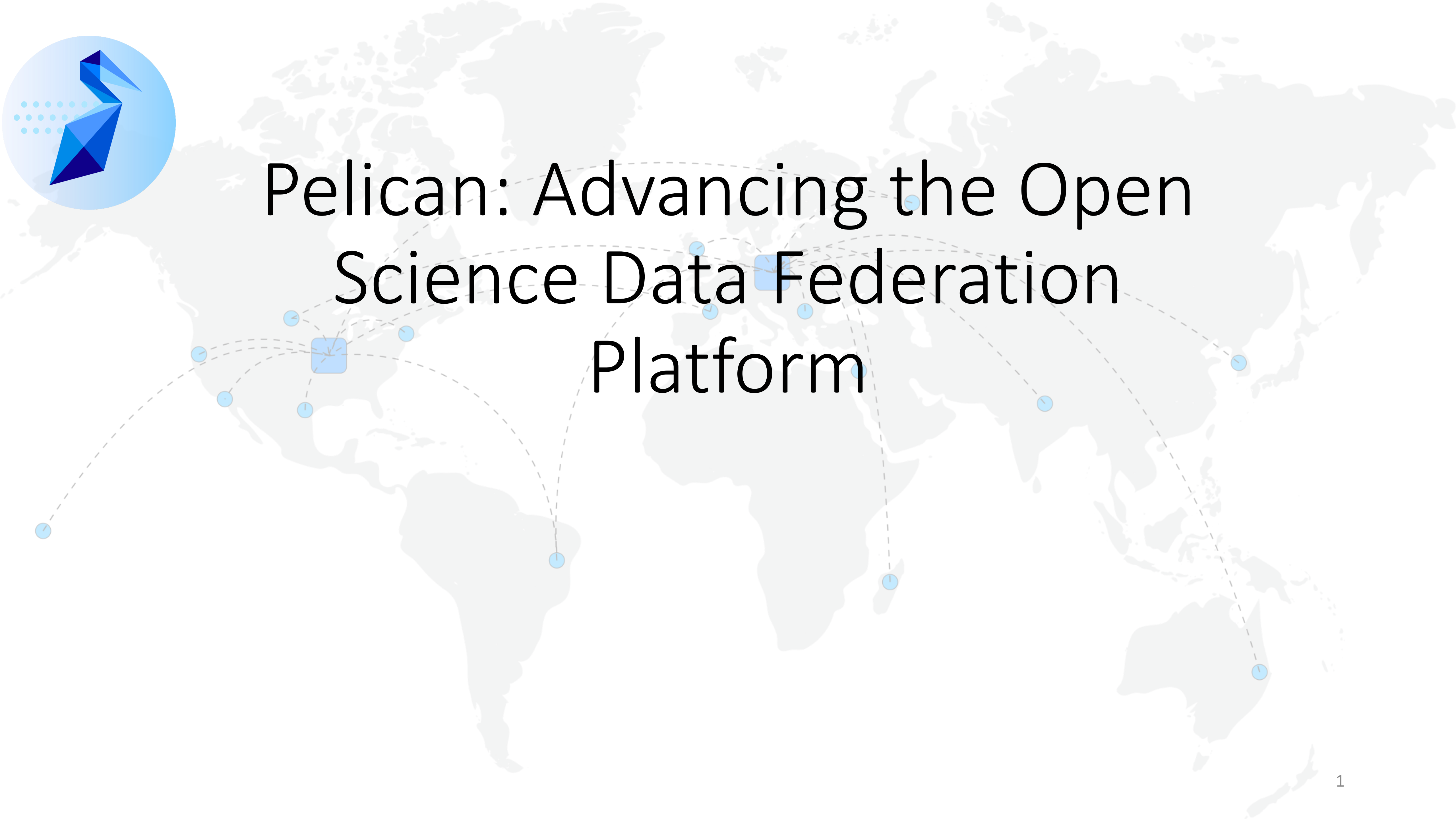
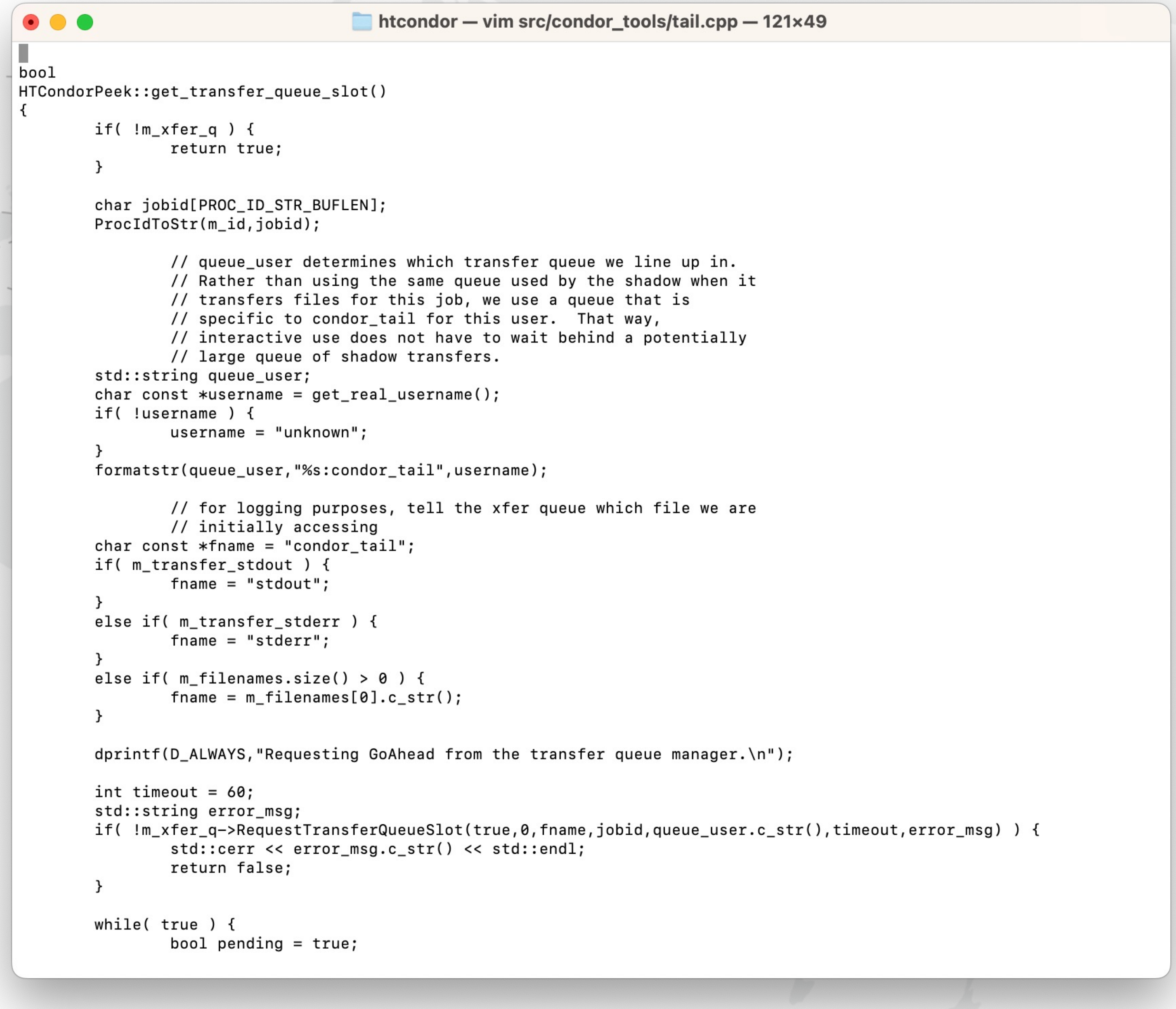


