ProxyStore

Decoupling Control and Data Flow in Workflows

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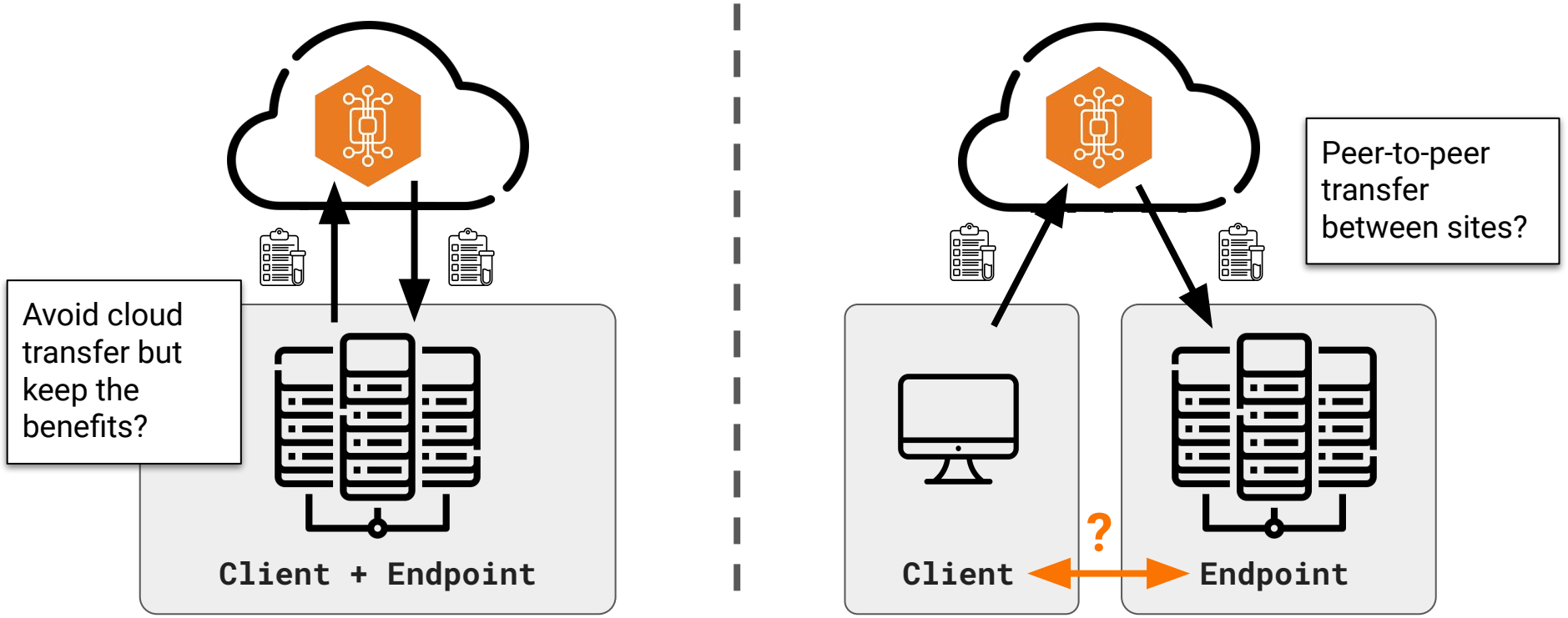
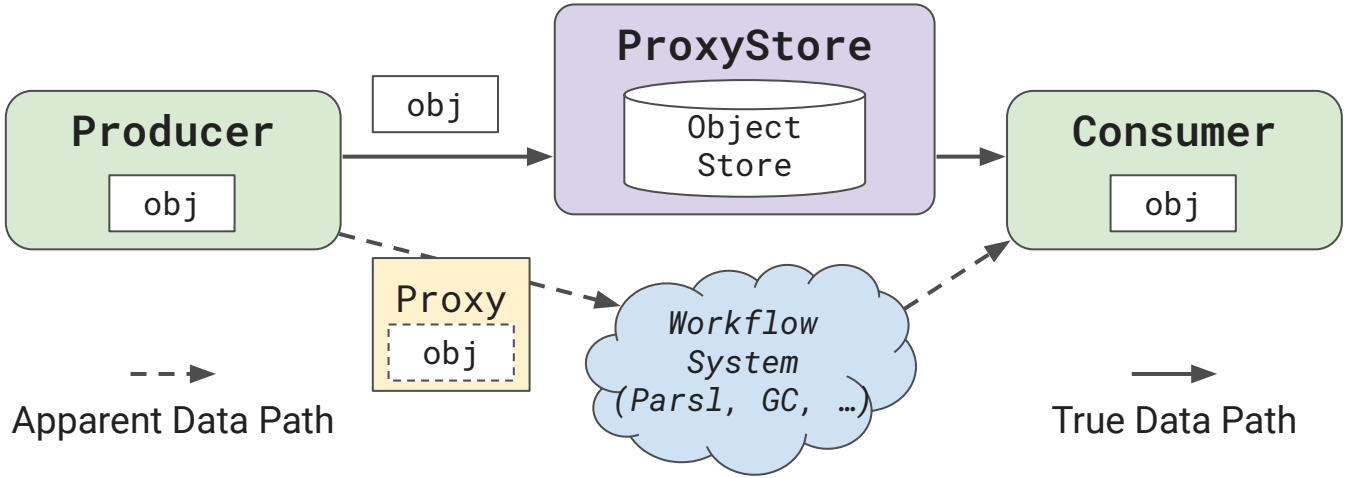
Motivation


