

*Applications*

Files

Tables

CRDTs

*Application Interface*

Directories

Key/Value Pairs

Graphs

*Wide-area SDS System*

Manifest

Manifest

Block

Block

Block

Block

**chunks**

*Service Interface*

create(), read(), delete()

Object storage

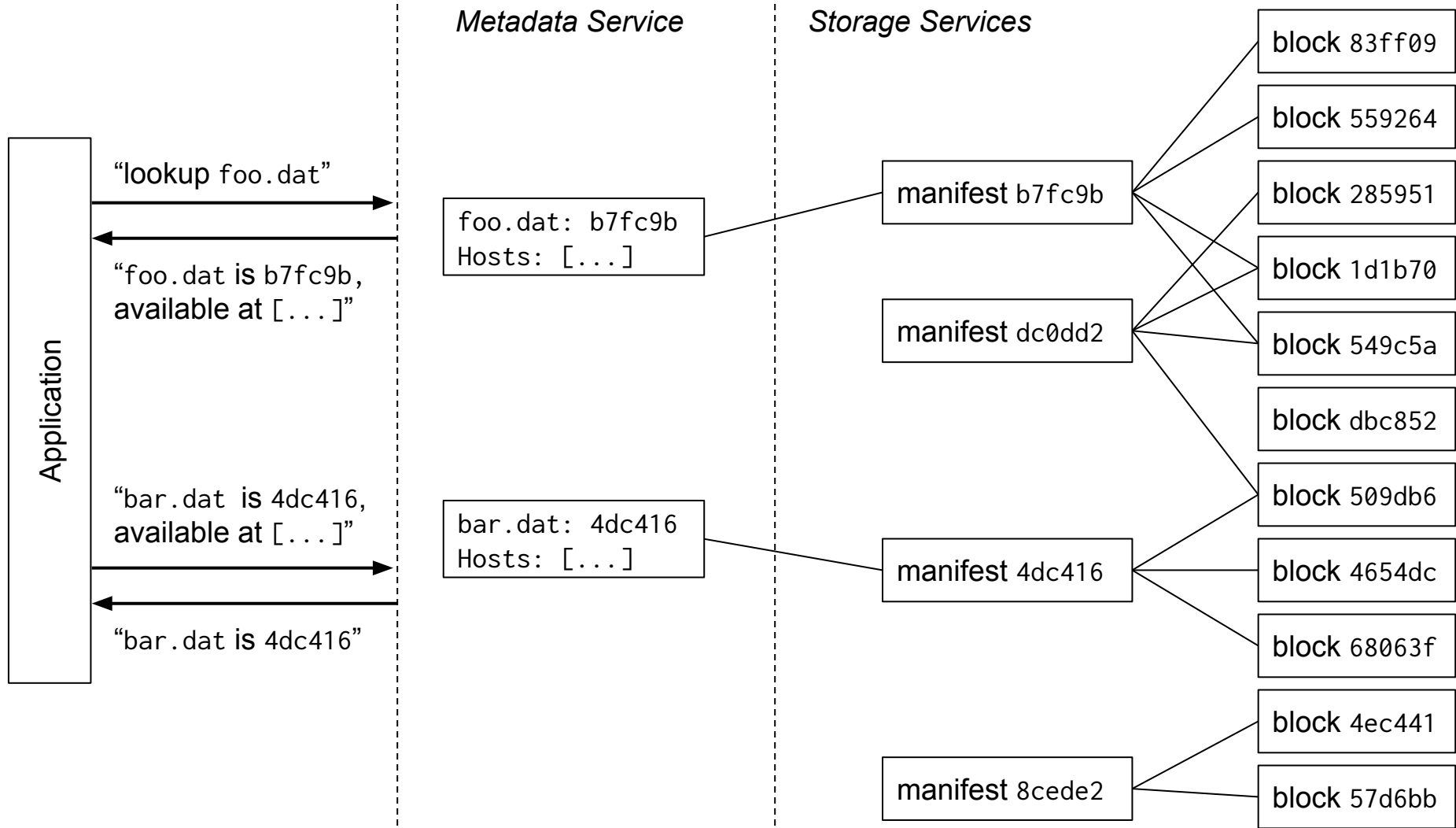
HTTP proxies

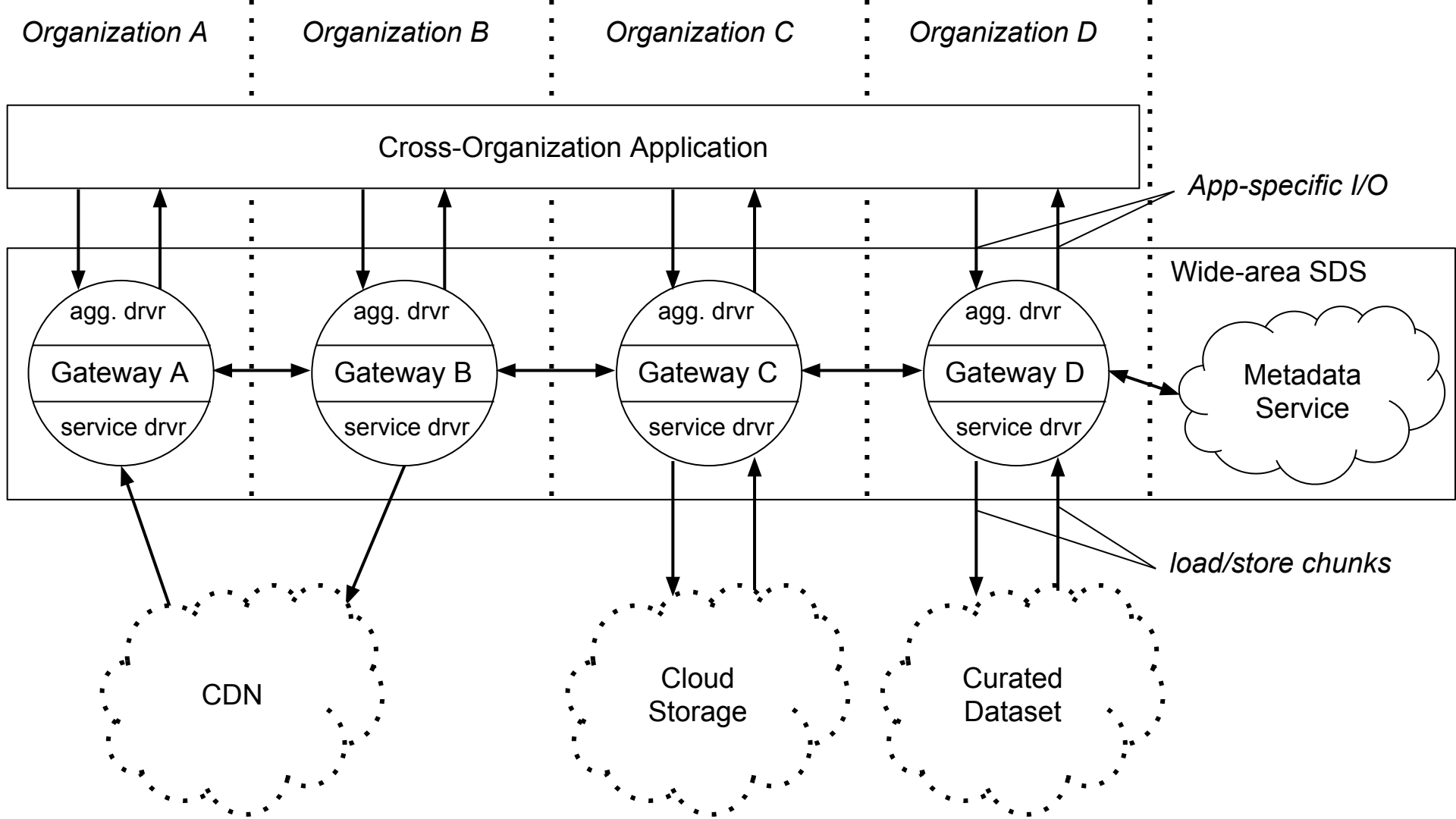
WebDAV

iSCSI

P2P networks

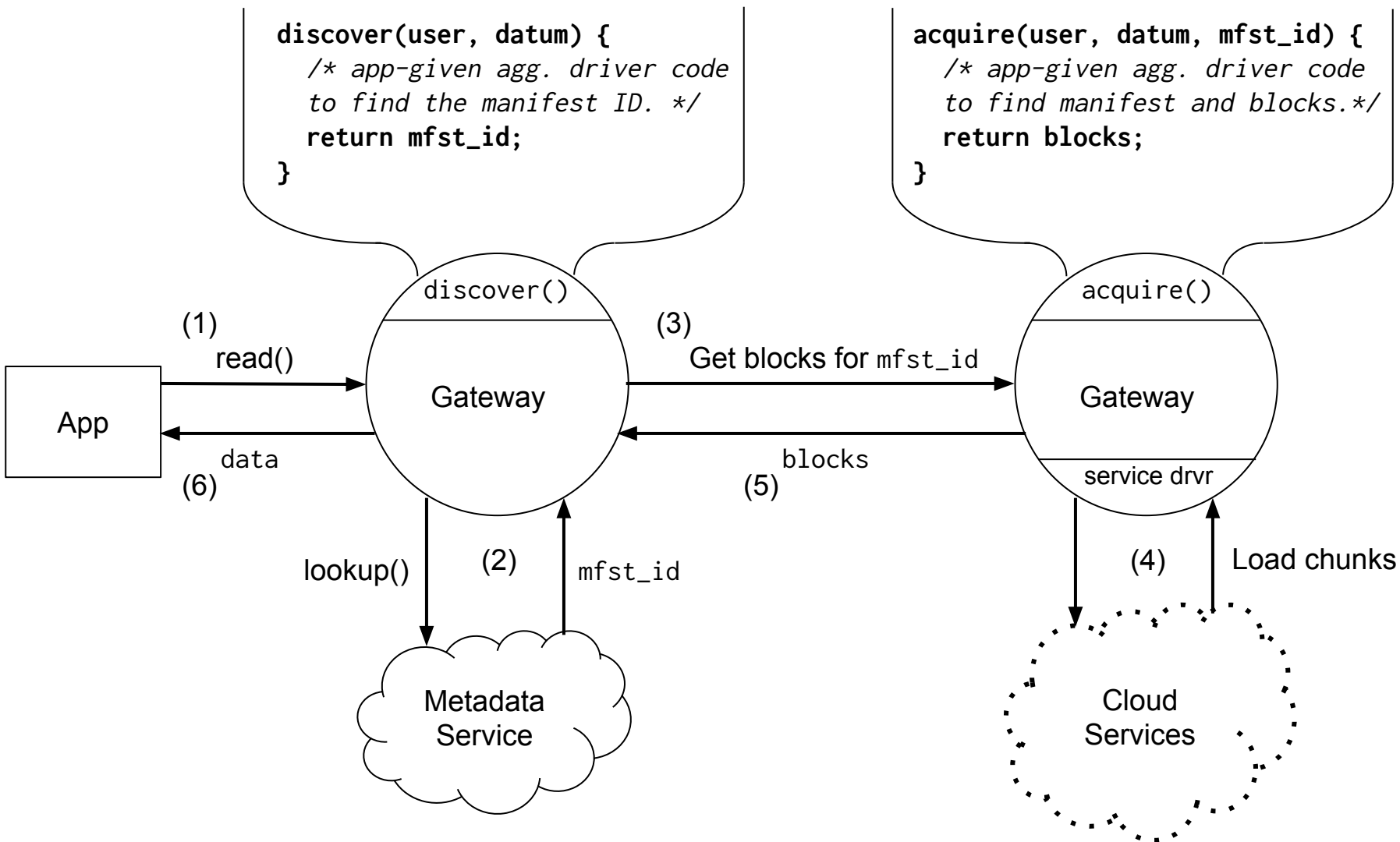
*Services*





```
discover(user, datum) {  
    /* app-given agg. driver code  
    to find the manifest ID. */  
    return mfst_id;  
}
```

