A GA4GH Data Repository Service for iRODS

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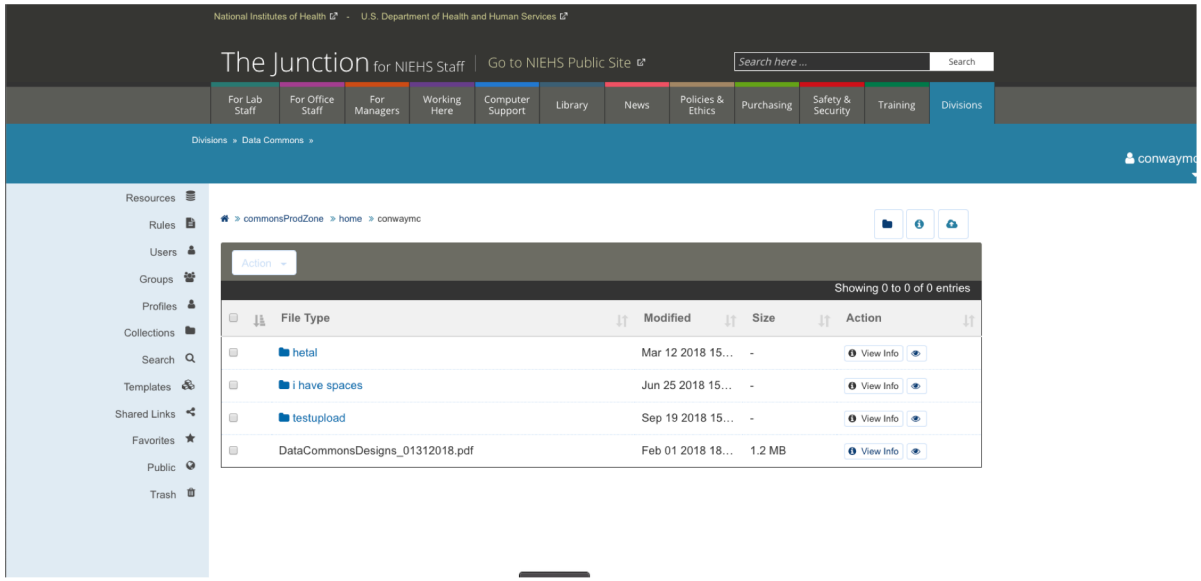
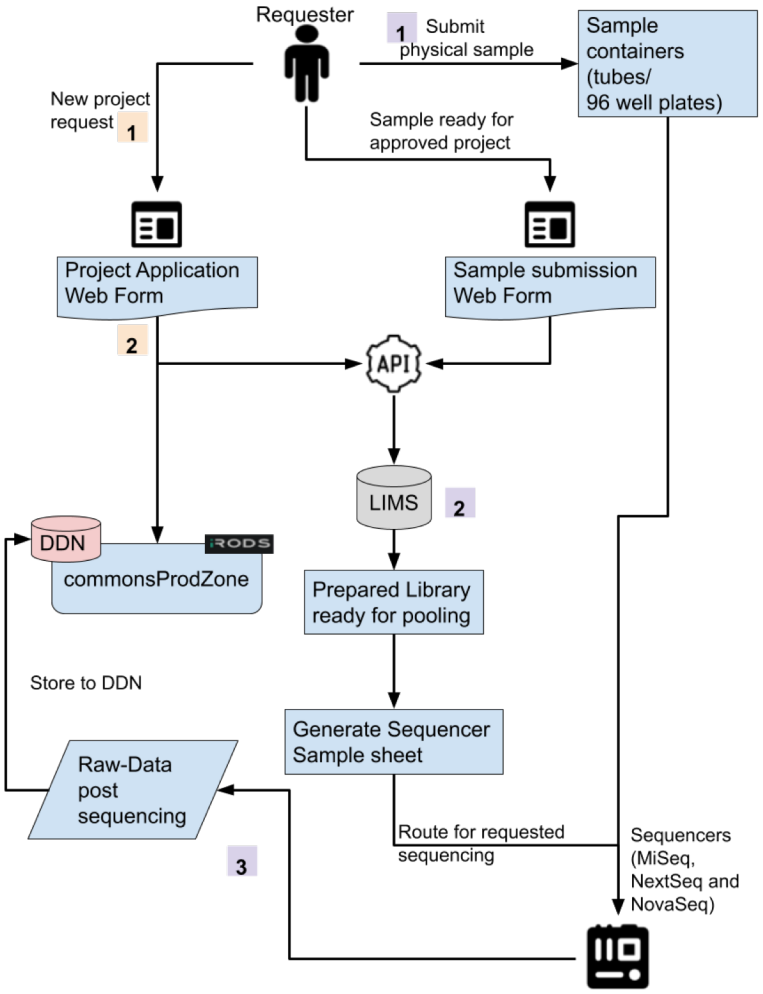
Developing an NIEHS Data Commons