Pelican: Advancing the Open Science Data Federation Platform

Before we start…

One 🍻 Please



```
bool
HTCondorPeek::get_transfer_queue_slot()
{
        if( !m_xfer_q ) {
                return true;
        }

        char jobid[PROC_ID_STR_BUFLEN];
        ProcIdToStr(m_id,jobid);

                // queue_user determines which transfer queue we line up in.
                // Rather than using the same queue used by the shadow when it
                // transfers files for this job, we use a queue that is
                // specific to condor_tail for this user.  That way,
                // interactive use does not have to wait behind a potentially
                // large queue of shadow transfers.
        std::string queue_user;
        char const *username = get_real_username();
        if( !username ) {
                username = "unknown";
        }
        formatstr(queue_user,"%s:condor_tail",username);

                // for logging purposes, tell the xfer queue which file we are
                // initially accessing
        char const *fname = "condor_tail";
        if( m_transfer_stdout ) {
                fname = "stdout";
        }
        else if( m_transfer_stderr ) {
                fname = "stderr";
        }
        else if( m_filenames.size() > 0 ) {
                fname = m_filenames[0].c_str();
        }

        dprintf(D_ALWAYS,"Requesting GoAhead from the transfer queue manager.\n");

        int timeout = 60;
        std::string error_msg;
        if( !m_xfer_q->RequestTransferQueueSlot(true,0,fname,jobid,queue_user.c_str(),timeout,error_msg) ) {
                std::cerr << error_msg.c_str() << std::endl;
                return false;
        }

        while( true ) {
                bool pending = true;
```

Dataset Sharing Powers Open Science

- Datasets are the lifeblood of science. Without them, the cleverest software or algorithms are essentially useless.
- To *utilize* these datasets, they need to be effectively connected to a broad set of computing types and capacity.
- Engineering this access is an immensely difficult problem:
  - Challenges in both software & infrastructure scale.
  - Inherently distributed problem: the archive and the computing may be separate resources.

The **Open Science Data Federation (OSDF)** federates dataset repositories with a reach of all of open science.