Avoid cloud transfer but keep the benefits?
Client + Endpoint
Peer-to-peer transfer between sites?
Client
?
Endpoint

Control Flow != Data Flow

Proxies + Object Stores = ProxyStore



- *Elegant* pass-by-reference in distributed Python apps
- Mechanism for *transparently* decoupling control and data flow
- Support for *any* (via plugins) object storage method

Proxy Objects

- Transparently wrap ***target*** objects
- Acts like a wide-area reference
- Initialized with a ***factory***
- Just-in-time ***resolution***

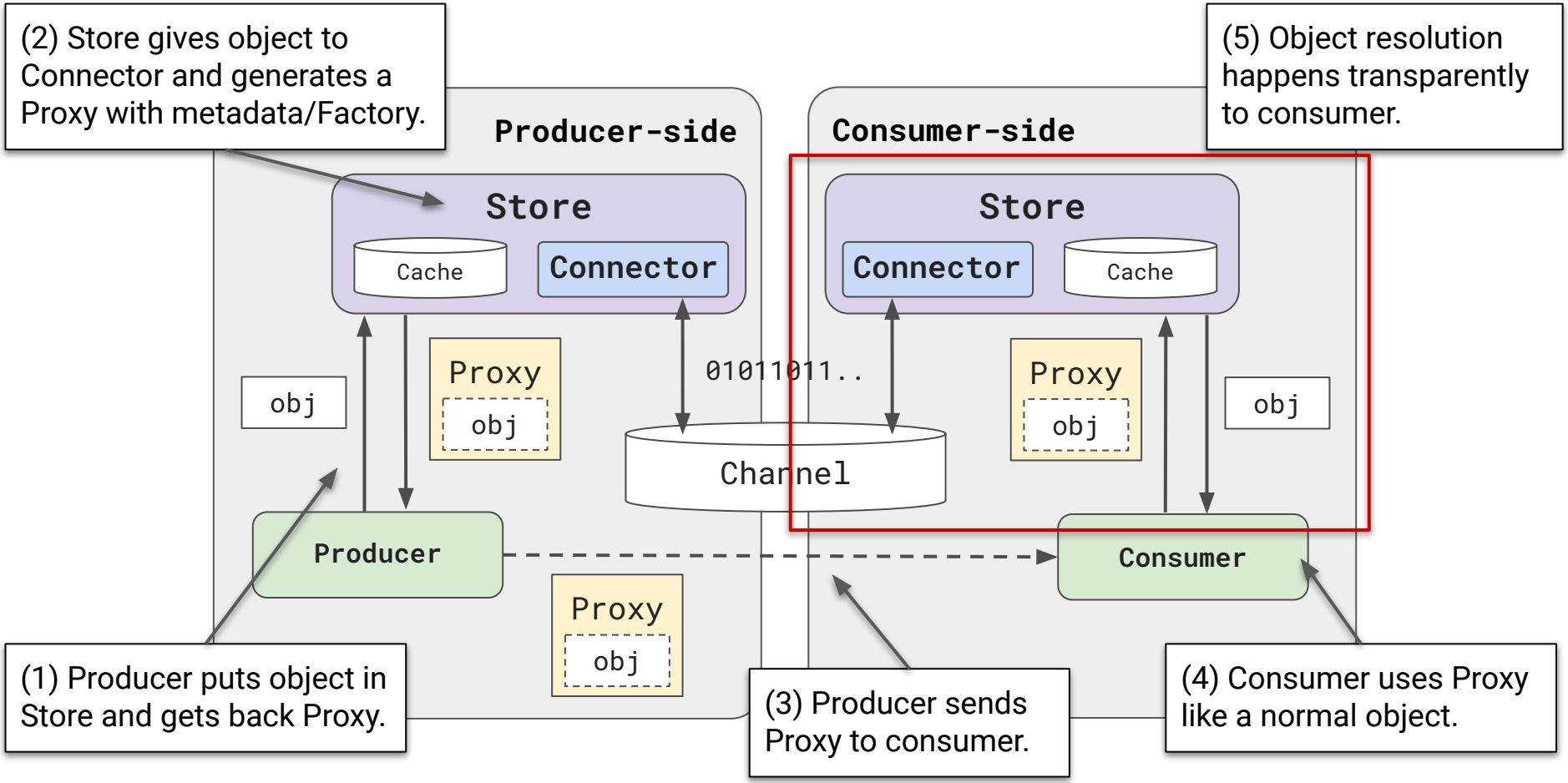
```python
import numpy as np
from proxystore.proxy import Proxy

x = np.array([1, 2, 3])

# Proxy(Callable[[], T]) -> Proxy[T]
p = Proxy(lambda: x)

# A proxy is an instance of its wrapped object
assert isinstance(p, Proxy)
assert isinstance(p, np.ndarray)

# The proxy can do everything the numpy array can
assert np.array_equal(p, [1, 2, 3])
assert np.sum(p) == 6
y = x + p
assert np.array_equal(y, [2, 4, 6])
```

```python
from proxystore.connectors.redis import RedisConnector
from proxystore.store import Store

store = Store(
    name='my-store',
    connector=RedisConnector('localhost', 6379),
    # extra options
)

my_object = MyData(...)

p = store.proxy(my_object)
```

```python
from proxystore.proxy import Proxy

def my_function(x: MyData) -> ...:
    # Resolve of x deferred until use
    assert isinstance(x, MyData)
    # More computation...

assert isinstance(p, Proxy)
my_function(p)
```

Why lazy resolution with proxies?

- Performance (pass-by-reference, async resolve, skip unused objects)
- Avoid writing shims/wrapper functions
- Partial resolution of large objects with nested proxies
- Access control (only resolve data where permitted)


(2) Store gives object to Connector and generates a Proxy with metadata/Factory.
(5) Object resolution happens transparently to consumer.
Producer-side
Consumer-side
Store
Cache
Connector
Store
Connector
Cache
Proxy
obj
obj
01011011..
Proxy
obj
obj
Channel
Producer
Consumer
Proxy
obj
(1) Producer puts object in Store and gets back Proxy.
(3) Producer sends Proxy to consumer.
(4) Consumer uses Proxy like a normal object.

What's changed since ParslFest 2022?