Developing a Commons to manage research data, using iRODS as a platform for unifying and managing local and cloud resources.



Data Commons integrated with processing pipelines and workflow systems.



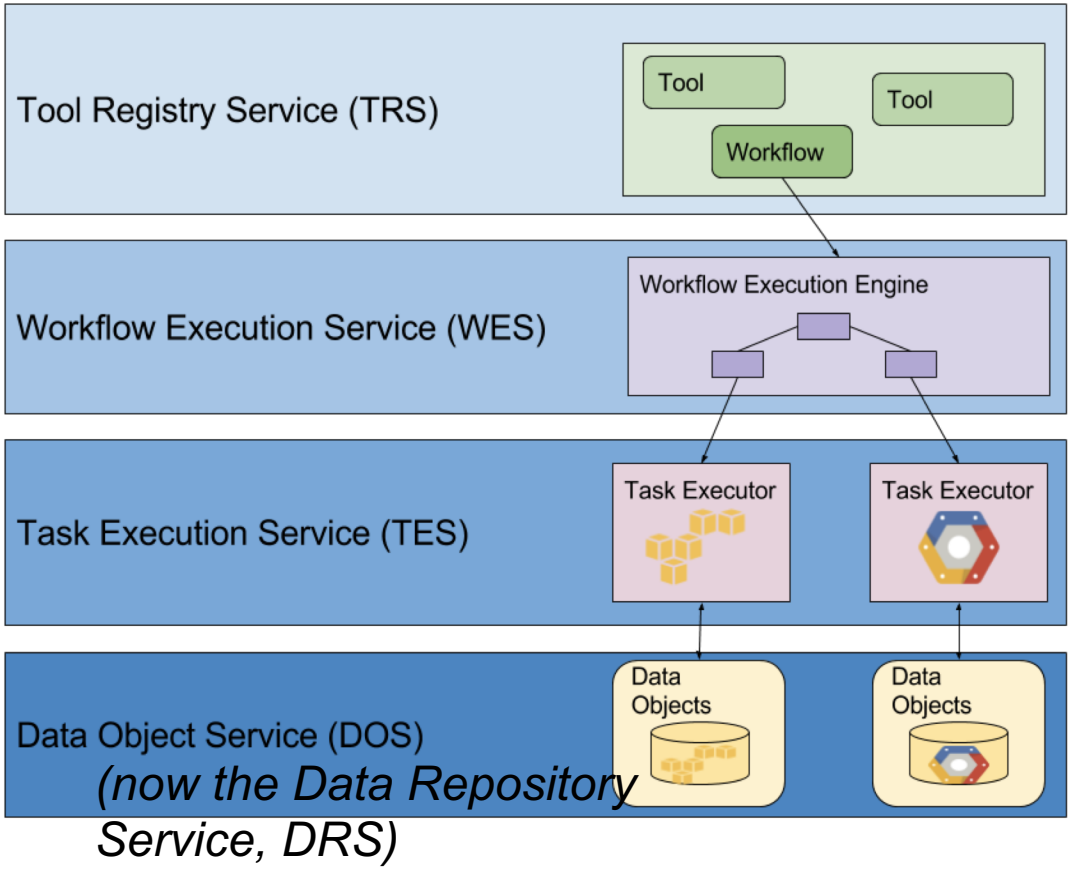
Use Case:

- Data Commons as the hub for managing research projects in an ISA model
- Sample submission integrated with Clarity LIMS triggers NextFlow pipelines
- Data Commons as delivery mechanism gathering metadata and pipeline results

Setting future strategy anticipating move to cloud over time, with a hybrid of local research data, published artifacts and tiered storage in the cloud.