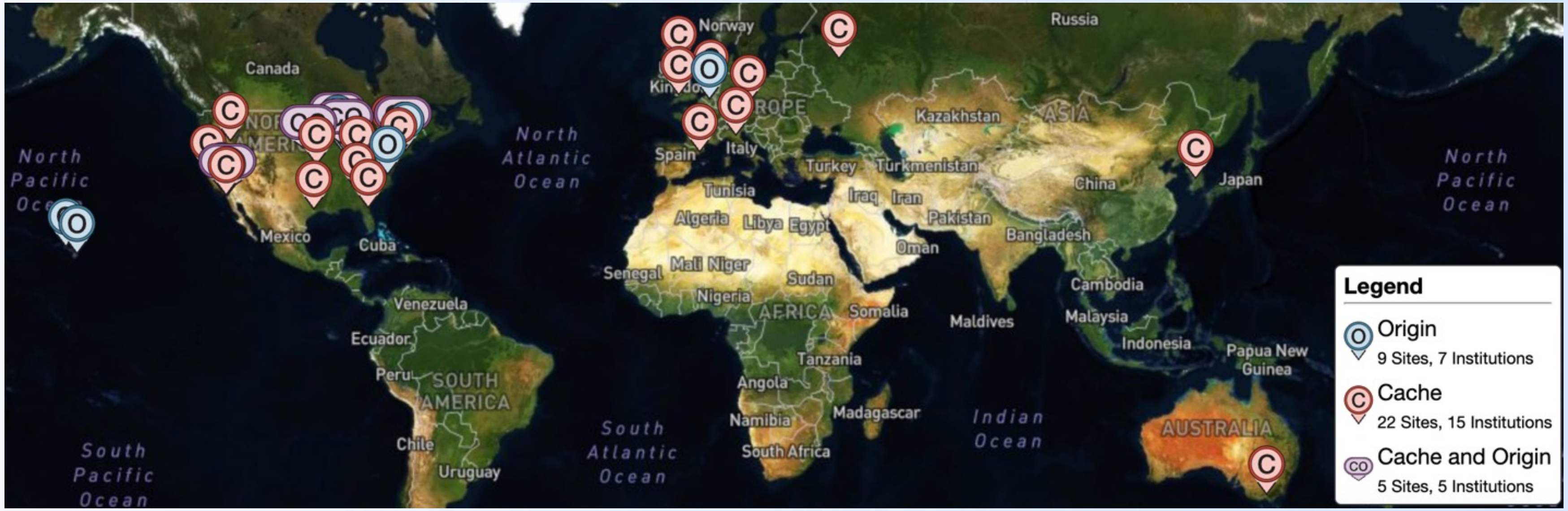
The Open Science Data Federation

The OSDF connects repositories through origin services and scales the dataset access through a series of distributed caches.

The OSDF is operated by PATh

Using hardware from NRP

And integrates a wide range of open science.



OSDF by the numbers

Over the last 12 months, the OSDF transferred

64PB &

62 files/s

Data used by

15 science collaborations &

~120 OSPool users

Boise
Sunnyvale
Pasadena
San Diego
Lincoln
Kansas City
Cincinnati
New York
Newport News
Atlanta
Houston
Jacksonville

Introducing: the Pelican Platform

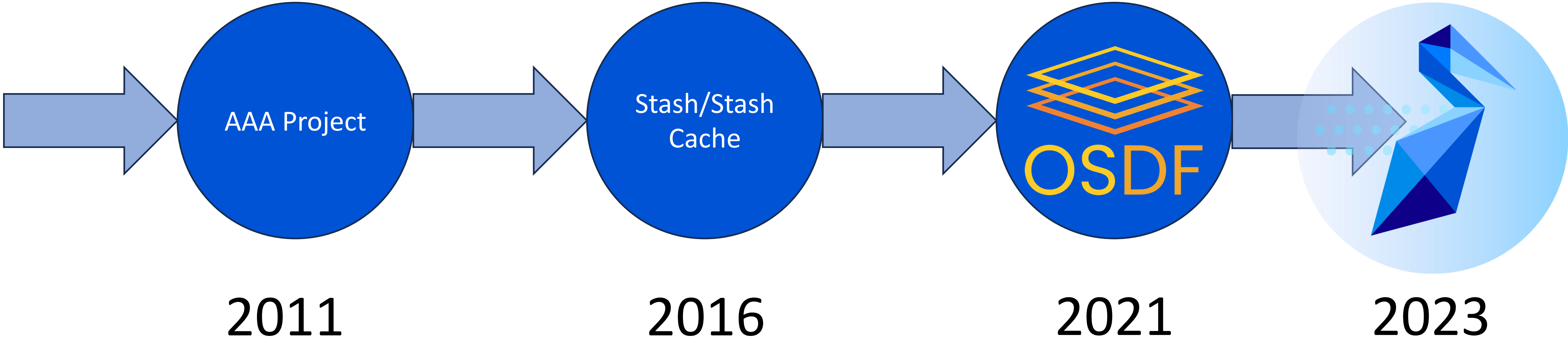
The Pelican Platform is a project recently funded by the NSF to help advance the OSDF. Scale: $7M over 4 years starting 1 September.

