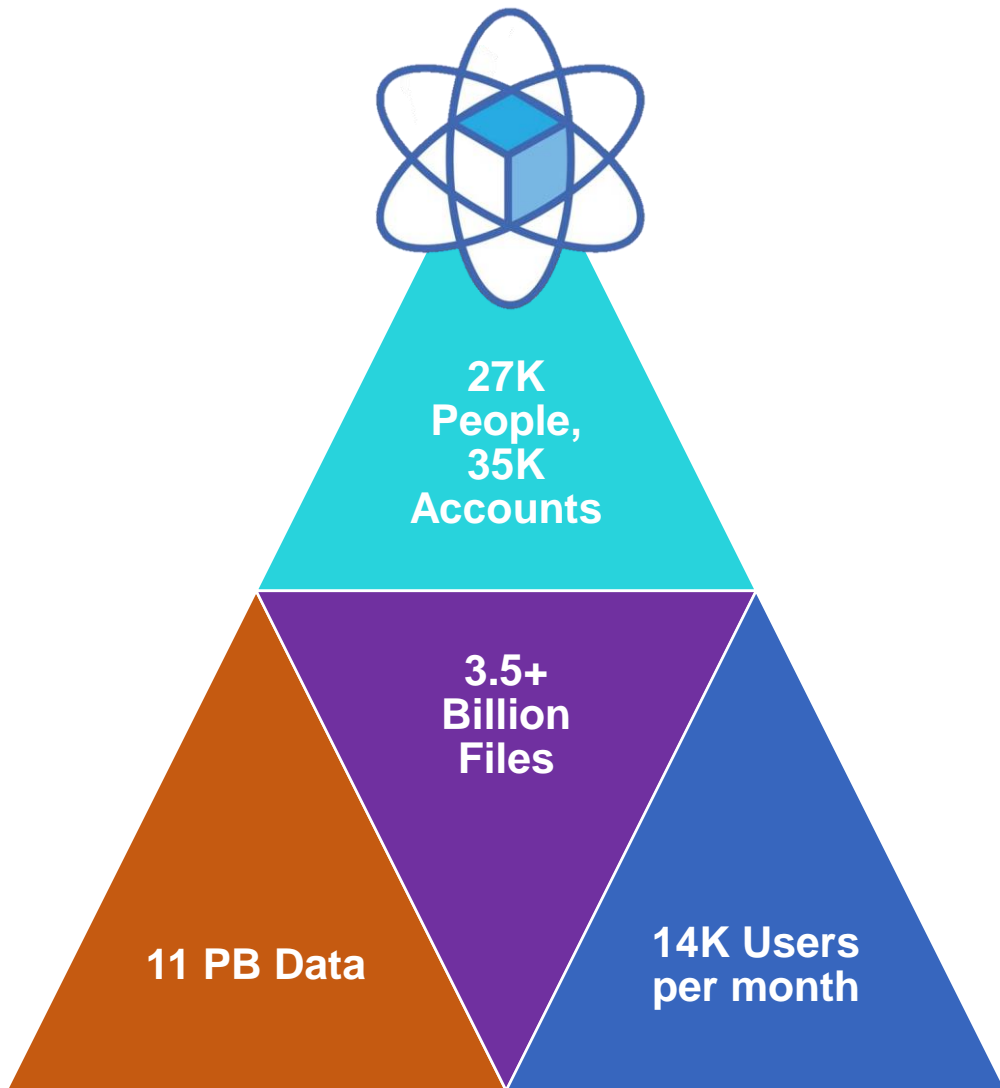 - **ownCloud for "Dropbox" use-case**
  - **EOS and Ceph for storage**

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

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, ...)

What makes CERNBox different?