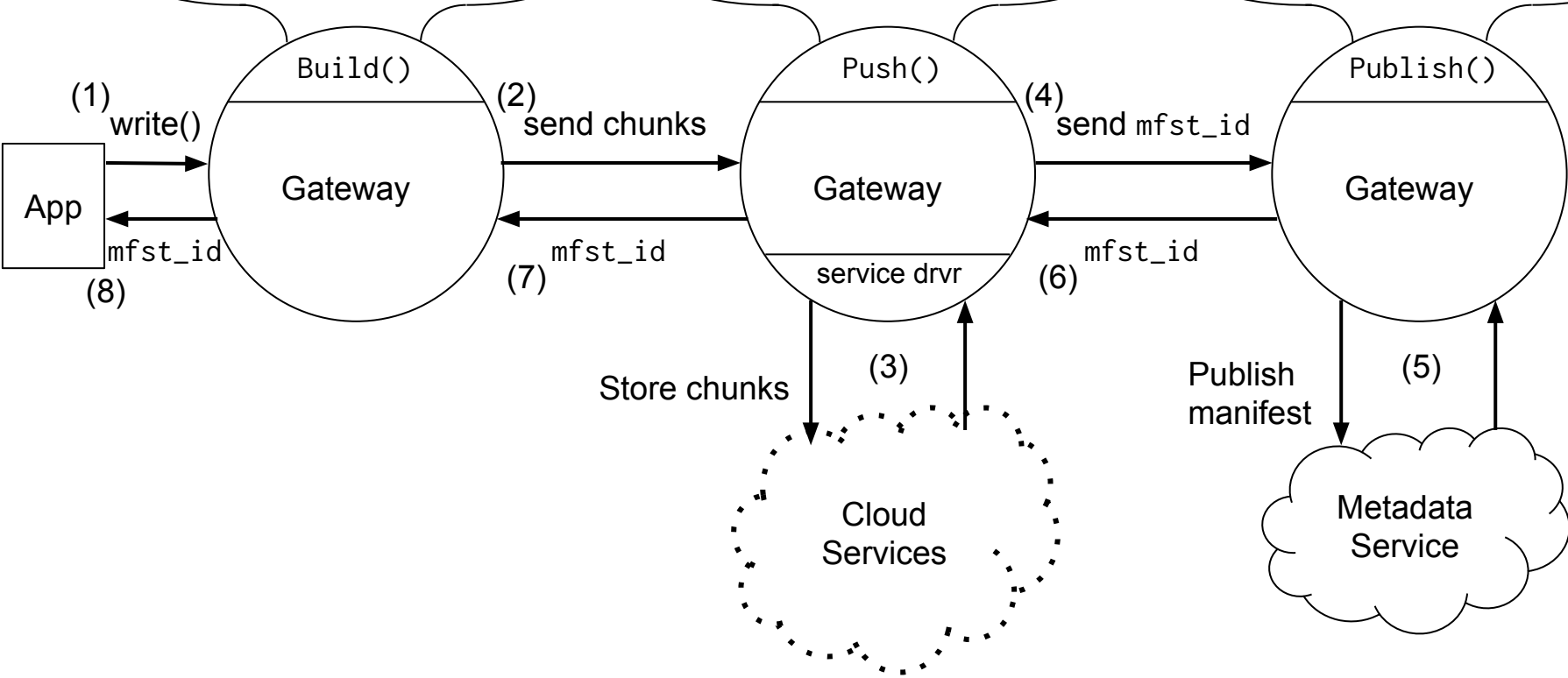
```
acquire(user, datum, mfst_id) {  
    /* app-given agg. driver code  
    to find manifest and blocks.*/  
    return blocks;  
}
```



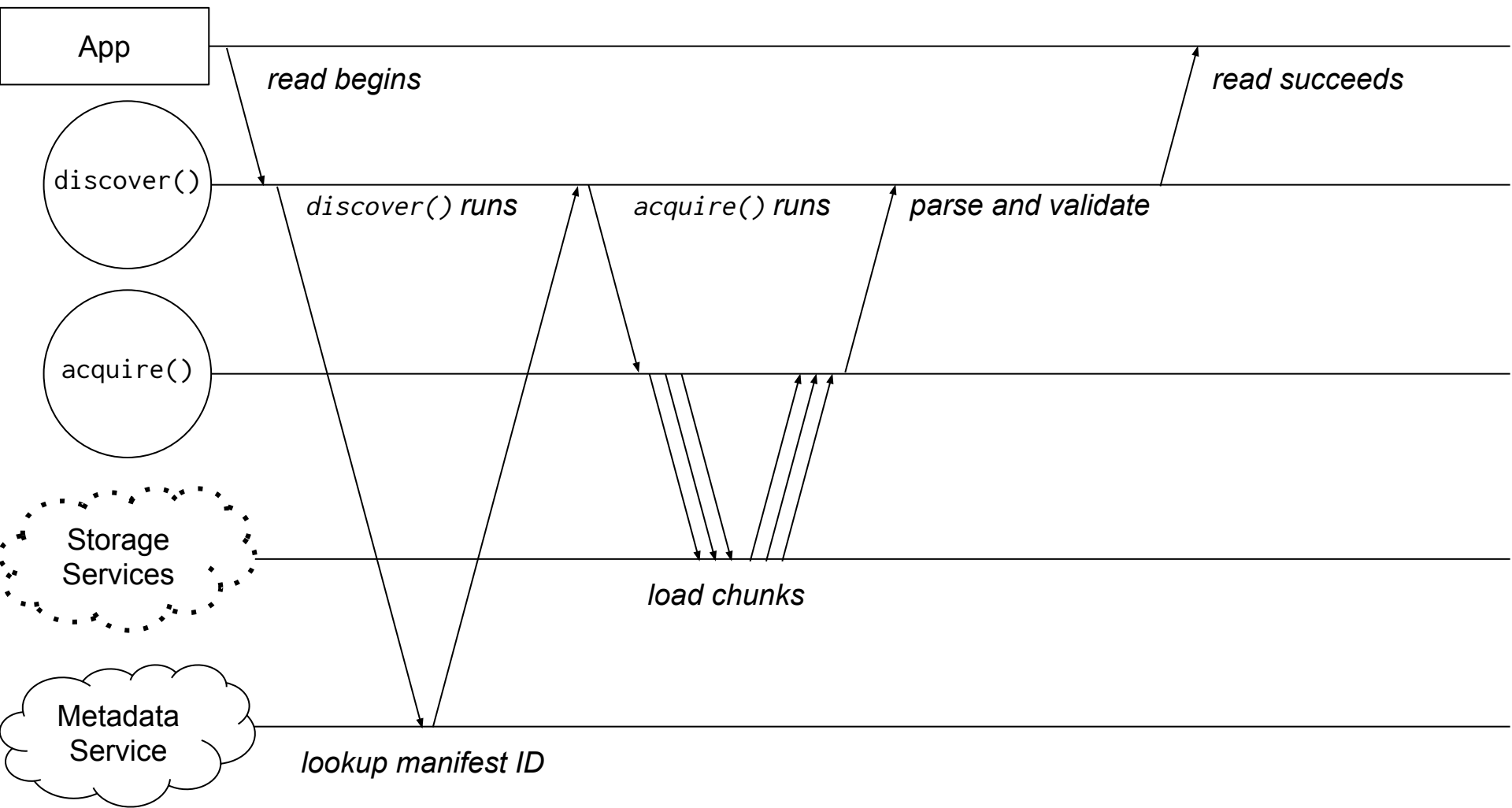
```
Build(user, datum, data) {  
  /* app-given agg. driver code  
  to generate new data. */  
  return (manifest, blocks);  
}
```

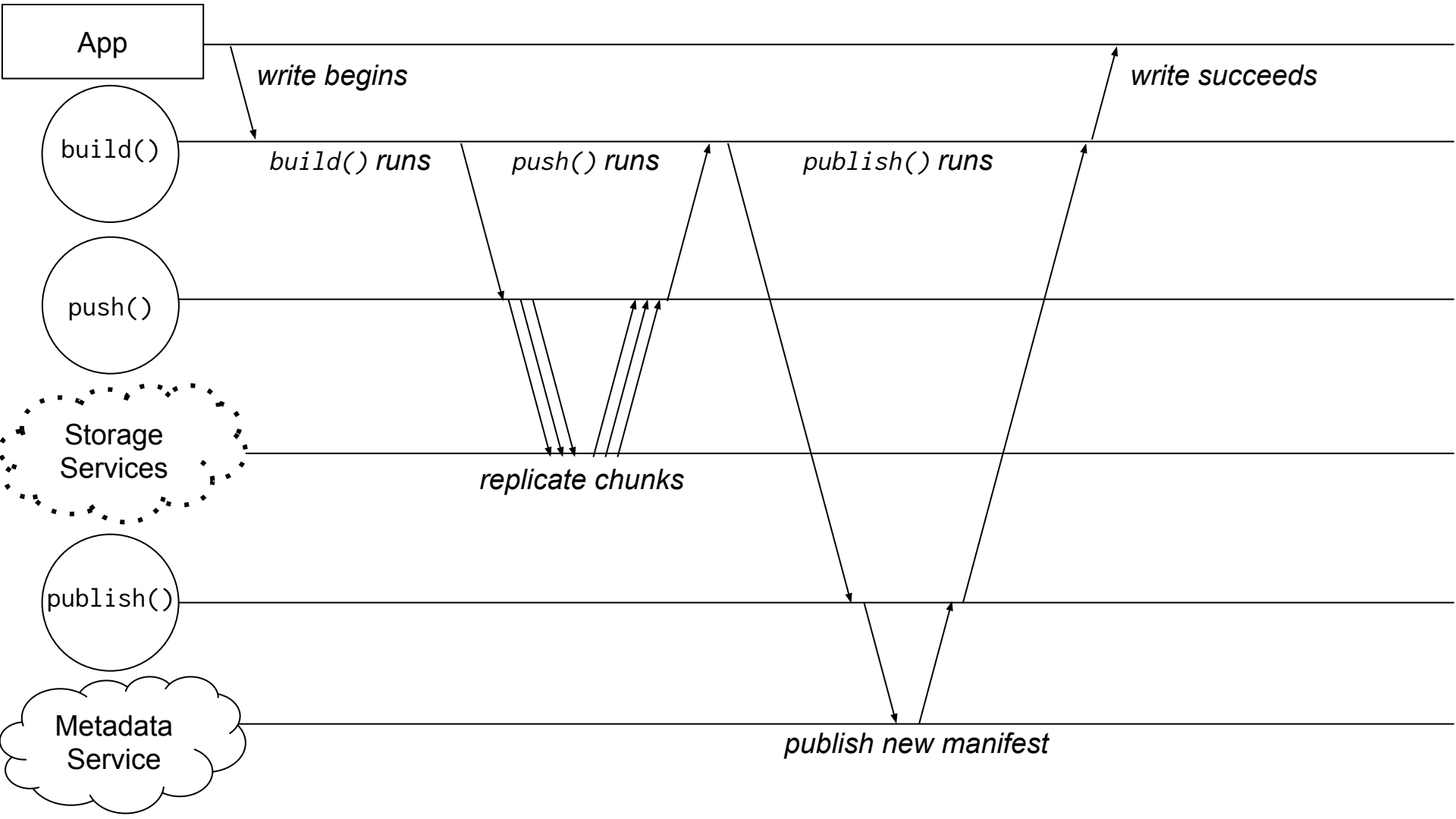
```
Push(user, datum, chunks) {  
  /* app-given agg. driver code  
  to replicate new chunks */  
  return manifest_id;  
}
```

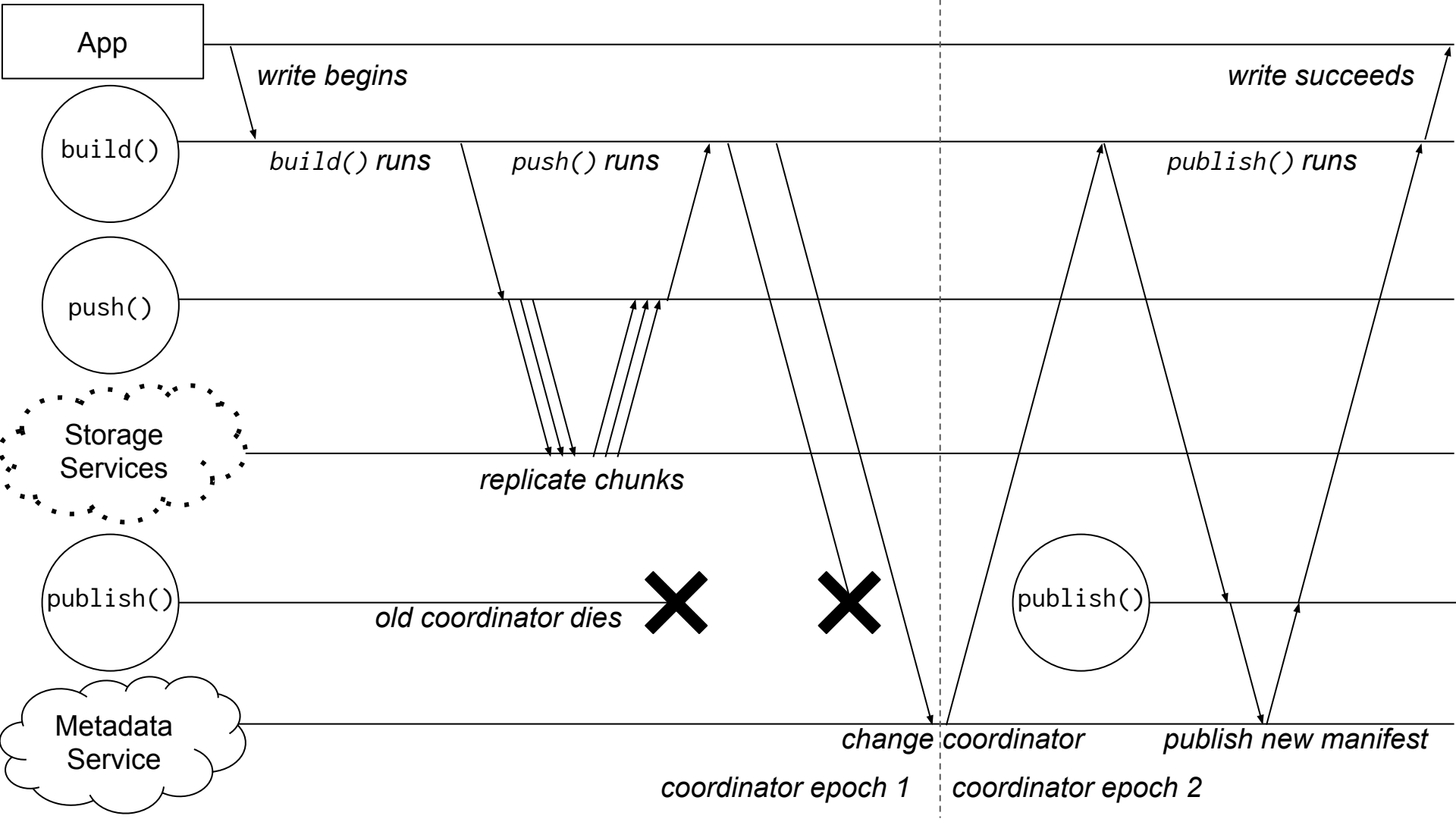
```
Publish(user, datum, mfst_id) {  
  /* app-given agg. driver code  
  to expose new data globally */  
  return mfst_id;  
}
```