Three main goals:

1. Strengthen and Advance the OSDF
2. Expand the types of computing where OSDF is impactful.
3. Expand the science user communities.
   - Particularly, Pelican is funded as part of the “National Discovery Cloud for Climate” (NDC-C) so there will be an early focus on climate datasets.

Project Goals and Approaches

1. Strengthen and Advance the OSDF.
   - Ensure the components of the OSDF – Pelican – functions as a standalone software suite.
   - Re-engineer the central services. Add abstraction layer between the OSDF and other OSG Services.
   - Expand the origin’s functionality, focusing on non-POSIX backends (S3, DataVerse) and easing authorization.
   - Maintain and improve the distributed caching services.
2. Expand the types of computing where OSDF is impactful.
   - Add new browser-based client & python API.
   - Integrate with ML frameworks such as PyTorch
3. Expand the science user communities.
   - Collaboration with NCAR, NationalDataPlatform (https://www.nationaldataplatform.org/)



AAA Project

Stash/Stash Cache

OSDF

2011

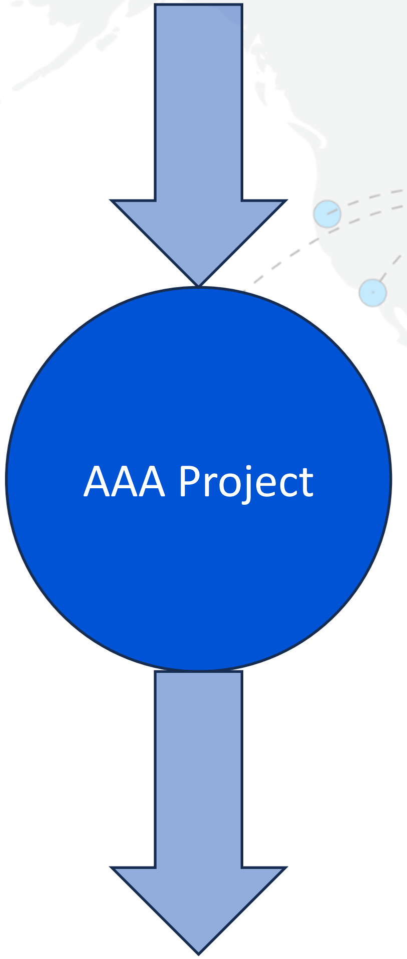
2016

2021

2023

A trip down memory lane...

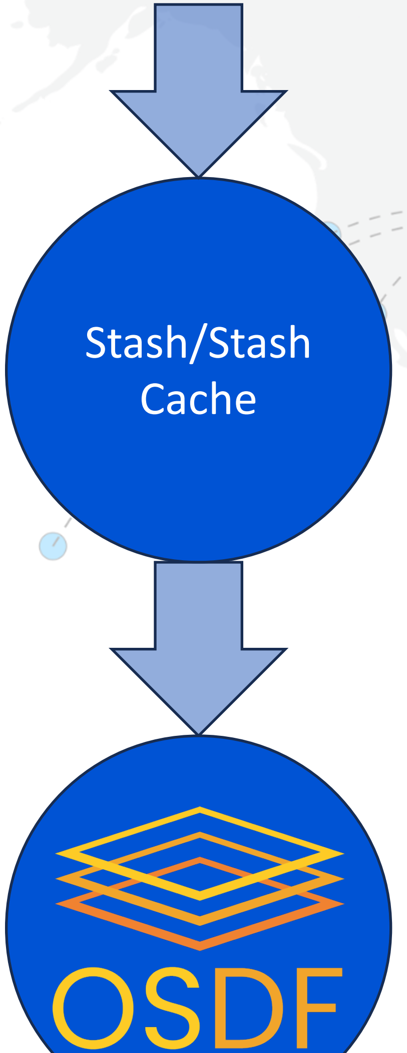
Any time, Any Data, Anywhere



AAA Project

- In ~2009, the teams at Nebraska, Wisconsin, and UCSD started using XRootD to build out a data federation for CMS.
- This turned into a 3-year funded project, AAA (NSF #1104664), starting in 2011.
- Outcomes include:
  - Design & implement AAA, completely based on XRootD software.
  - First generation of XRootD monitoring collectors used by the WLCG.
  - First (and second) implementation of the XRootD caching proxy (later rechristened “XCache”).