- Namespace metadata lives in the storage
  - Setting metadata on files from Web or mobile/desktop applications reflects it on the storage

- Storage is directly accessible and mountable
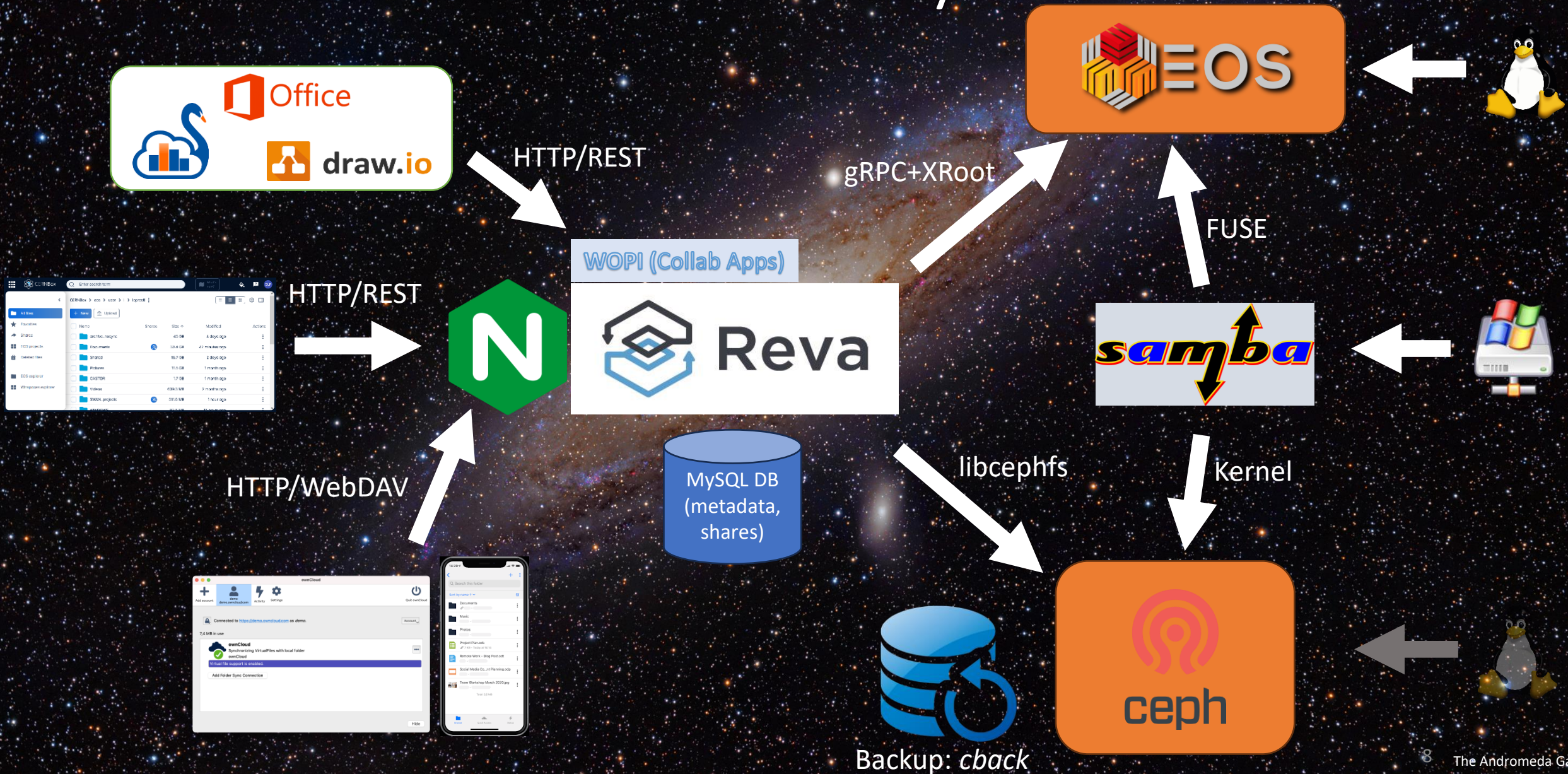 - This allows convergence of access via multiple access methods
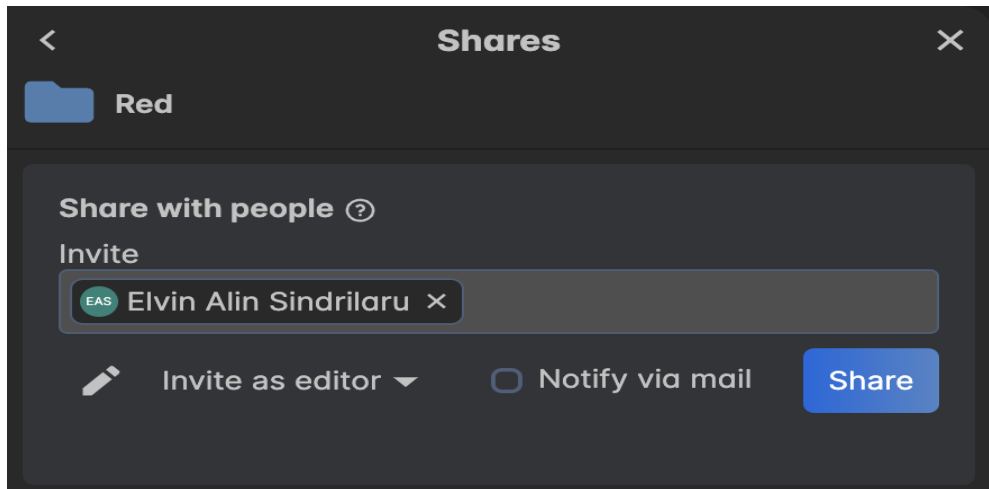

```
[root@eosblublu (mgm:master mq:master) ~]$ eos attr ls /eos/user/g/gonzalhu/Red
sys.acl="u:elvin:rwxm+dq"
```