How can we develop strategies that work for cloud and local use cases?

GA4GH Cloud Work Stream APIs



(now the Data Repository Service, DRS)

Sharing Tools and Workflows

Executing Workflows

Executing Individual Tasks

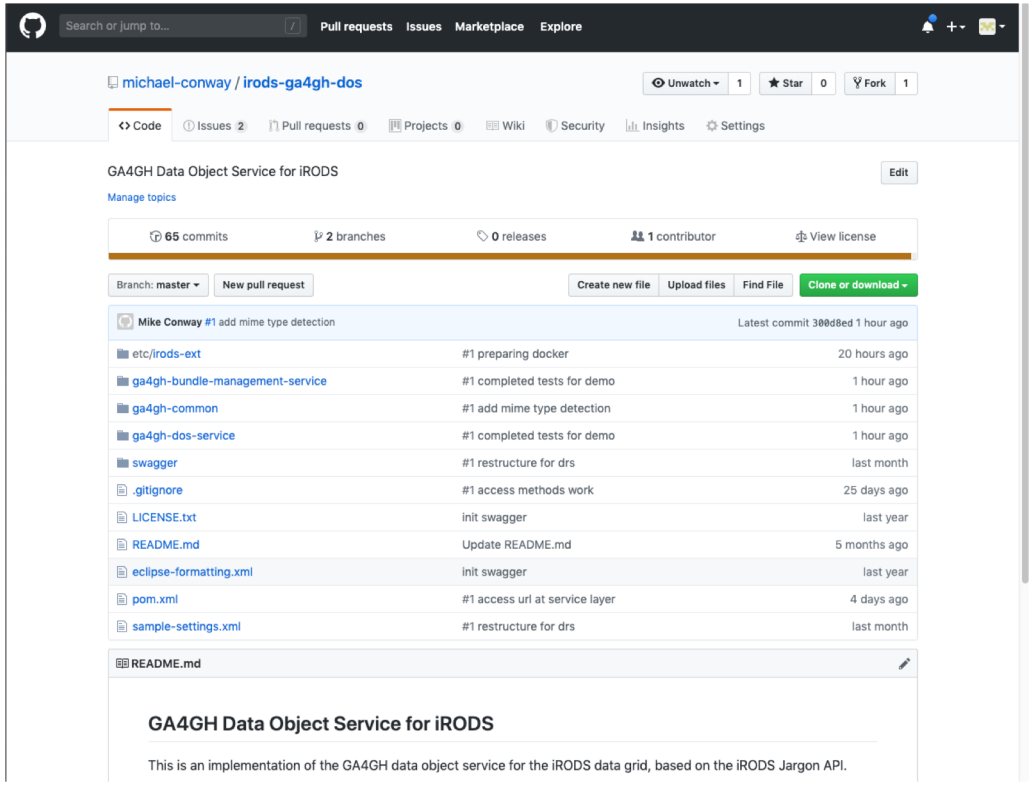
Accessing Data

O'Connor, Frian, and David Glazer. n.d. "20190319 - GA4GH Cloud Work Stream Overview - Google Slides." Accessed June 25, 2019. https://docs.google.com/presentation/d/1_MFTCw1uDrFNtbki2Nvyh2I2IYOlQKTHmrZgMTspdm4/edit#slide=id.g54dc8a46d6_0_0.

GA4GH Data Repository Service

Described by GA4GH:

"The Data Repository Service (DRS) API provides a generic interface to data repositories so data consumers, including workflow systems, can access data in a single, standard way regardless of where it's stored and how it's managed. The primary functionality of DRS is to map a logical ID to a means for physically retrieving the data represented by the ID."