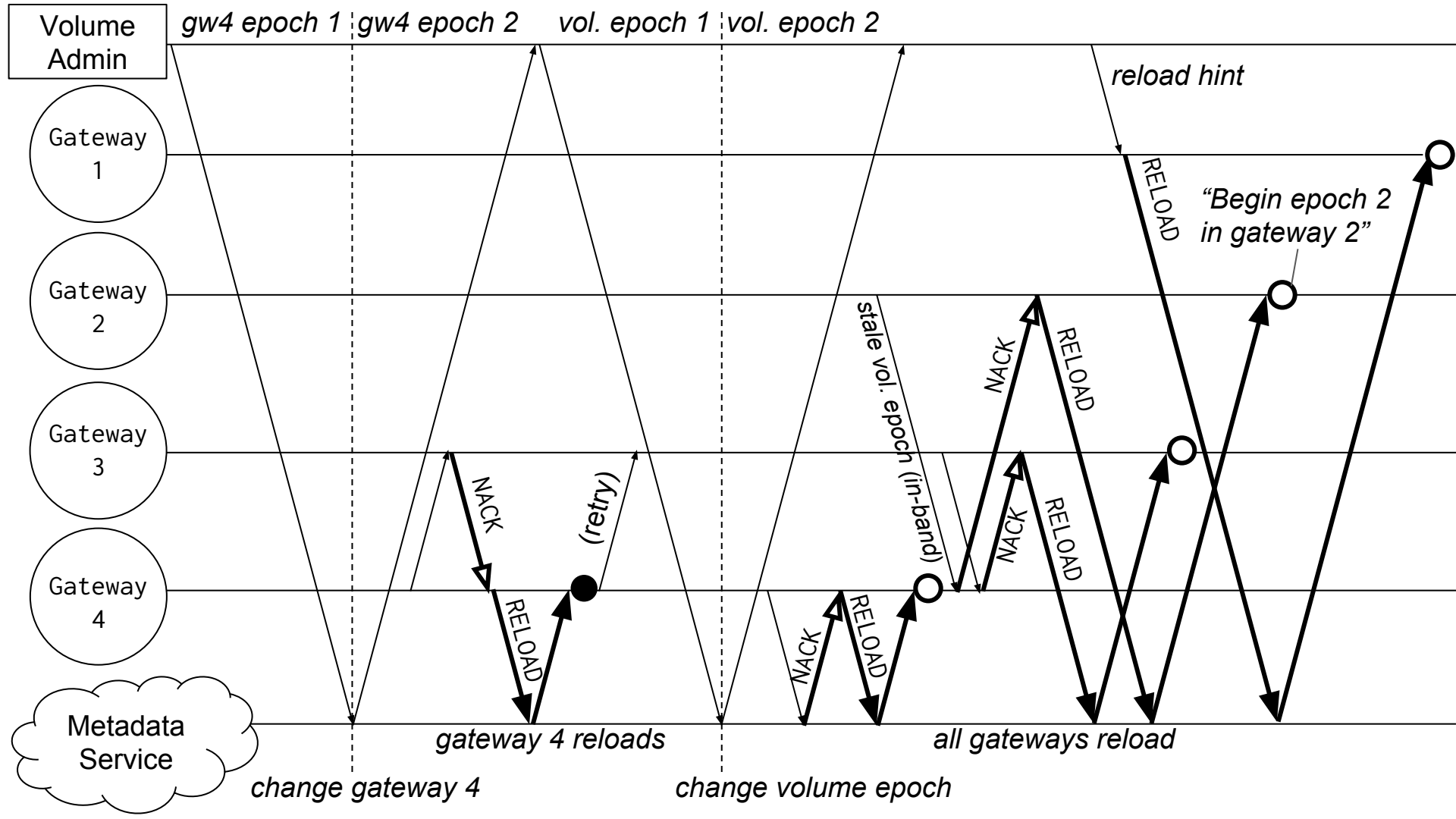


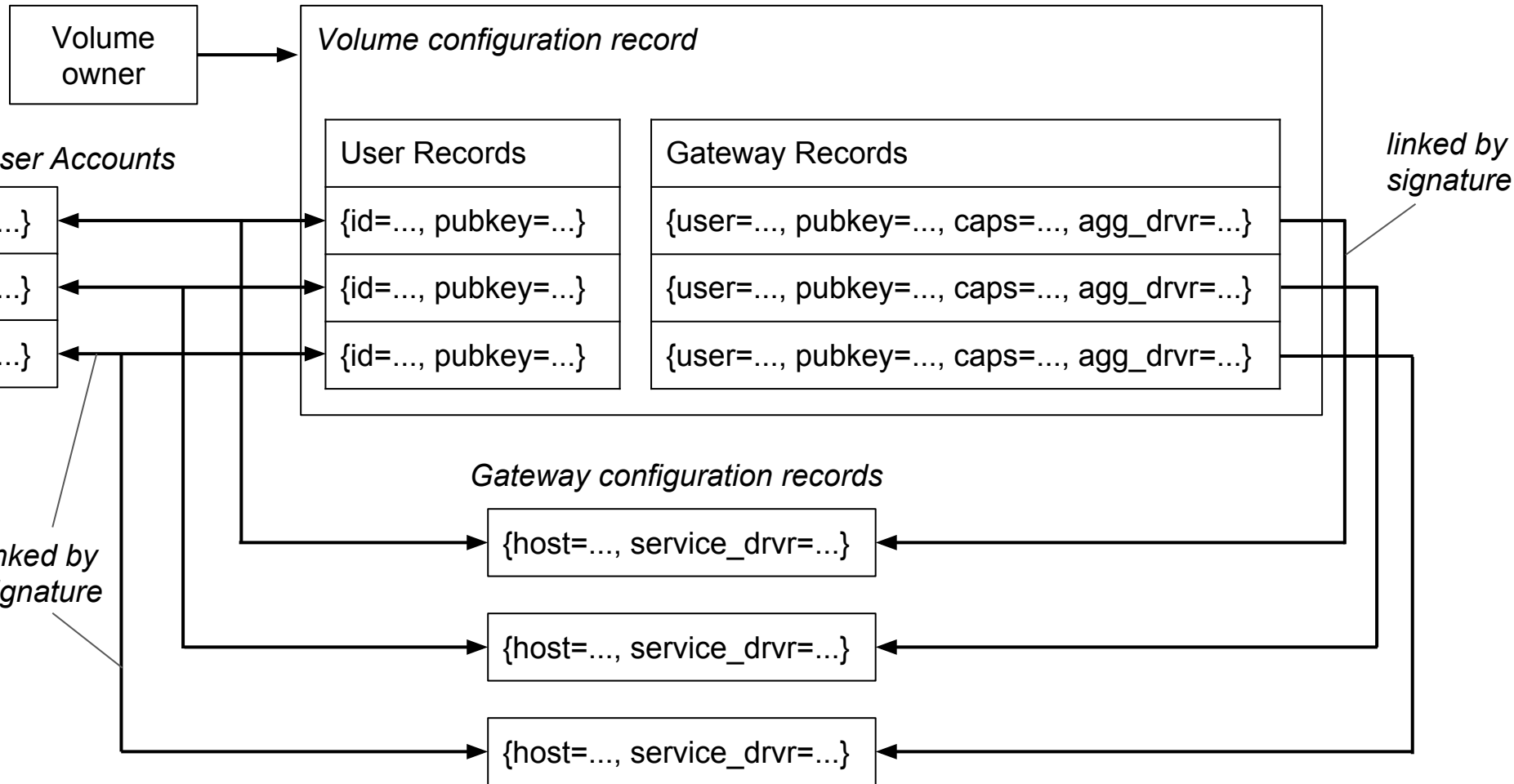


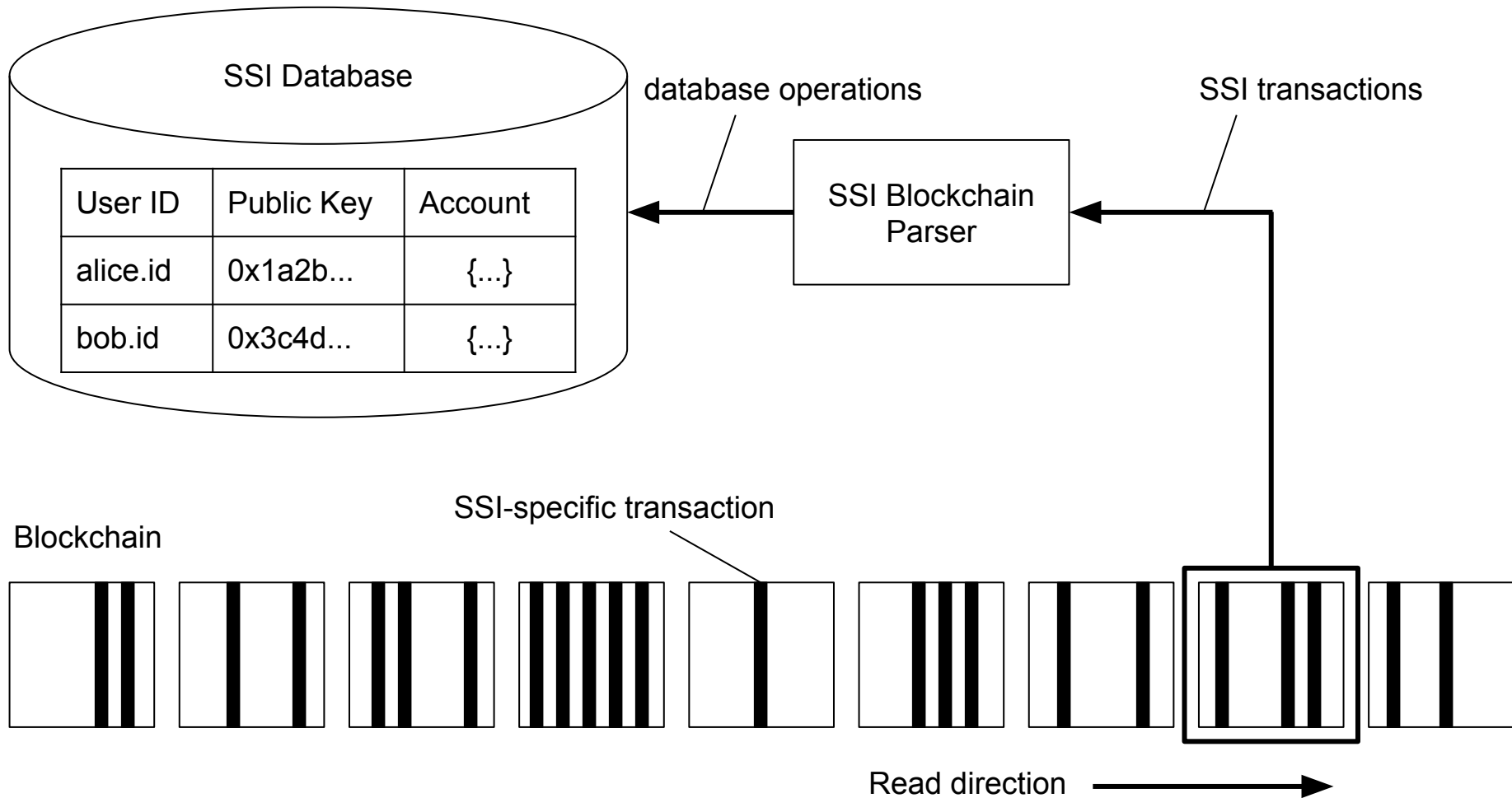