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*

The Andromeda Galaxy
Source: Wikimedia

- 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: Golang and Python, Protobuf
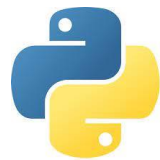
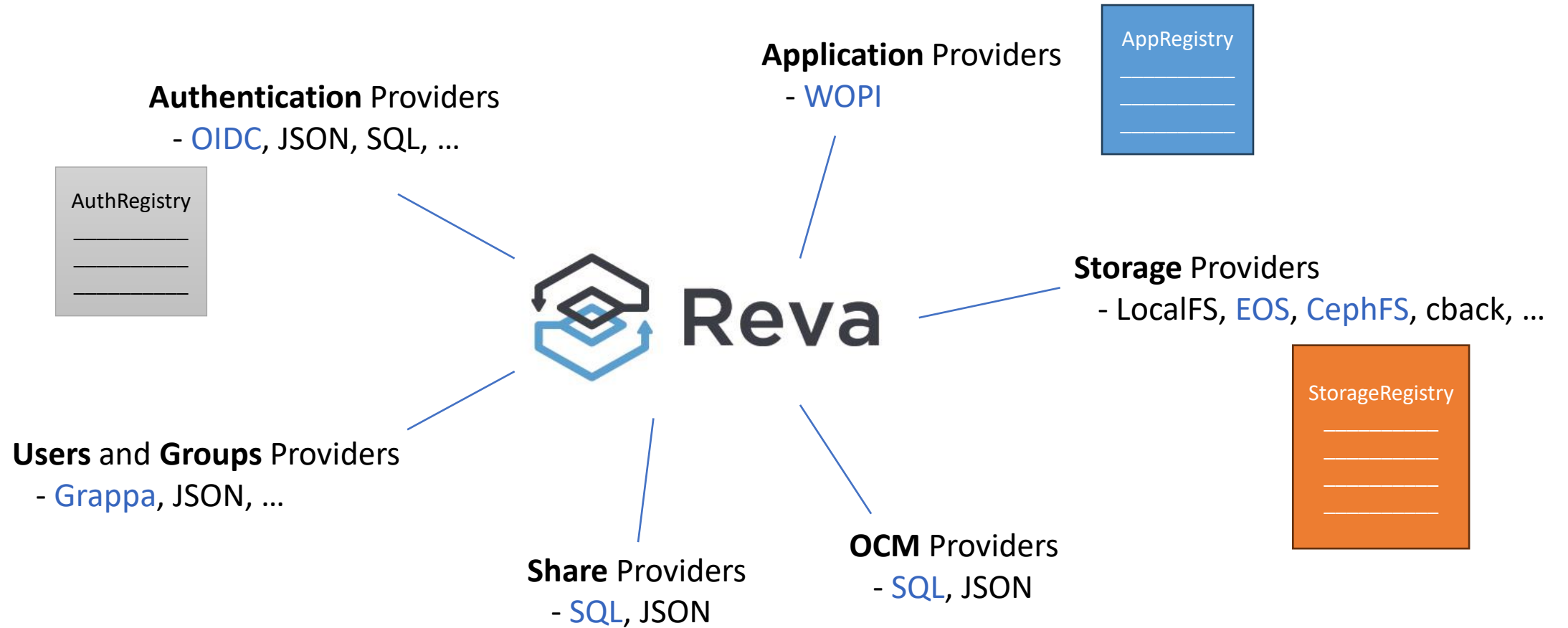# The Technology: protocols and APIs