- v0.3.3 → v0.6.0
- New architecture
- New data transfer methods
  - Peer-to-peer Endpoints
  - RDMA
  - DAOS
  - Bring your own
- SC23 paper

Protocol	Storage	Intra-Site	Inter-Site	Persistence
File	Disk	✓		✓
Redis	Hybrid	✓		✓
Margo	Memory	✓		
UCX	Memory	✓		
ZMQ	Memory	✓		
Globus	Disk		✓	✓
DAOS	Disk*	✓		✓
Endpoint	Hybrid	✓	✓	✓
Multi	*	*	*	*

ProxyStore in Parsl

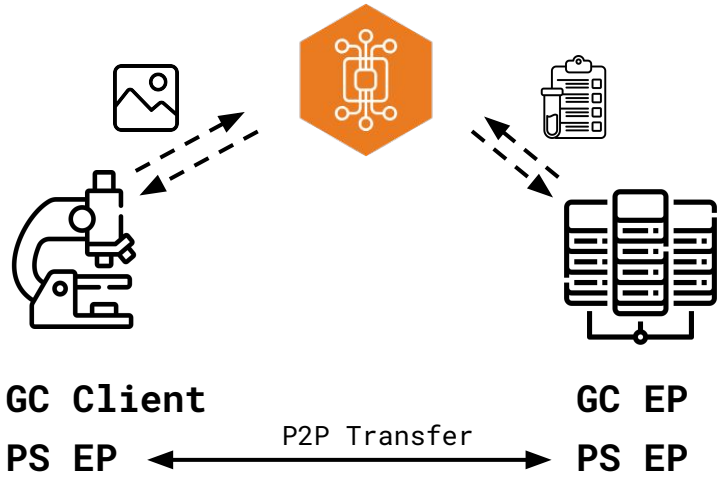
Serialization Plug-ins

```
(venv) $ pip install parsl>=2023.7.31 proxystore>=0.5.0
```

```python
import parsl
from parsl.serialize.facade import register_method_for_data
from parsl.serialize.proxystore import ProxyStoreSerializer
...

parsl.load(htex_config())

@parsl.python_app
def my_sum(data: list[int]) -> int:
    from proxystore.proxy import Proxy
    assert isinstance(data, Proxy)
    return sum(data)

with Store('my-store', FileConnector('/tmp/proxystore')) as store:
    serializer = ProxyStoreSerializer(store=store, should_proxy=lambda o: isinstance(o, list))
    register_method_for_data(serializer)  # Note: some extra boilerplate excluded
    assert my_sum([1, 2, 3]).result() == 6
```

ProxyStore in Globus Compute

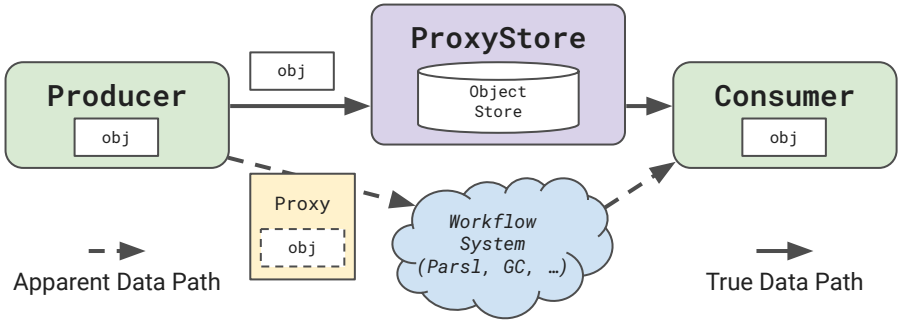
Avoiding Globus Compute Cloud Transfer Costs




```
$ globus-compute-endpoint configure demo
$ proxystore-endpoint configure demo
```

```python
from globus_compute_sdk import Executor
from proxystore.connectors.endpoint import EndpointConnector
from proxystore.store import Store

ENDPOINT_UUID = '5b994a7d-8d7c-48d1-baa1-0fda09ea1687'

def compute(obj: MyData) -> Result:
    # Computation ...
    return Result(...)

with Store('my-store', EndpointConnector(...)) as store:
    with Executor(endpoint_id=ENDPOINT_UUID) as gce:
        proxy = store.proxy(MyData(...))
        future = gce.submit(compute, proxy)
        print(future.result())
```

https://docs.proxystore.dev/main/guides/globus-compute
https://docs.proxystore.dev/main/guides/endpoints



Questions?

Contact:
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github.com/proxystore/proxystore/issues

SC Paper:
docs.proxystore.dev/main/publications