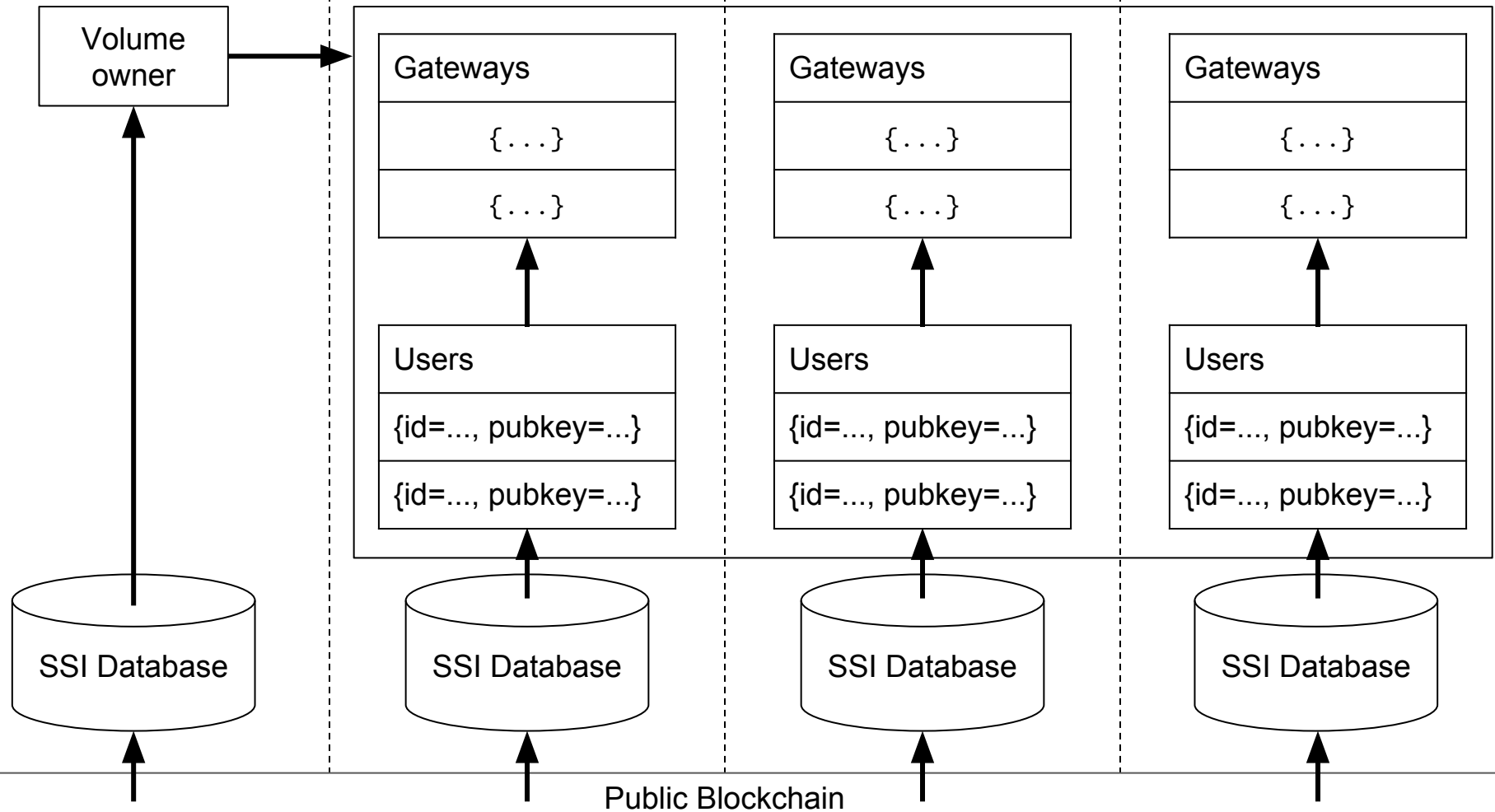


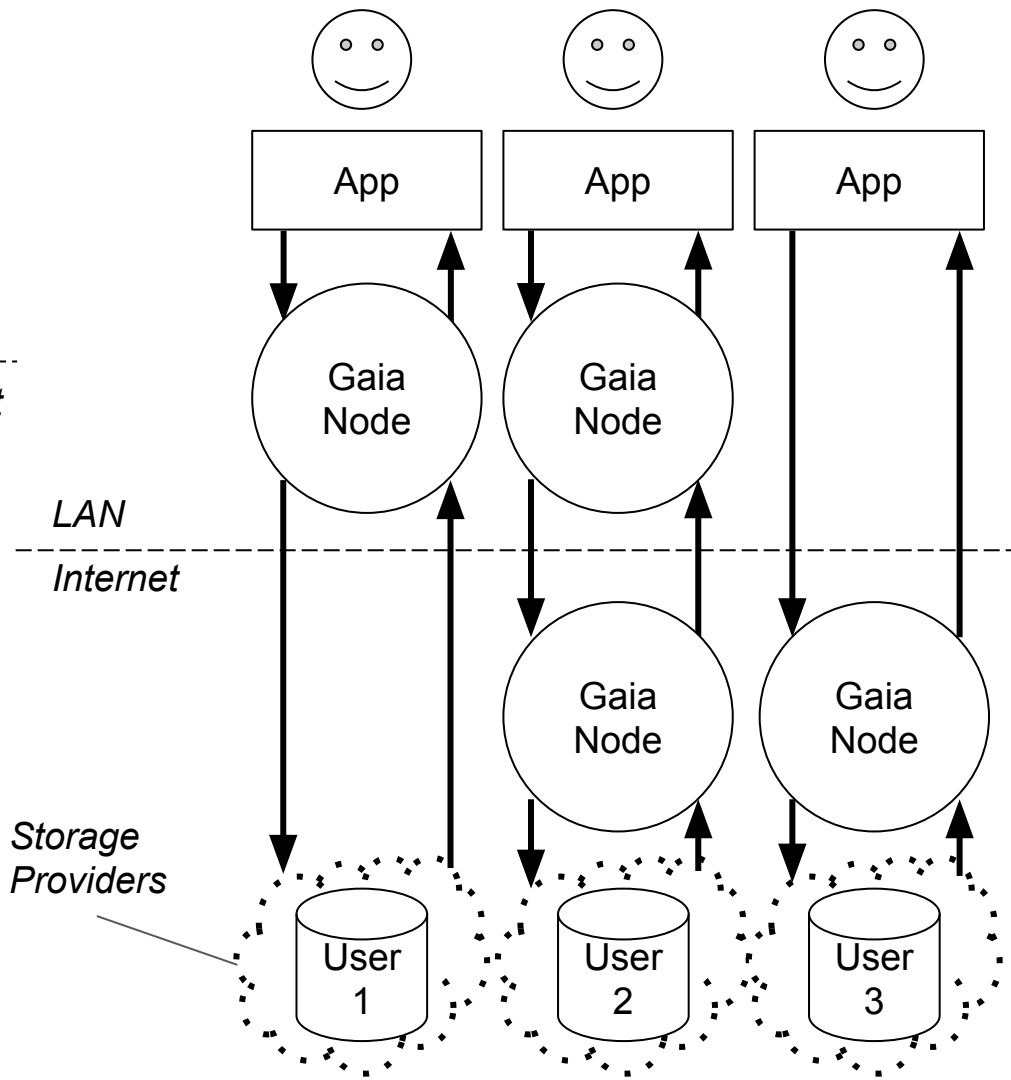
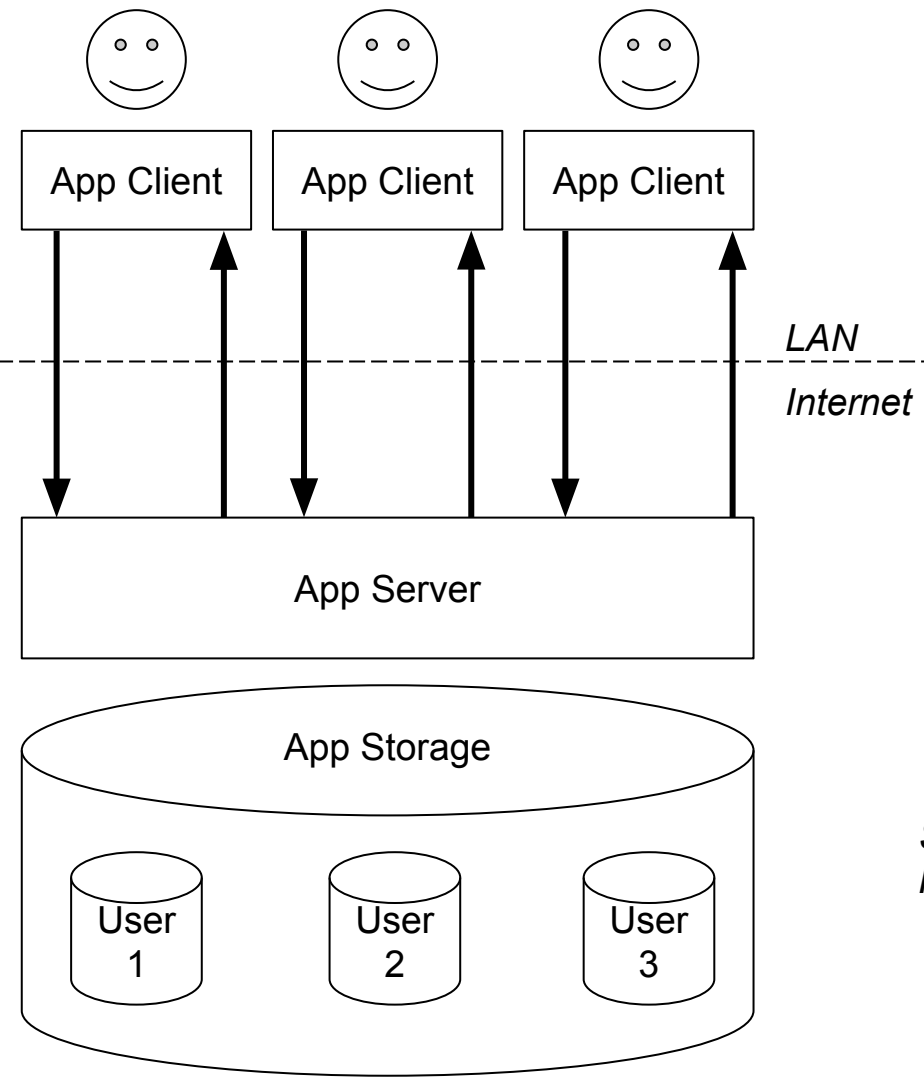
Organization A