- GA4GH DRS implementation for ‘native’ iRODS collections.
- Service to designate an iRODS Collection ‘in place’ as a Data Bundle.
- URL creation, including ticket based access via https are supported.
- Low barrier to entry, no special setup, stateless Docker image.

https://github.com/michael-conway/irods-ga4gh-dos

Demo – Designate an iRODS Collection as a Data Bundle

Code snippet designates a collection root as a bundle

```
79          String bundleRoot = irodsCollectionRootAbsolutePath + "/" + bundleDir;
80          DosConfiguration dosConfiguration = new DosConfiguration();
81          DosServiceFactory factory = new ExplodedDosServiceFactoryImpl(irodsFileSystem.getIRODSAccessObjectFactory());
82
83          DosBundleManagementService explodedDosService = new ExplodedDosBundleManagementServiceImpl(
84                  irodsFileSystem.getIRODSAccessObjectFactory(), irodsAccount, factory, dosConfiguration);
85          String guid = explodedDosService.createDataBundle(bundleRoot);
86          Assert.assertNotNull("no guid returned", guid);
87
```

Marks bundle with AVUs for GUID and checksum of checksums

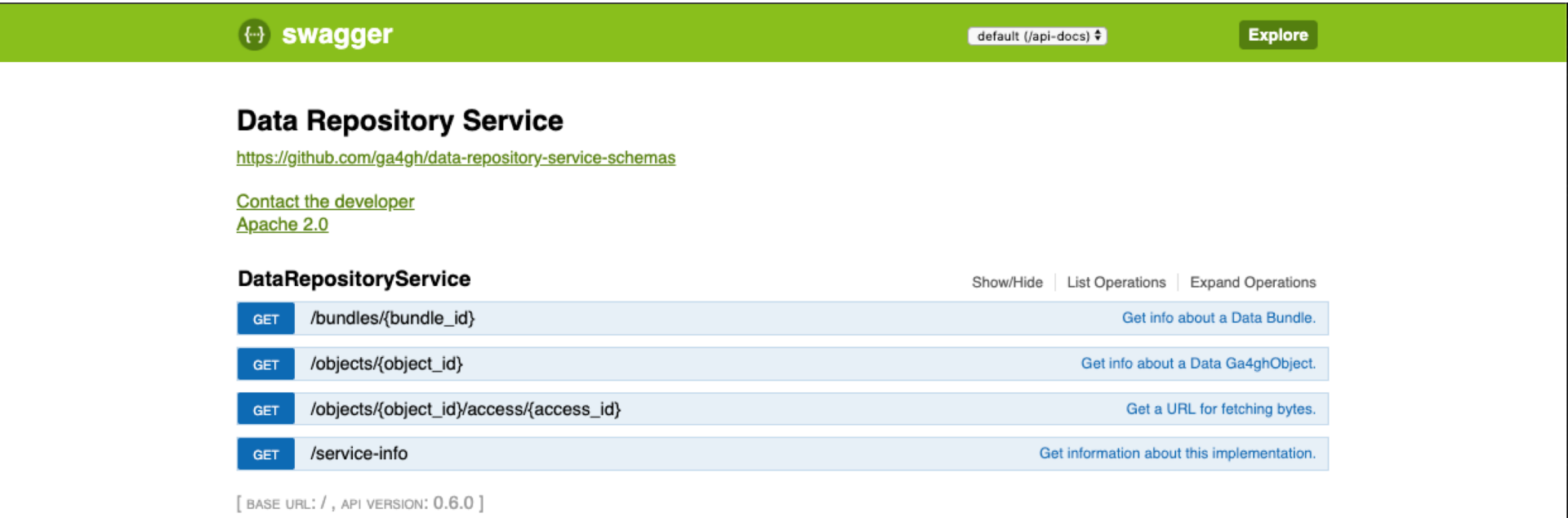
```
test@server1:~$ imeta ls -C /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle
AVUs defined for collection /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle:
attribute: ga4gh:bundleChecksum
value: d68d4685be3b13168b63bb31df1c0a4ee9c267a0cbe300869b08768c43d9b6dd
units: irods:ga4gh:dos
----
attribute: ga4gh:bundleId
value: aa713031-e421-4783-b522-068b63020def
units: irods:ga4gh:dos
test@server1:~$
```

Demo – Designate an iRODS Collection as a Data Bundle

Child objects (nested) flattened and marked as a Data Object. GUID is added as AVU and checksum is computed.

```
test@server1:~$ ils
/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0:
  testFile0.txt
  testFile1.txt
  testFile2.txt
  testFile3.txt
  testFile4.txt
  testFile5.txt
  testFile6.txt
  testFile7.txt
  testFile8.txt
  C- /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testPutCollectionWithTwoFileslvl2nbr0
  C- /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testPutCollectionWithTwoFileslvl2nbr1
  C- /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testPutCollectionWithTwoFileslvl2nbr2
  C- /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testPutCollectionWithTwoFileslvl2nbr3
test@server1:~$ imeta ls -d /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testFile0.txt
AVUs defined for dataObj /zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle/testPutCollectionWithTwoFileslvl3nbr0/testFile0.txt:
attribute: ga4gh:dataObjectId
value: 4de8f3ee-73c0-4e47-9f95-617e05998d91
units: irods:ga4gh:dos
test@server1:~$
```