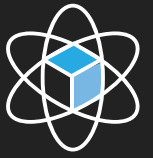- Core backend written in Go
  - Public API available at https://github.com/cs3org/cs3apis, implemented as well by ownCloud Infinite Scale (oCIS)
  - Exposes **HTTP** and **gRPC** services
  - Exposes **OCM** HTTP endpoints (https://github.com/cs3org/OCM-API) for federating storages

- 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

- Sync clients provided by ownCloud, branded with the CERNBox logo
  - 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

Zooming into Reva

Authentication Providers
- OIDC, JSON, SQL, …

AuthRegistry
_____
_____
_____

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

Application Providers
- WOPI

AppRegistry
_____
_____
_____

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

StorageRegistry
_____
_____
_____
_____

Share Providers
- SQL, JSON

OCM Providers
- SQL, JSON

Journey of a web request

A mini-dive into the web system: a user clicks on a "public link" and opens an app
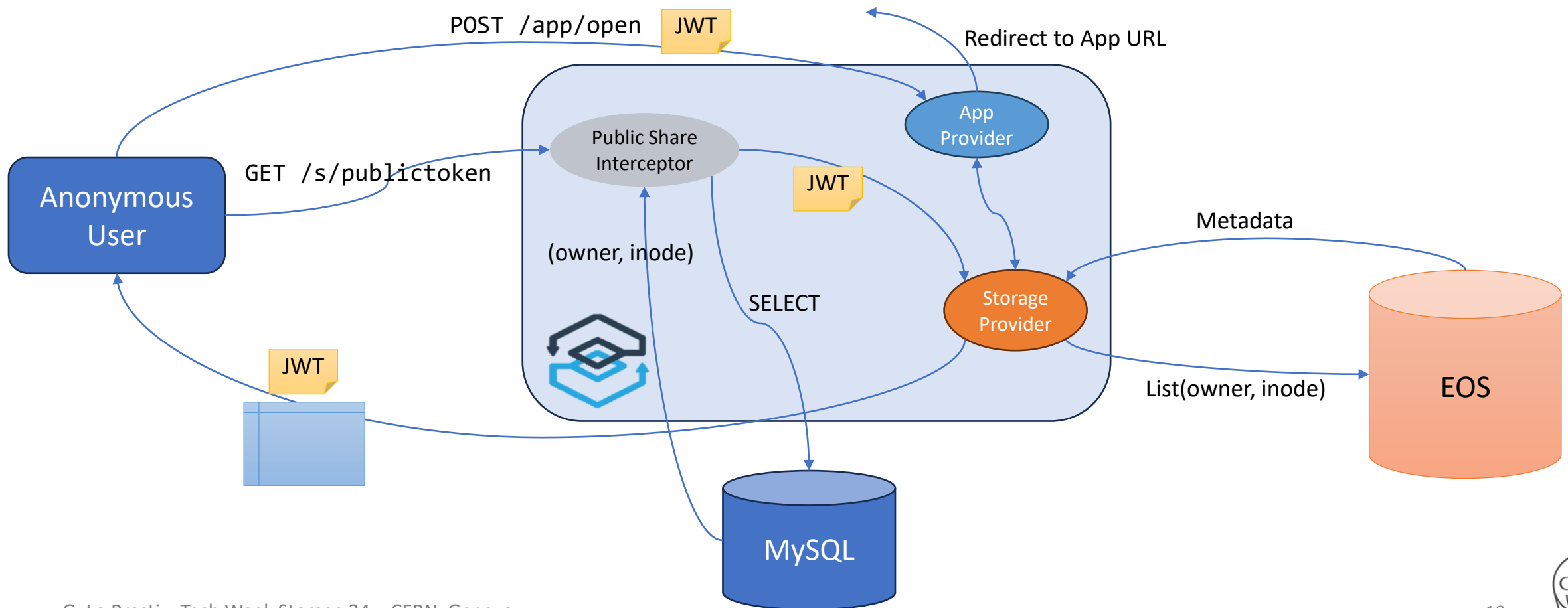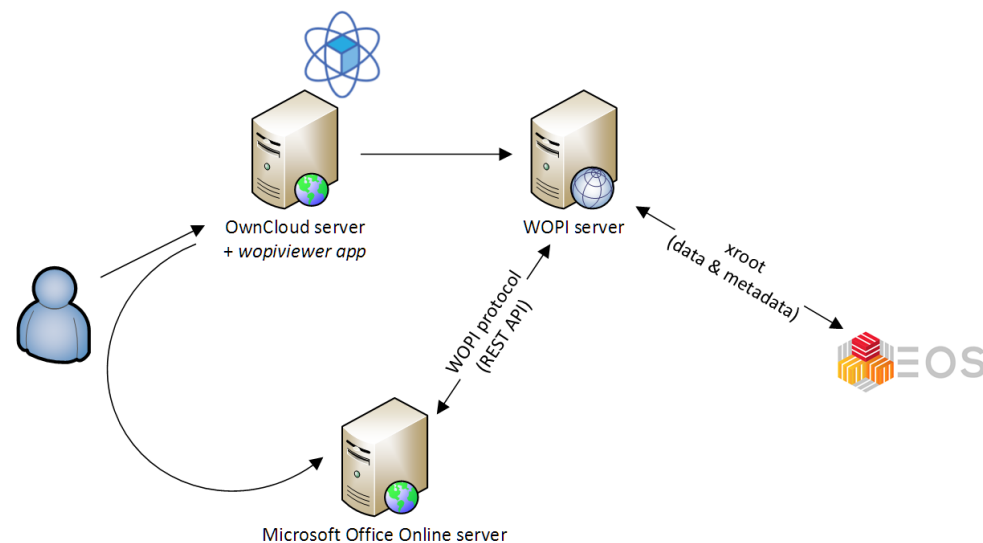
CERNBox Applications

- 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
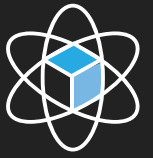
- For Engineering
  - CAD viewer

WOPI for Collaborative Apps

- A journey started in 2017: integrate Microsoft Office Online in CERNBox
  - Deployed on-premises back then

- Web-application Open Platform Interface: a HTTP REST protocol, specified by Microsoft
  - Adopted by a bunch of other vendors, notably Collabora Online and Onlyoffice

- Currently, CERNBox supports the full standard
  - Works with **Microsoft Office 365** (on-cloud), Collabora Online, and Onlyoffice
  - Integrates **CodiMD** with custom extensions
  - Could integrate further apps such as **Diagrams.net** in collaborative mode

OwnCloud server + wopiviewer app

WOPI server

xroot (data & metadata)

WOPI protocol (REST API)