Organization B

Organization C

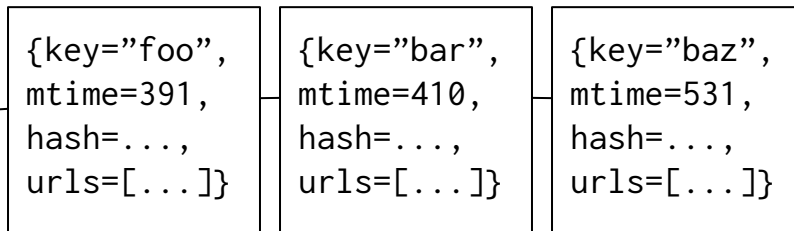
Organization D







## Application-level Key/Value Storage View



Gaia Volume

*Per-device manifest*

Manifest  
7ea4da

Manifest  
b86a62

Manifest  
135f0e

`{key="foo",  
mtime=100,  
hash=...,  
urls=[...]}`

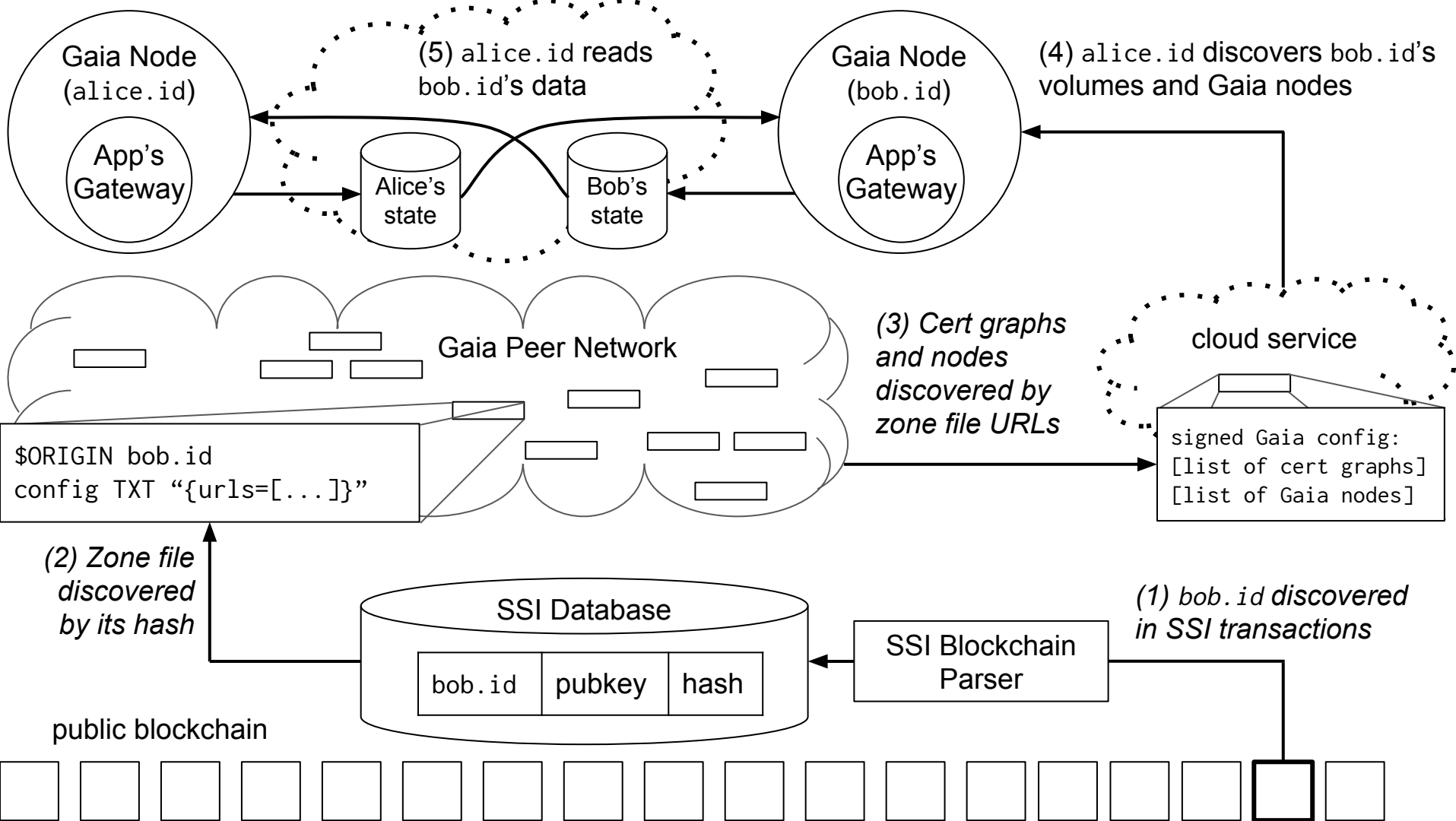
`{key="foo",  
mtime=210,  
hash=...,  
urls=[...]}`

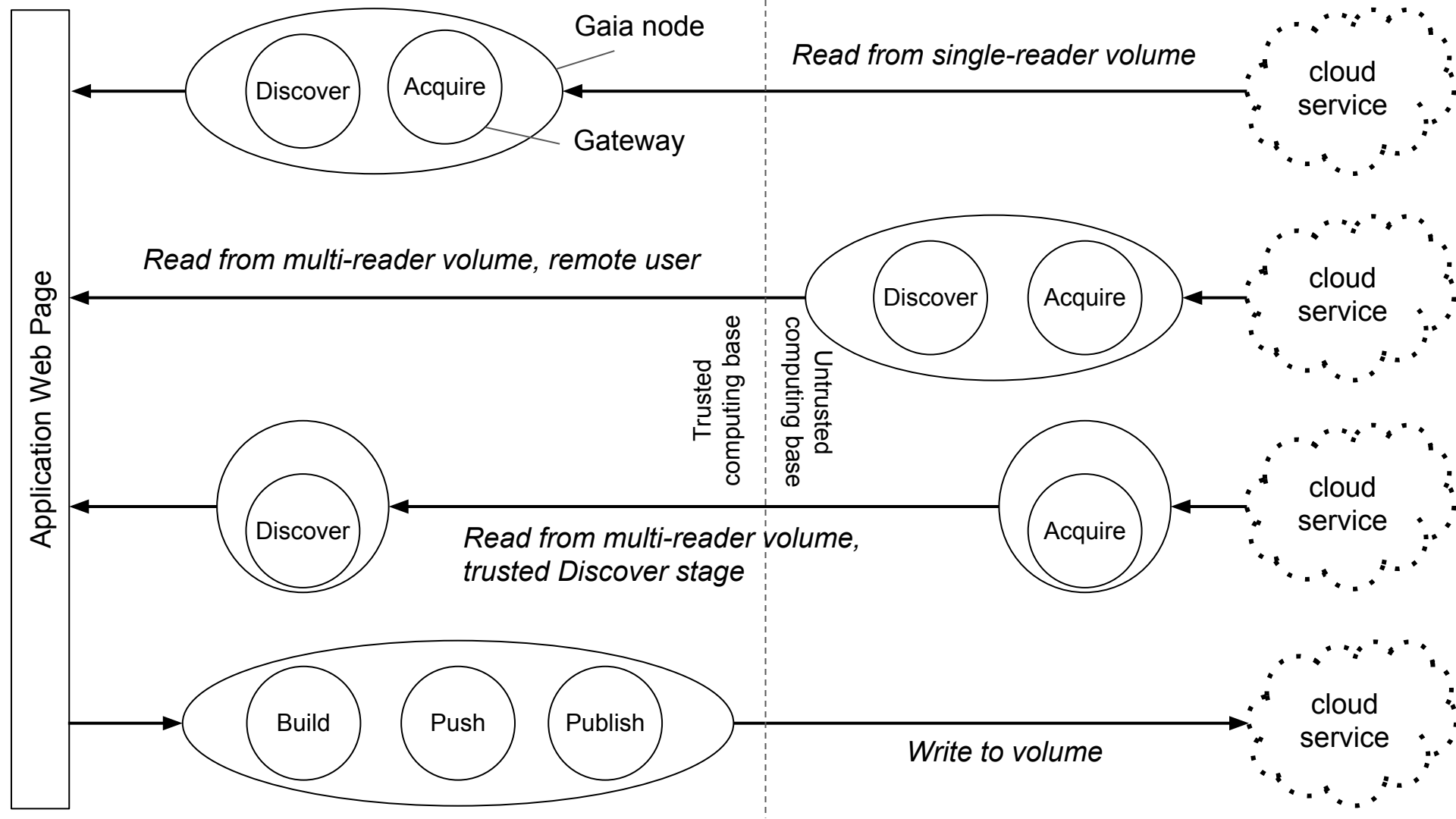
`{key="foo",  
mtime=391,  
hash=...,  
urls=[...]}`