Evolution toward the OSDF

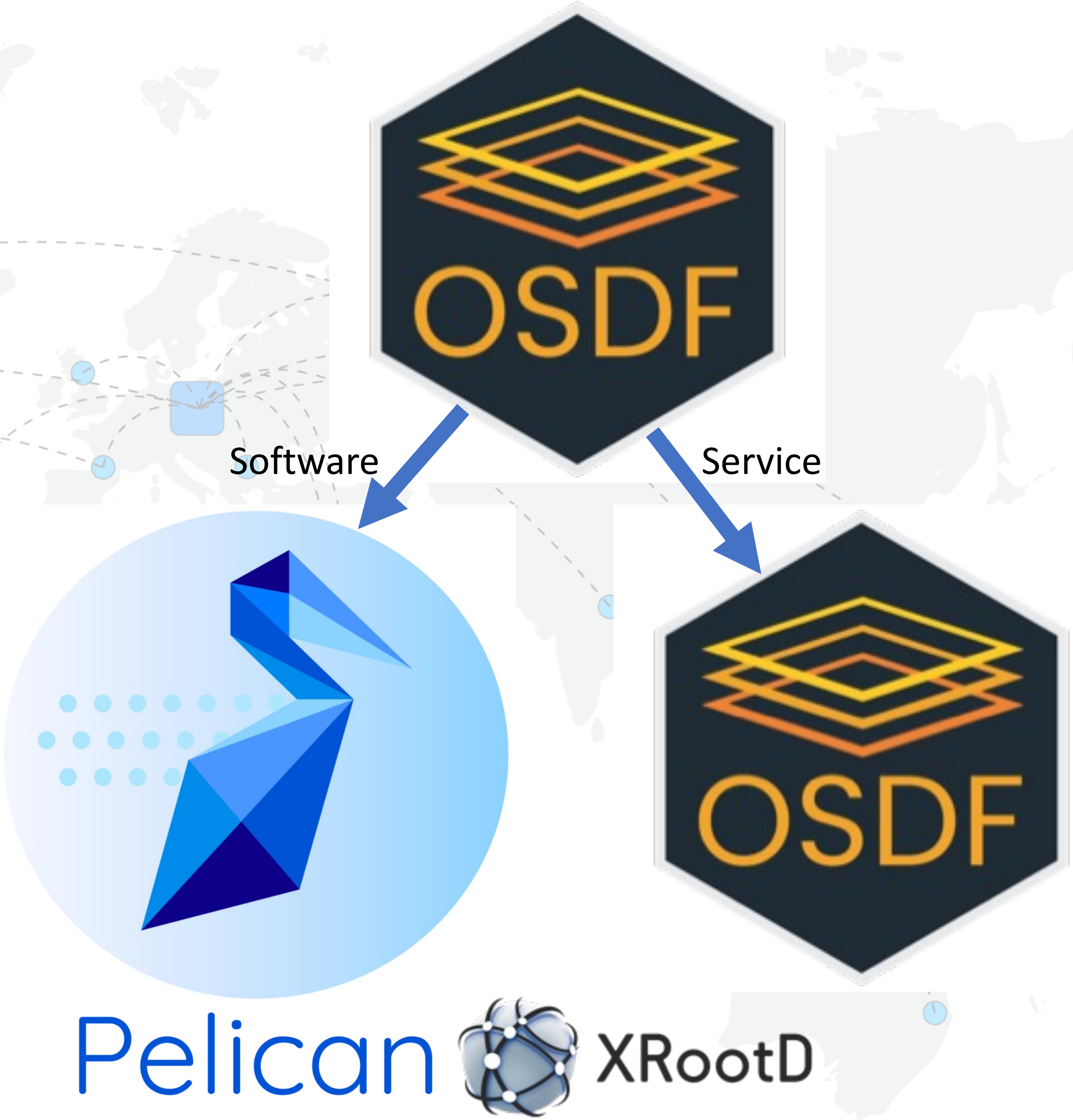


Stash/Stash Cache

- Around 2016, the OSG Consortium built on top of the AAA approach.
  - Originally used to export the “Stash” filesystem at U.Chicago; hence, the caching infrastructure was “StashCache”.
- Evolutions from being CMS-specific:
  - Was used to scale access to Stash via an origins – strong focus on data caching and delivery.
  - Developed a client for cache discovery and robust downloads (Python).
  - Configuration & registration based on OSG’s Topology service.
  - Start switch to HTTP protocol & token-based auth.
- This evolved into the OSDF in ~2021:
  - Client was rewritten into Go.
  - Hardware was placed into the network.
  - Emphasis on Kubernetes-based packaging.
  - Distributed service operations with Kubernetes and the NRP.
  - NSF-funded hardware projects join in the federation.