Microsoft Office Online server

The Storage: EOS and CephFS

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

- **EOS is the reference implementation**, as it includes all desired capabilities
  - Rich ACLs management
  - Atomic uploads for the sync clients
  - Automatic file **versioning** upon overwrites
  - **Recycle bin**
  - File **locking**
  - Mounted filesystem (FUSE) access, "near-POSIX" interface

- CephFS has been recently integrated
  - Not all capabilities have been implemented yet: no atomic uploads, no versioning, no recycle
 - Those may come as a community effort

The Service

- **14K** monthly users, **6K+ daily users**

- **420K** public links, **160K** shares, **1.3K** project areas

- Spanning the whole Organization
  - Physics, Engineering, Administration

- A great diversity of use-cases and workflows
  - Generating tens of thousands of different file types
  - Most represented: ROOT, followed by source code

- *More statistics will be presented during the EOS workshop*

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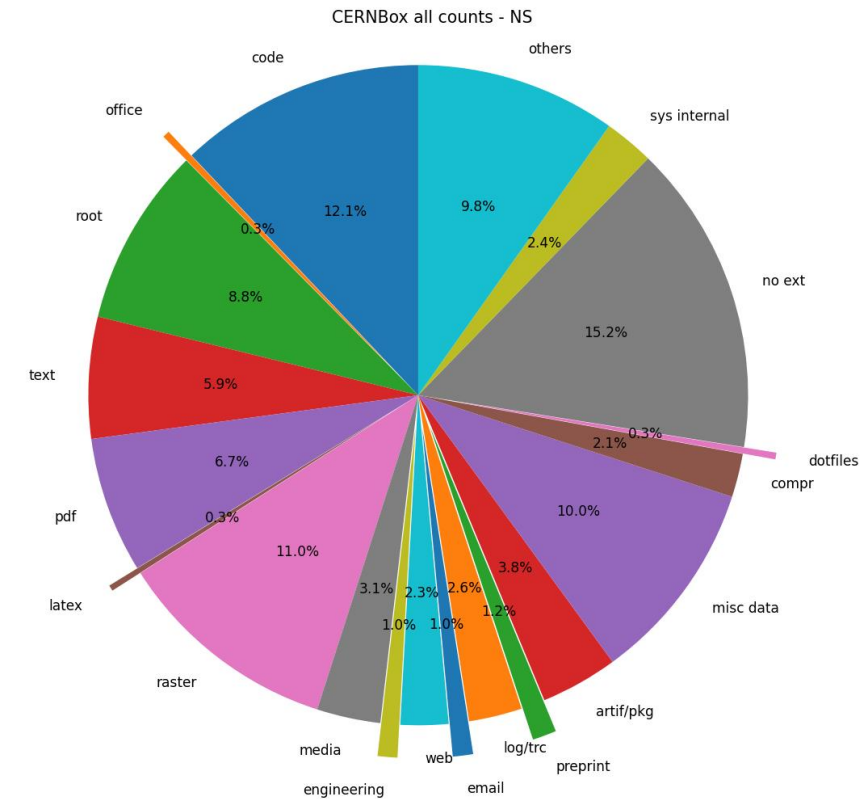
The Service: usage on a single day (Tue Feb 27th)