`{key="bar",  
mtime=240,  
hash=...,  
urls=[...]}`

`{key="bar",  
mtime=410,  
hash=...,  
urls=[...]}`

`{key="baz",  
mtime=531,  
hash=...,  
urls=[...]}`



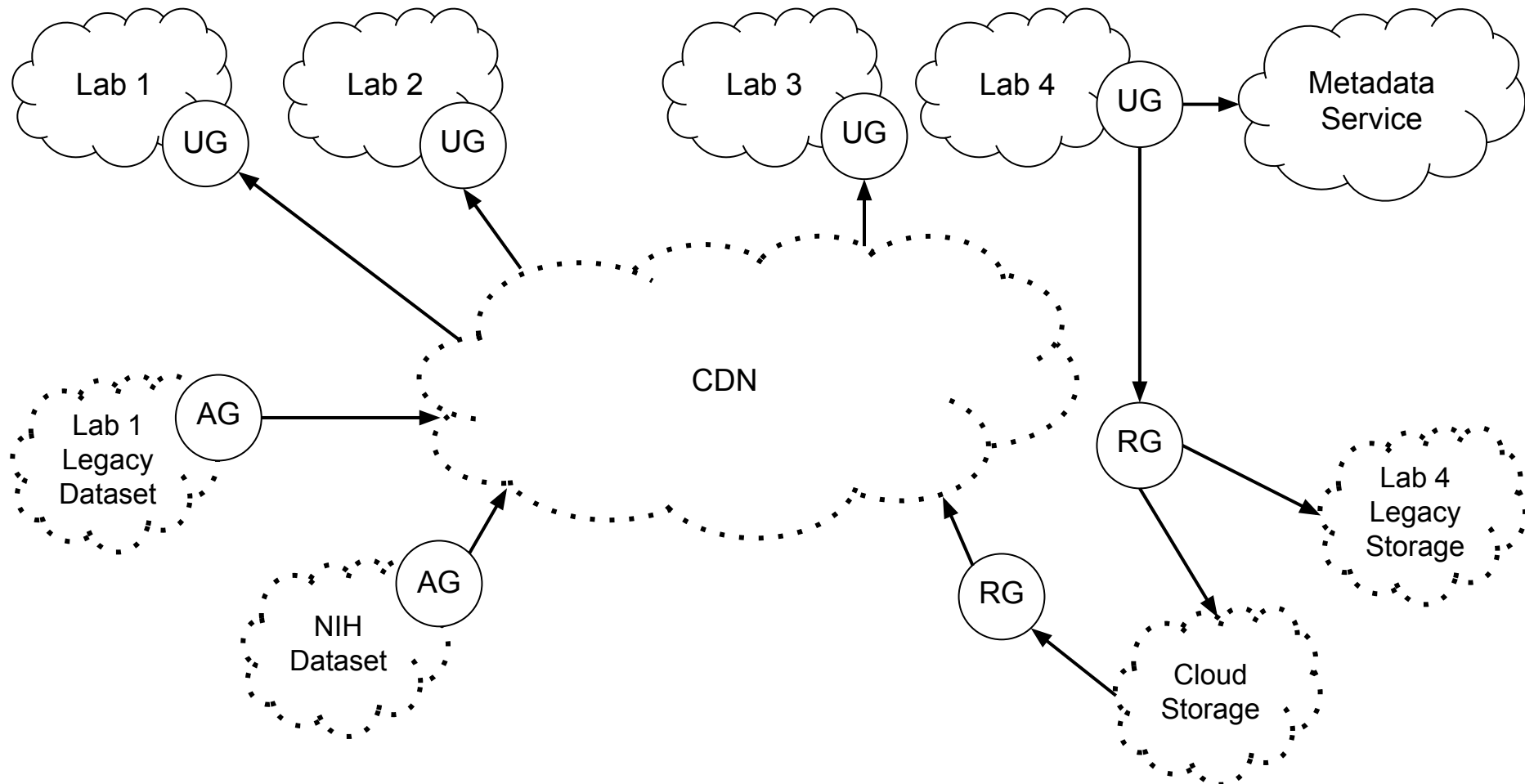


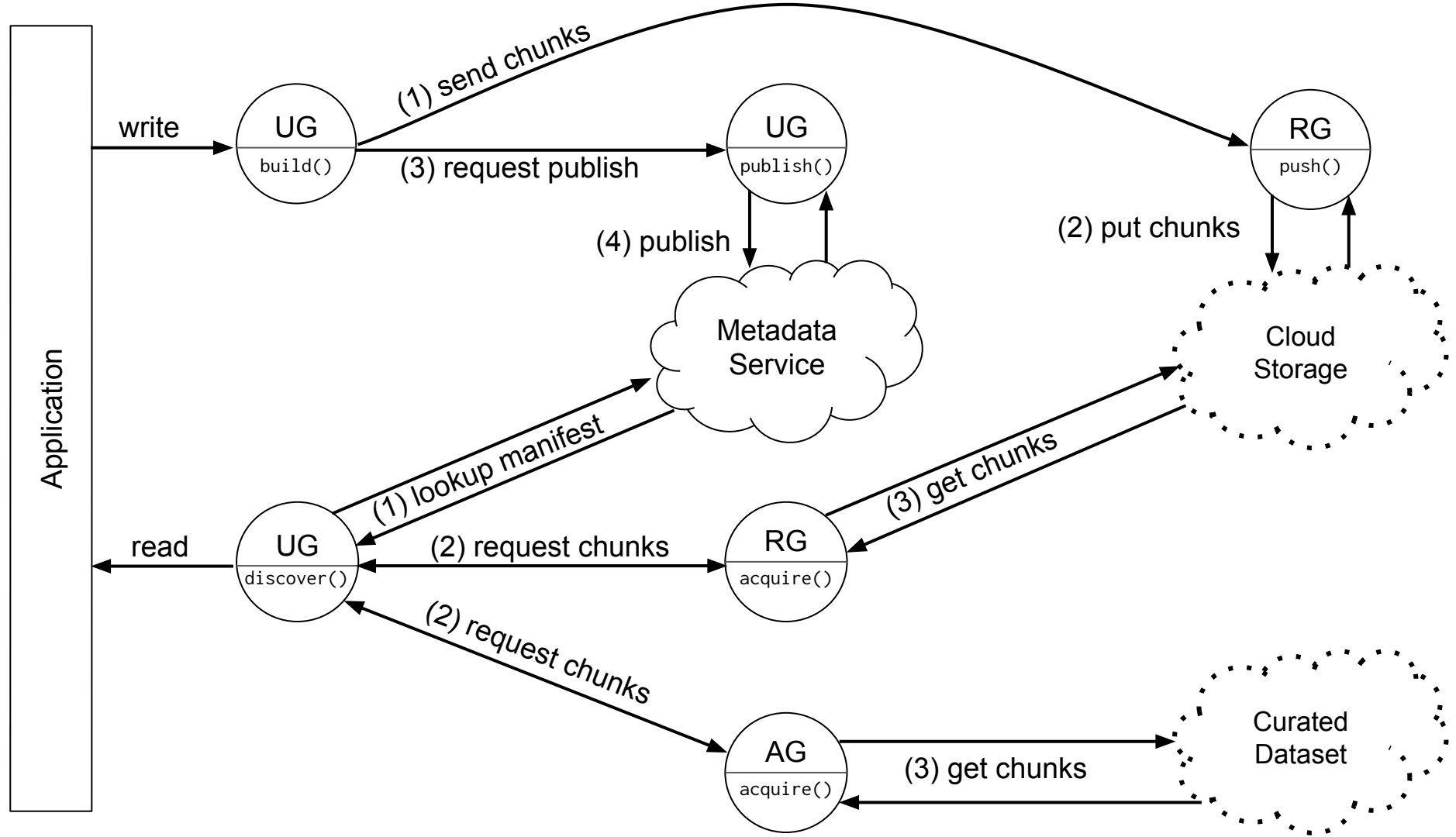
*Lab 1: Reads  
NIH data*

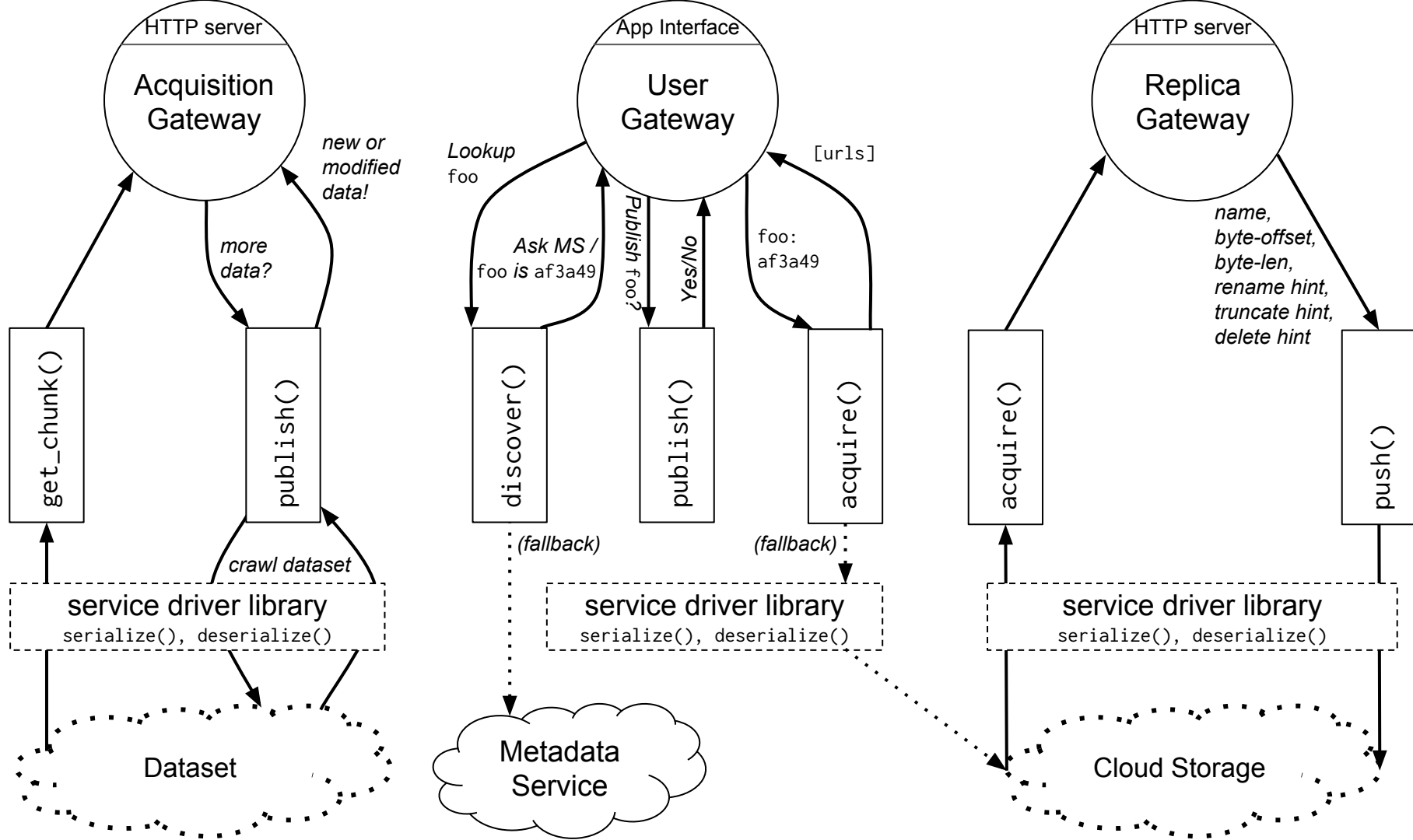
*Lab 2: Reads  
Lab 1's dataset*

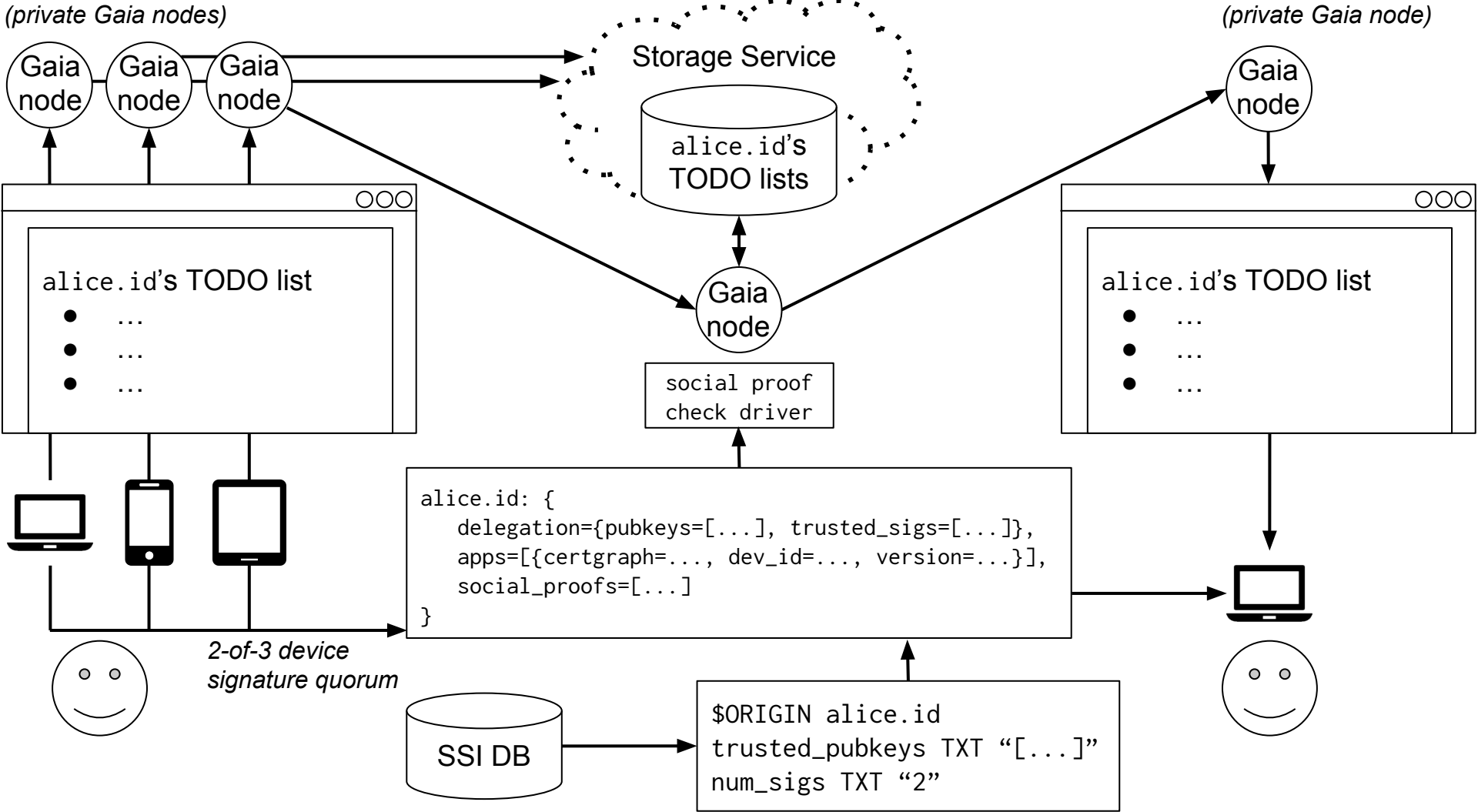
*Lab 3: Reads Lab 4's  
data from cloud storage*

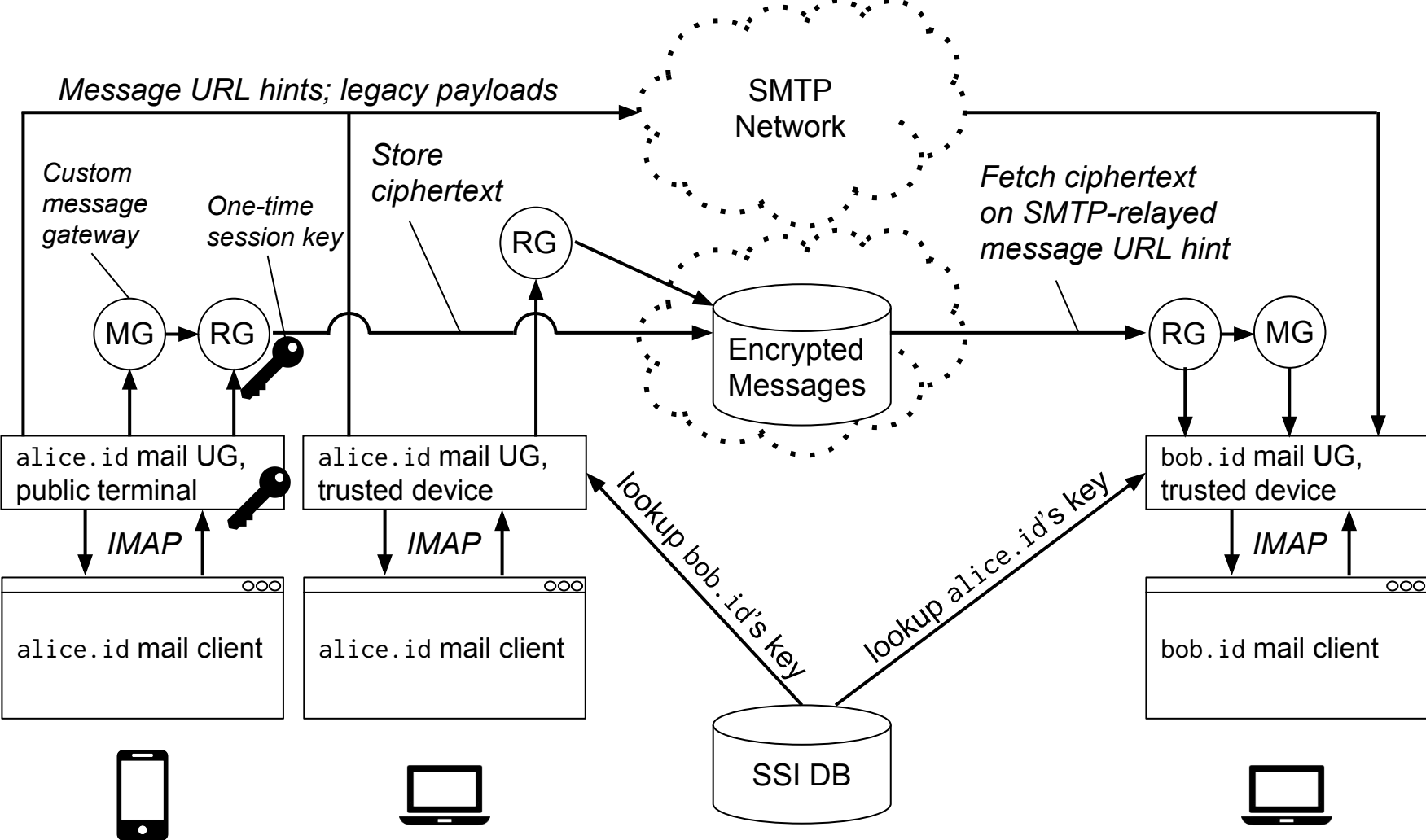
*Lab 4: Mirrors data to legacy  
and cloud storage*