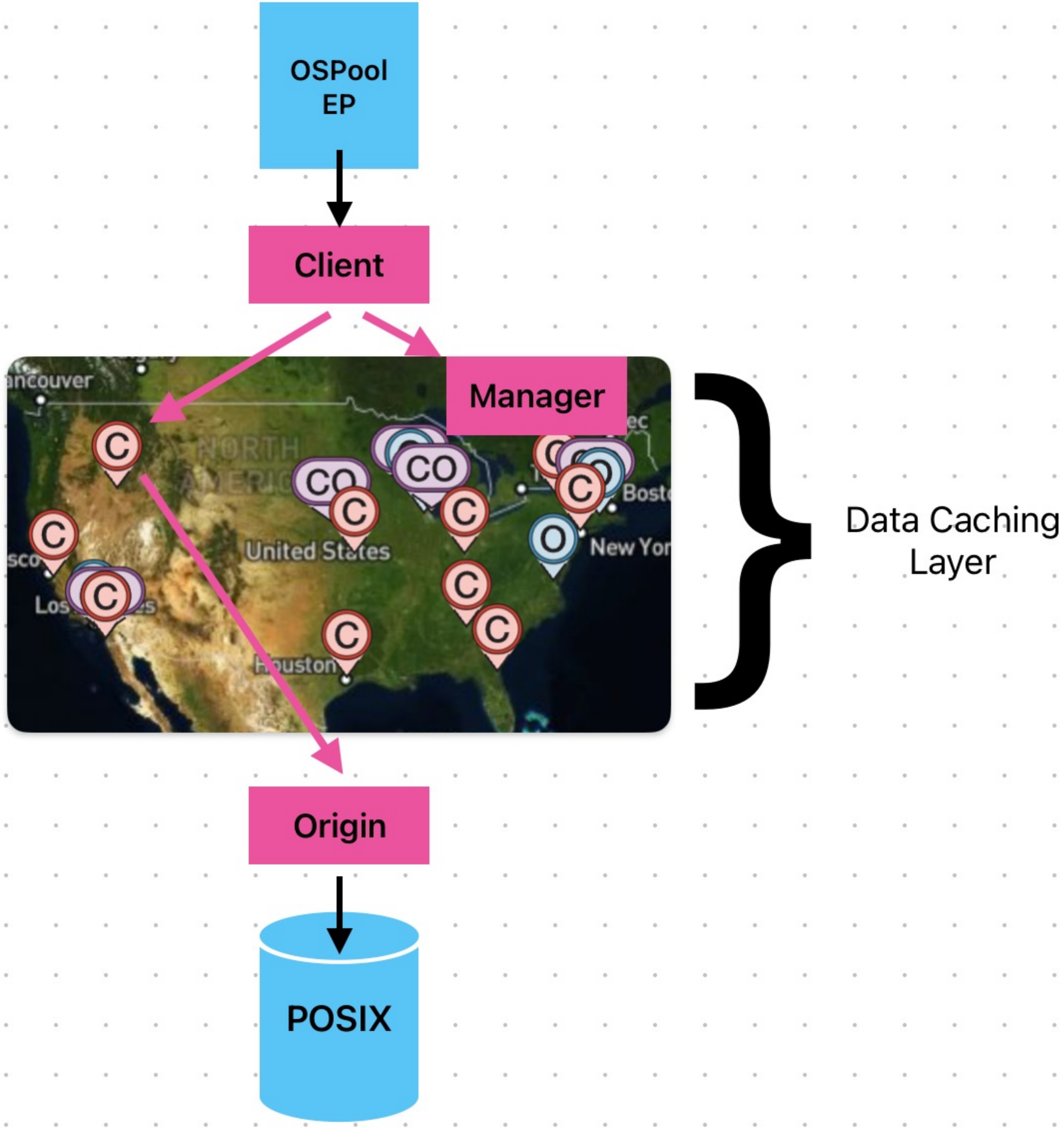
OSDF & Pelican

- We split out the technology powering the OSDF and christened it the “**Pelican Platform**”.
    - The software is the same – integrating technologies like XRootD, SciTokens, OA4MP, and the ‘stashcp’ client utilities.
- The Pelican project provides the effort for a solid engineering foundation.