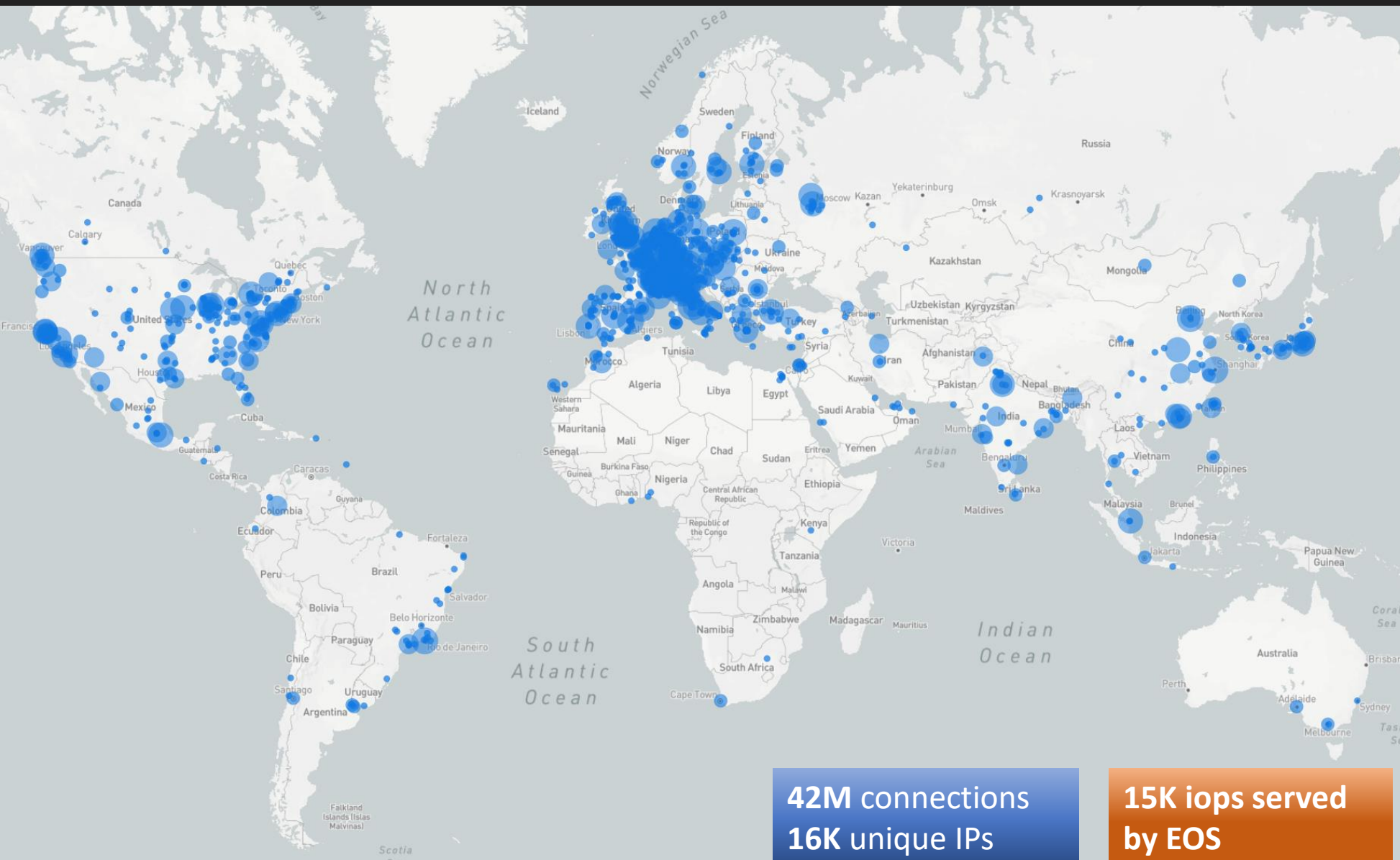
89 COUNTRIES   1467 CITIES

Copy URL   New Map

Country	IPs
🇨🇭 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
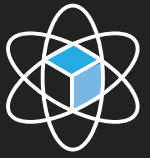
Future Prospects

- Plenty of nice ideas about extensions and additional features
  - Thanks to the rich feedback from our users

- However, the limited development effort available right now imposes to consolidate and streamline
  - We are a relatively small team!

- Focus for this year:
  - Commission CephFS to onboard Windows use-cases (**+1B** files, more later today)
  - Bring in the new Spaces concept, to benefit from upstream ownCloud web interface
  - Improve and automate operations procedures

- Happy to dive in more details in the afternoon session!

CERNBox Docs and Resources

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

- Reva server: https://github.com/cs3org/reva

- ownCloud Infinite Scale: https://doc.owncloud.com/ocis/next

- CERNBox publications:
  https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=cernbox&btnG=

Thanks for your attention!
Credits to the excellent team that makes CERNBox a reality!