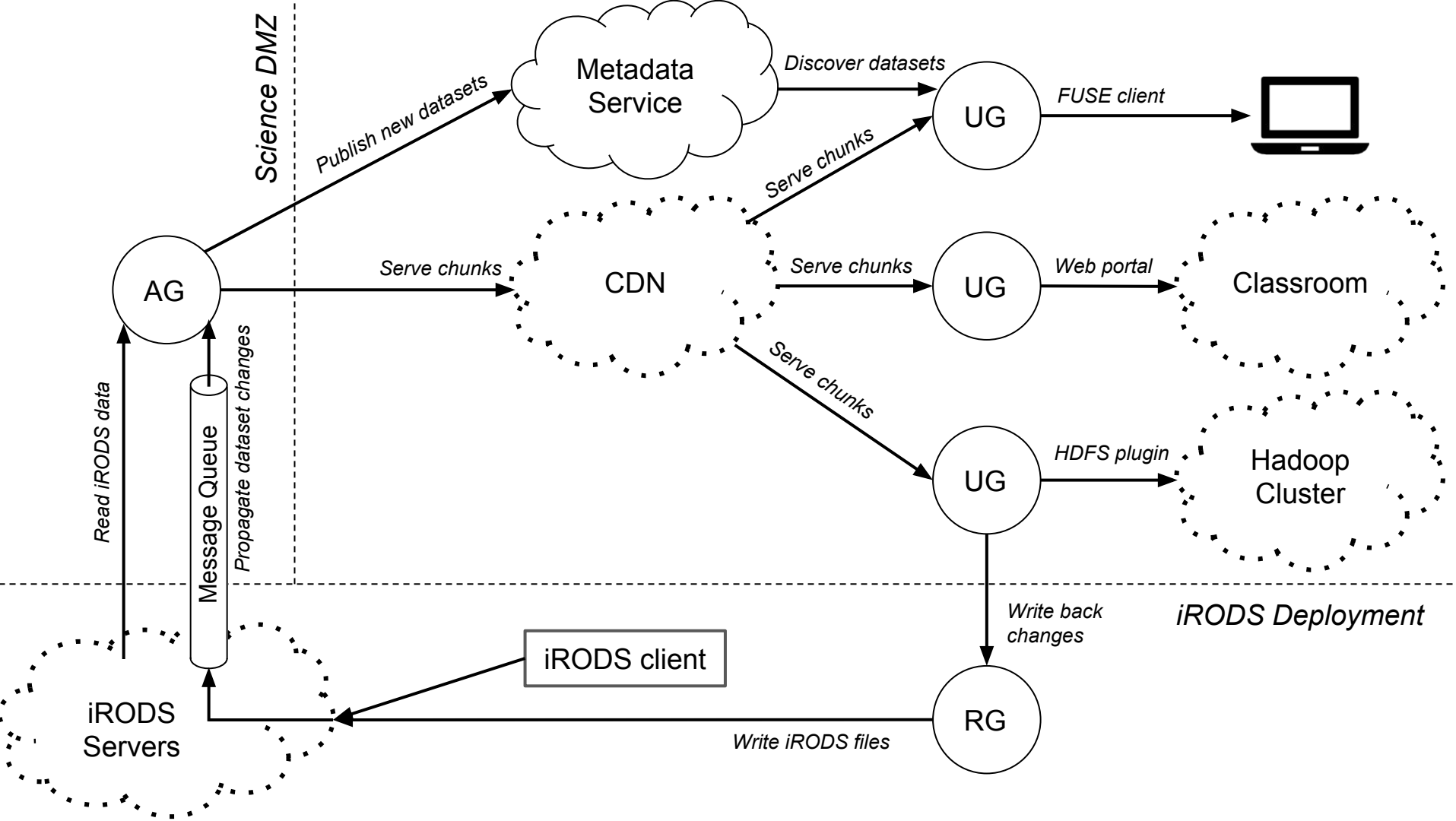


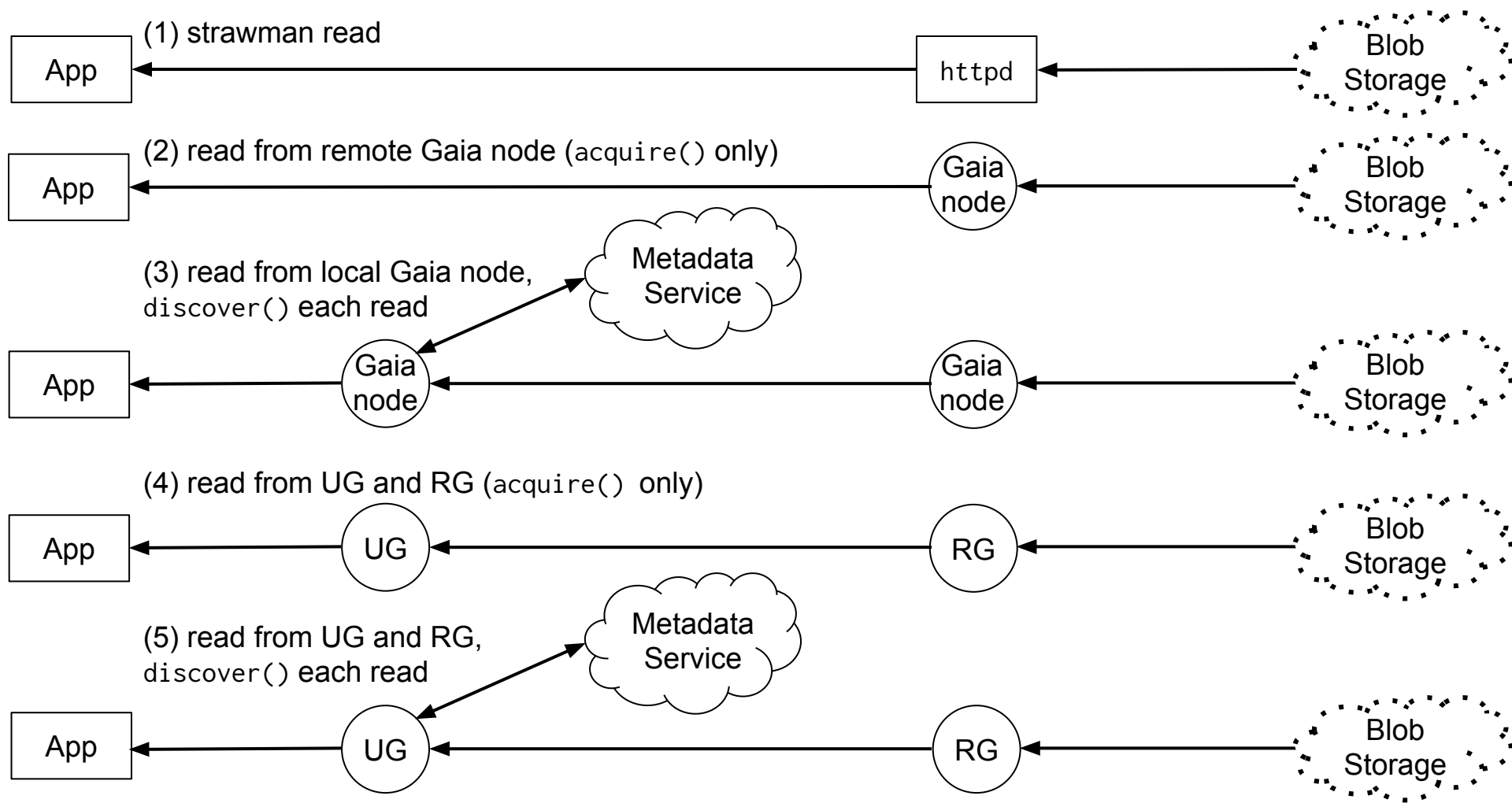


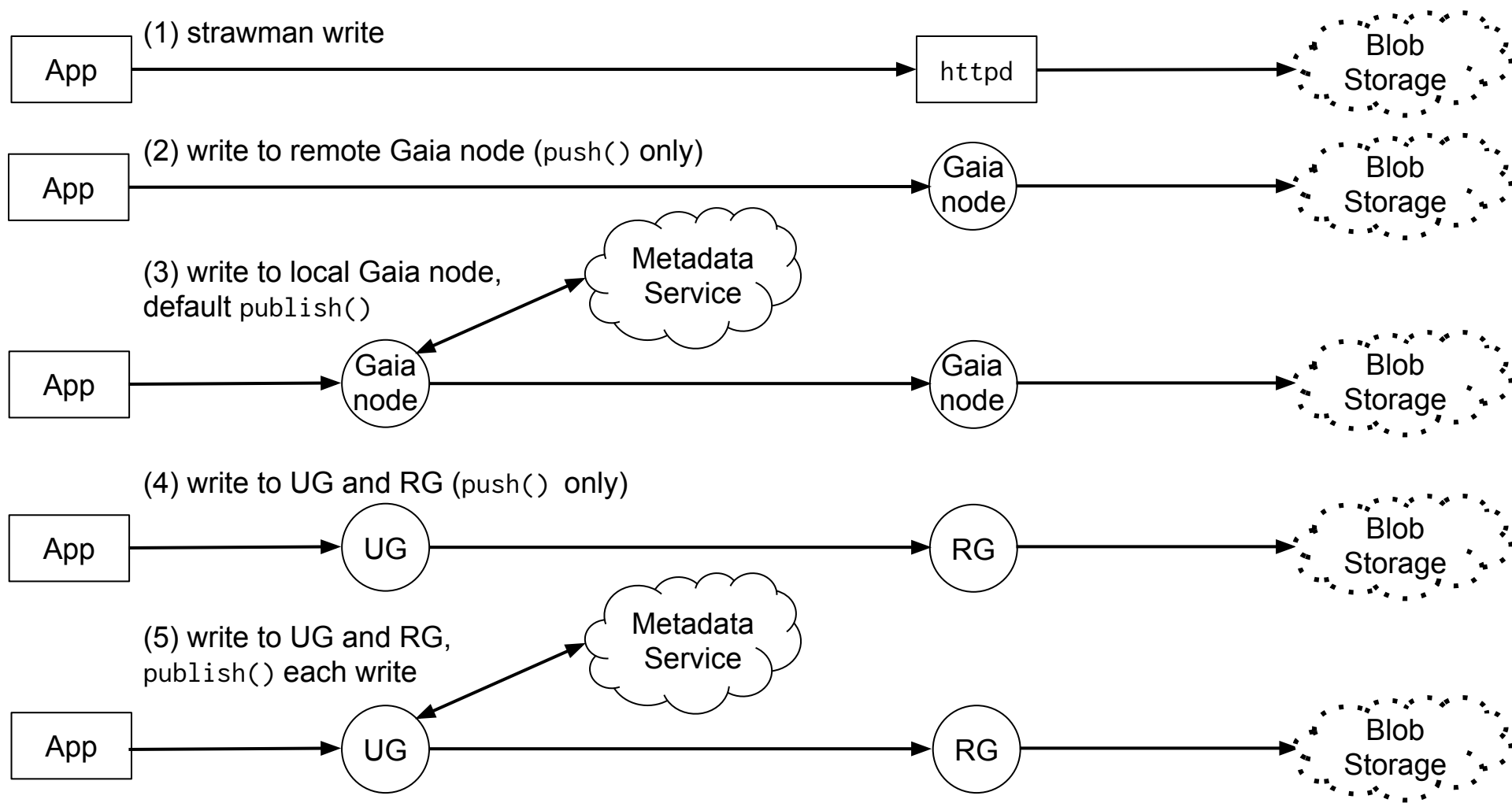












# *Applications*

Scientific workflows

Encrypted email

Groupware

Online games

Blogging

Social media

Video-streaming

*Aggregation drivers*

## *Wide-area SDS System*

*Service drivers*

Akamai CDN

Dropbox

Amazon Cloudfront