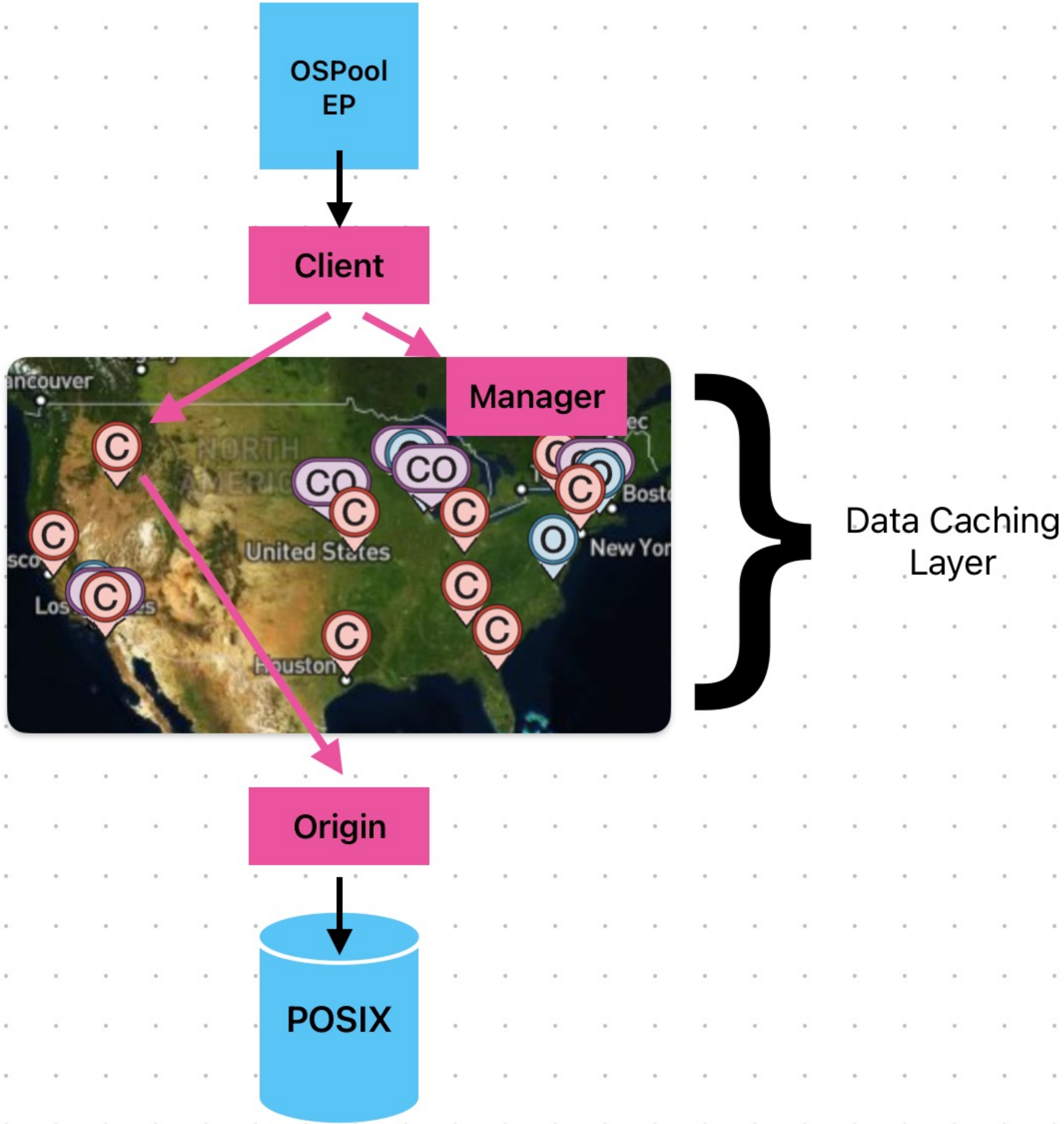
Pelican Architecture

- An **origin service** integrates the object store into the OSDF in the same way a CE integrates a batch system into the OSPool. Interfaces to move data and map authorizations.
- The **cache service** stores and forwards objects, providing scalability to the data access.
- The **manager** selects a source/sink of an object for clients and maintains the namespace.