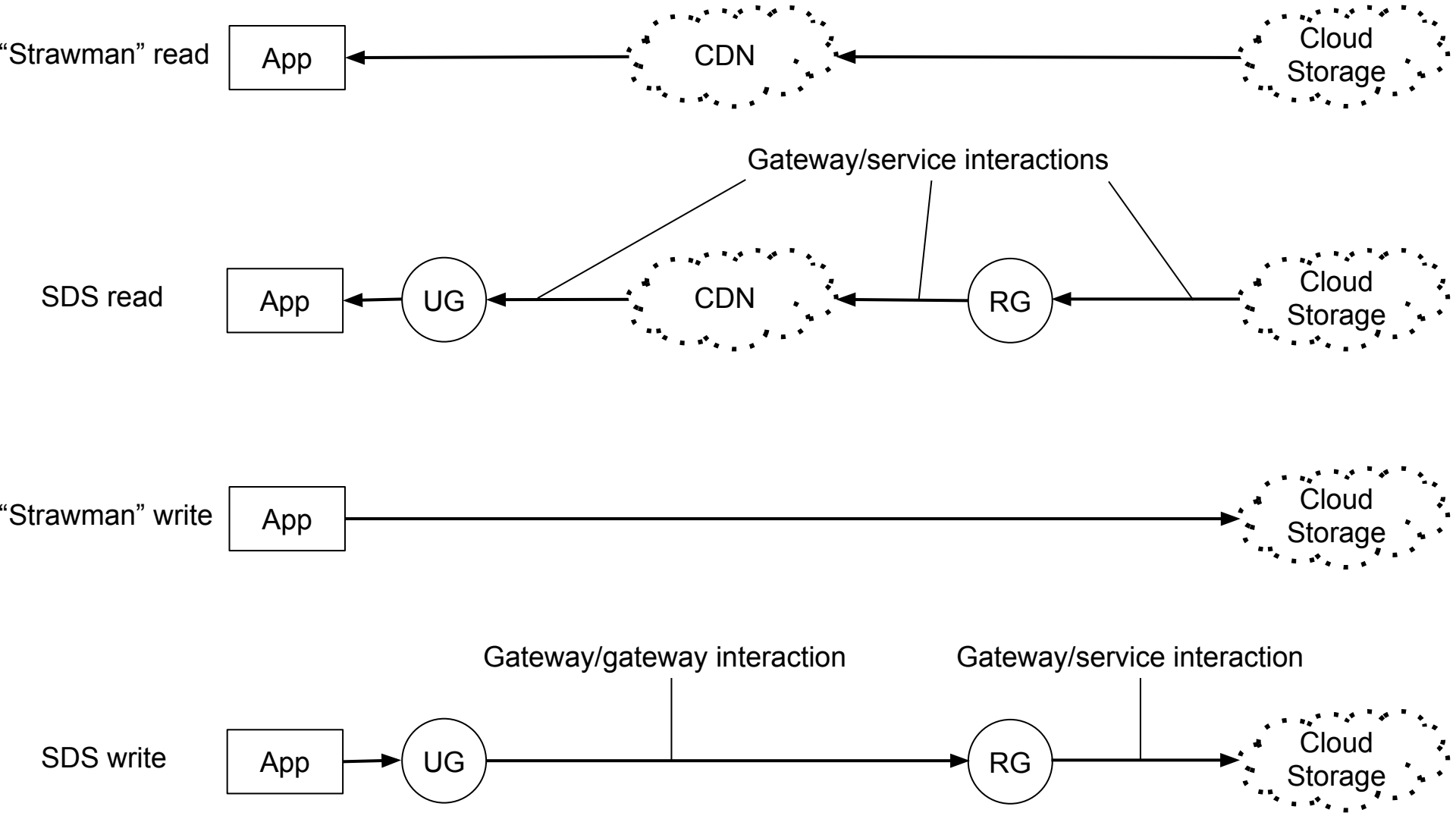
Amazon S3

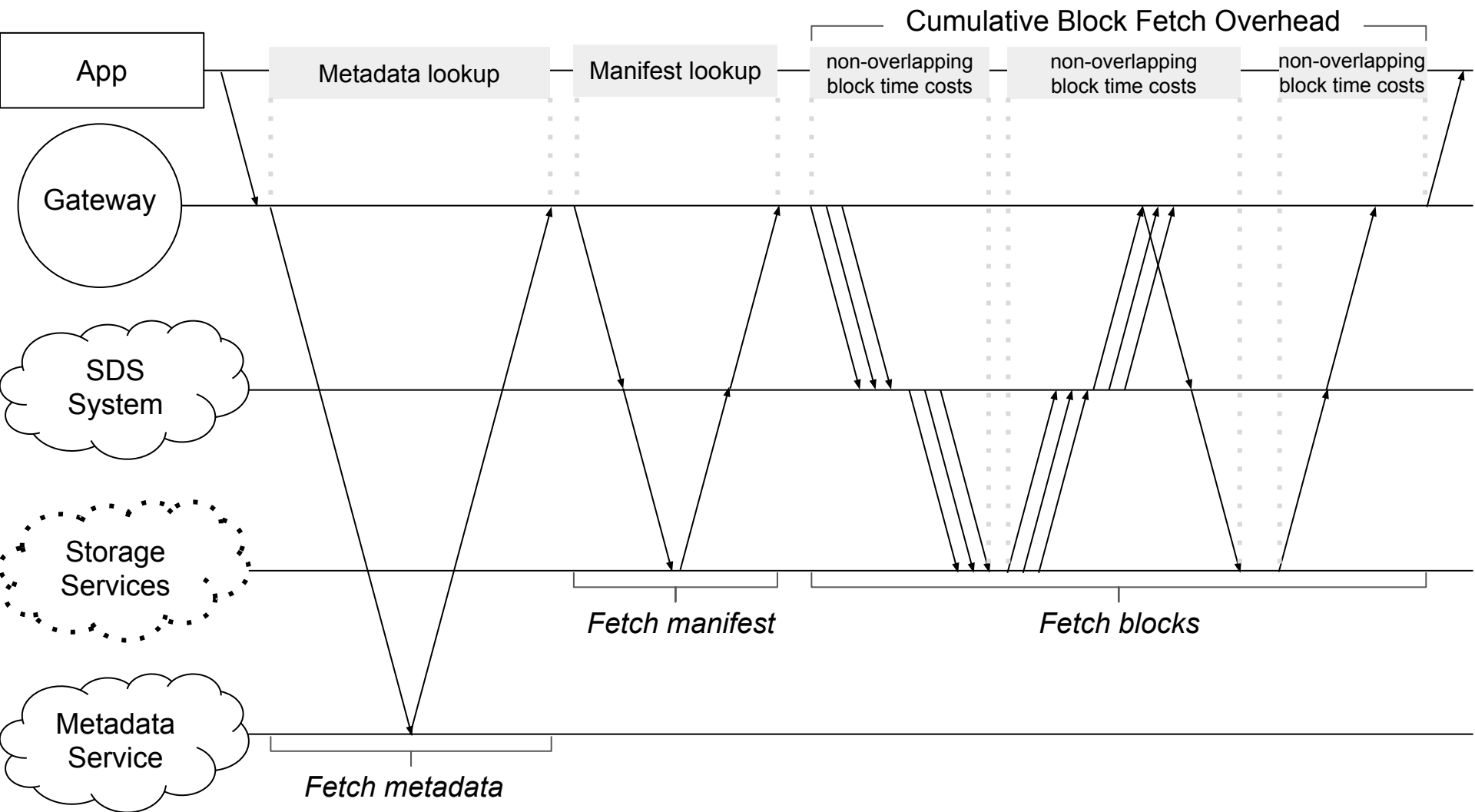
NIH GenBank

iRODS catalogs

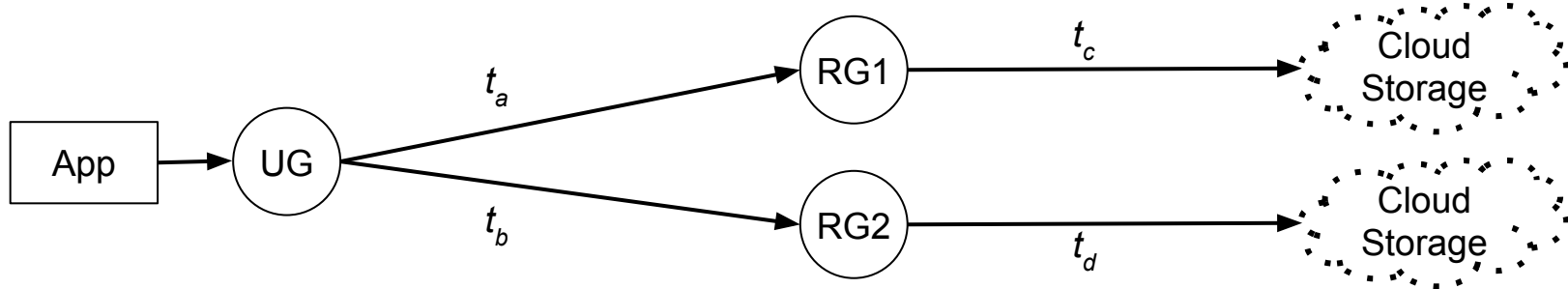
M-Lab dataset

# *Cloud Services*

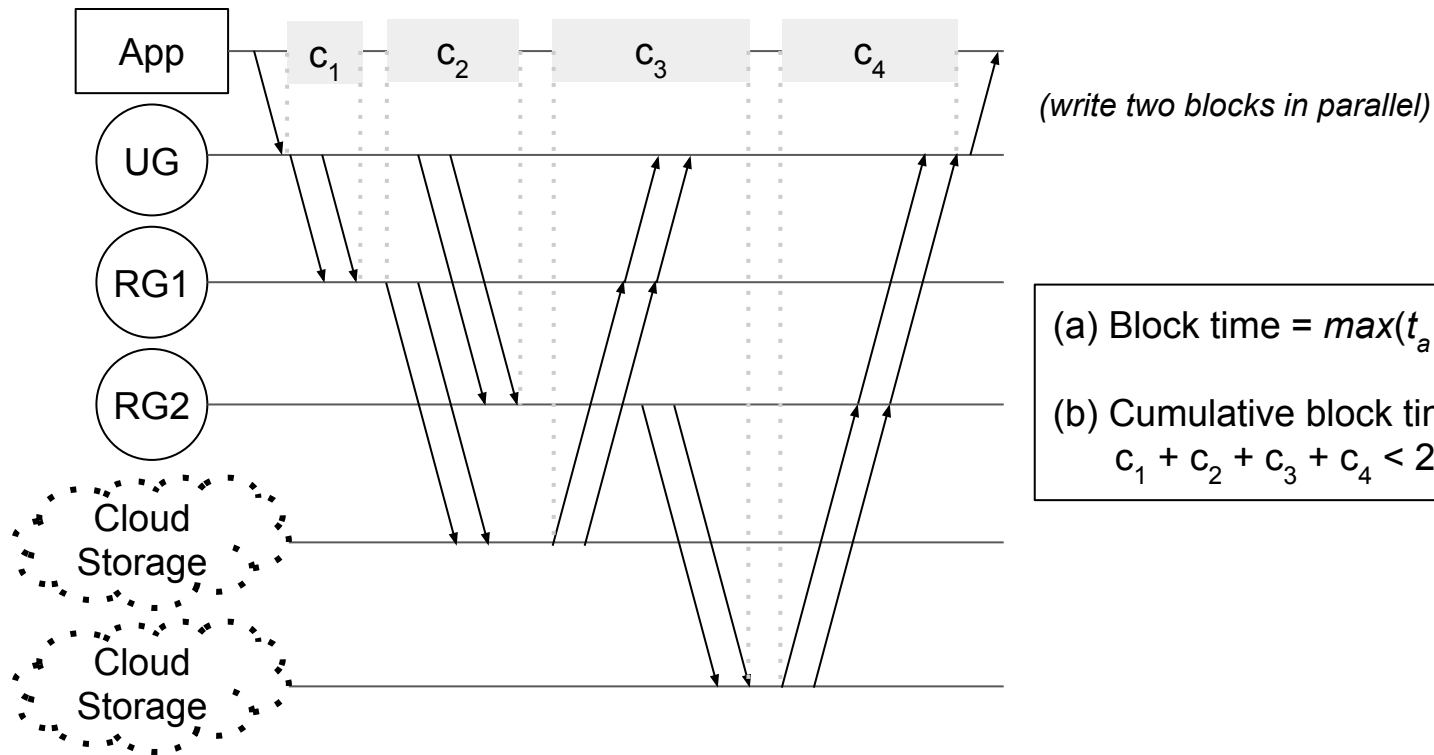




(a)



(b)



(a) Block time =  $\max(t_a + t_c, t_b + t_d)$

(b) Cumulative block time for 2 blocks:  
 $c_1 + c_2 + c_3 + c_4 < 2 * (\text{Block time})$