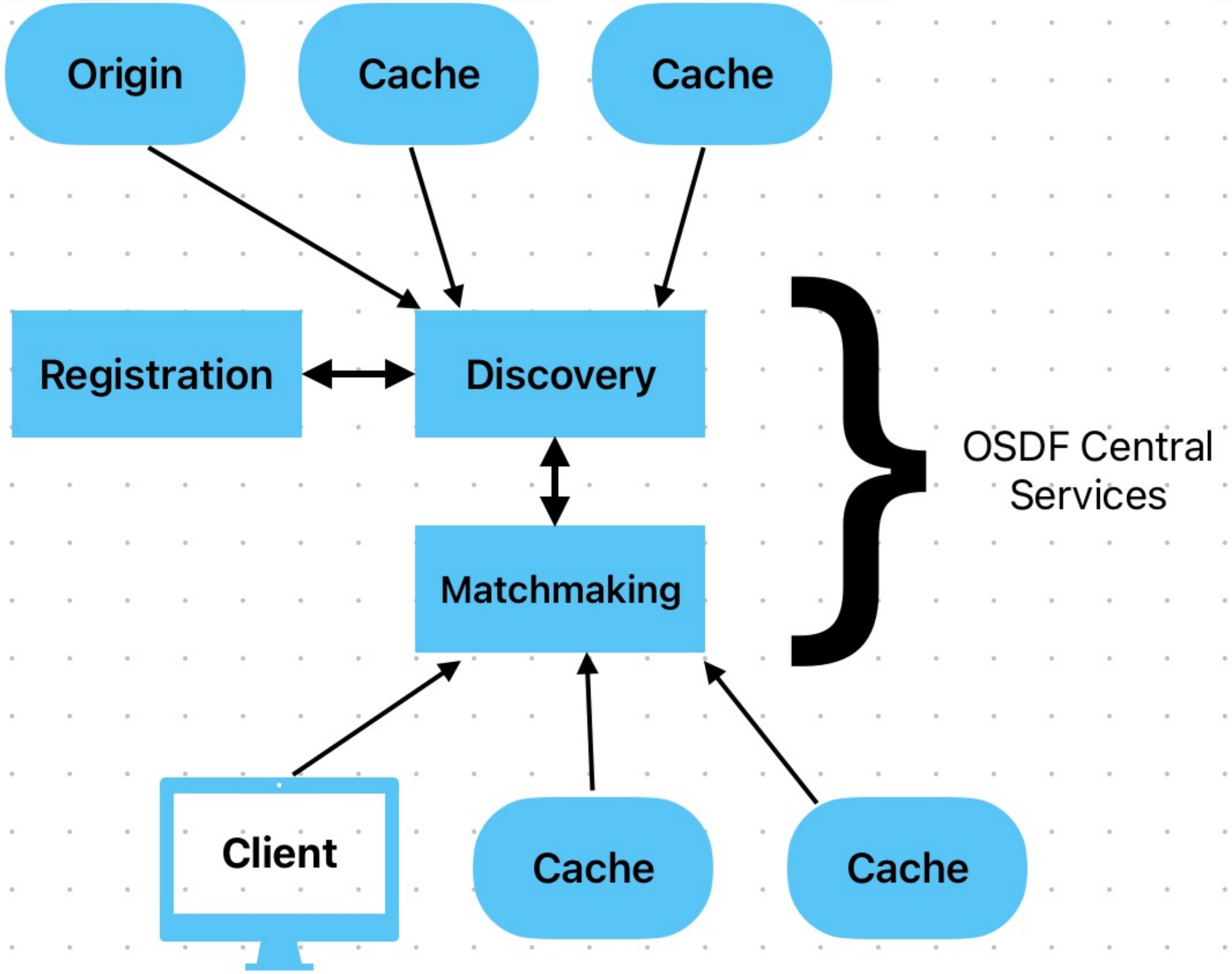


OSDF in Practice

- The OSPool is tightly integrated with the OSDF, giving jobs reliable, scalable means to move data in and out.
  - Same technique used by the CHTC, IGWN, PATh pools.
- OSDF is just starting to integrate more with campuses (often via the NSF) and address non-compute cases.



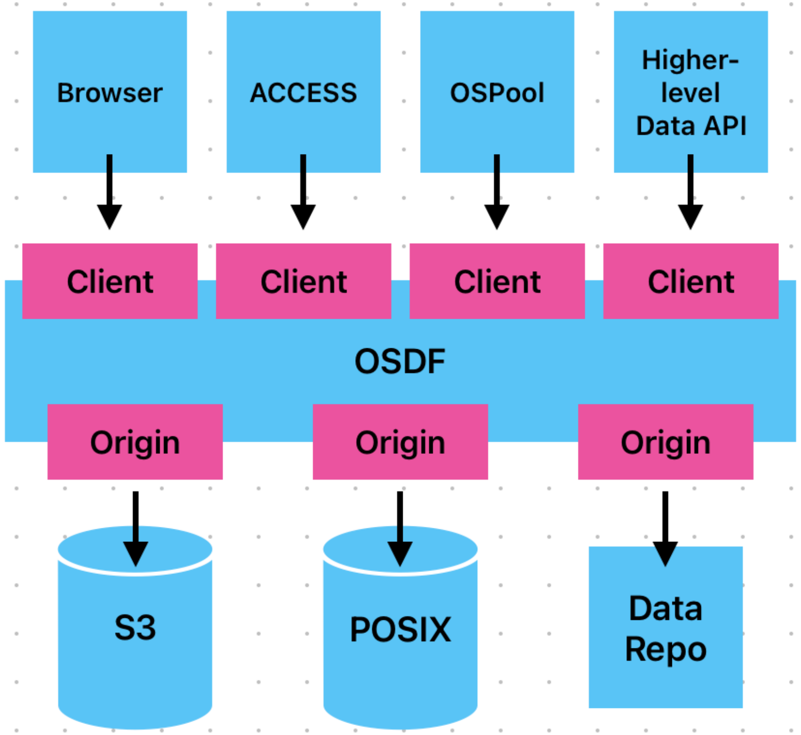
Pelican Architecture – Central Services



The central services are seeing a massive overhaul for Pelican.

- Standalone registration workflow, not tied to OSG Topology.
- Service registration associated with a public key – better protection against spoofing.

OSDF Architecture - Vision



- **Long-term vision**: Pelican Platform, provides a ‘transport bus’, connecting a broad range of dataset providers to consumers.
  - Today, we just integrate POSIX backends which leaves out a wide range of storage types (S3, data repositories like DataVerse)
- Become a platform beyond the CLI-centric, object delivery service it is today.

Pelican as the ‘most favored nation’ of HTCSS

- Pelican and PATh (the project funding the majority of the HTCSS work) share common leadership and principles.
- Unique opportunity to co-design and have Pelican drive new transfer & storage management capabilities in HTCondor.
- Examples:
  - Pelican client ships with HTCondor EP.
  - Pelican drove the development of the new shadow-side plugins.
  - HTCSS is integrating the LotMan component for storage management.
- Even as Pelican broadens the OSDF, we will still leverage this relationship!

+ PATh = ♥

Pelican Platform: making federated storage available to everyone

The OSDF was seeded out of the technologies of the HEP and dHTC communities.

- Already has made a huge impact on science!

Pelican opens this further:

- Anyone can setup their own data federation, not explicitly tied to the OSG Consortium.
- Targets a broader range of science & computing approaches.
  - While keeping its roots with the HTCondor community

Looking forward to changing how you connect to datasets in the next years!

Questions?

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