Running DRS via Docker – Swagger API



Service Info - Configurable

404 Not Found

Try it out! | Hide Response

Curl

```
curl -X GET --header 'Accept: application/json' 'http://localhost:8080/service-info'
```

Request URL

```
http://localhost:8080/service-info
```

Request Headers

```
{
  "Accept": "application/json"
}
```

Response Body


```
{
  "version": "0.0.1-SNAPSHOT - 2019-06-25T14:40:59Z",
  "title": "iRODS GA4GH Data Repository Service Demo",
  "description": "",
  "contact": "NIEHS Office of Data Science",
  "license": "BSD 3-Clause"
}
```


Response Code

```
200
```

Response Headers

Retrieve a Data Bundle via GUID

```
curl -X GET --header 'Accept: application/json' 'http://localhost:8080/bundles/aa713031-e421-4783-b522-068b63020def'
```

Request URL

```
http://localhost:8080/bundles/aa713031-e421-4783-b522-068b63020def
```

Request Headers

```
{
  "Accept": "application/json"
}
```

Response Body


```
{
  "id": "aa713031-e421-4783-b522-068b63020def",
  "name": "/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle",
  "size": "0",
  "created": "2019-06-25T11:15:11Z",
  "updated": "2019-06-25T11:15:11Z",
  "version": "0",
  "checksums": [
    {
      "checksum": "d68d4685be3b13168b63bb31df1c0a4ee9c267a0cbe300869b08768c43d9b6dd",
      "type": "sha256"
    }
  ],
  "description": "iRODS exploded bundle collection",
  "aliases": [
    "/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle"
  ],
  "contents": [
    {
      "name": "testFile0.txt",
```


Checksum of Checksums

Response Code

```
200
```

Response Headers

Data Bundle links to child Data Objects


```
    "/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServiceImplTest/testCreateDataBundle"
  ],
  "contents": [
    {
      "name": "testFile0.txt",
      "id": "4de8f3ee-73c0-4e47-9f95-617e05998d91",
      "drs_uri": [
        "http://localhost:8080//objects/4de8f3ee-73c0-4e47-9f95-617e05998d91"
      ],
      "type": "object"
    },
    {
      "name": "testFile1.txt",
      "id": "9ade673d-83df-4d2e-ad6b-a468ff9c0243",
      "drs_uri": [
        "http://localhost:8080//objects/9ade673d-83df-4d2e-ad6b-a468ff9c0243"
      ],
      "type": "object"
    },
    {
      "name": "testFile2.txt",
```


Child Data Objects listed in bundle with GUID and access URI

Accessing a Data Object by GUID

Curl

```
curl -X GET --header 'Accept: application/json' 'http://localhost:8080/objects/27119224-78ff-42f6-8e99-a64d39e092ec'
```

Request URL

```
http://localhost:8080/objects/27119224-78ff-42f6-8e99-a64d39e092ec
```

Request Headers

```
{
  "Accept": "application/json"
}
```

Response Body


```
{
  "id": "27119224-78ff-42f6-8e99-a64d39e092ec",
  "name": "testFile3.txt",
  "size": 144,
  "created": "2019-06-25T11:15:30Z",
  "updated": "2019-06-25T11:15:30Z",
  "version": "",
  "mime_type": "text/plain",
  "checksums": [
    {
      "checksum": "zwSgAvMofVr0R4j1zx/LJ8uGjzPSUntOKYOfxR41fyk=",
      "type": "SHA256"
    }
  ],
  "access_methods": [
    {
      "type": "file",
      "access_url": {
        "url": "irods://test1@server1.local:1247/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagementServic
```


Individual iRODS file as a Data Object, has GUID, checksum, computed MIME Type

Generating an Access URL on demand

An access method without a URL requires a call to obtain the URL.
In this case generating an iRODS ticket on demand for read access.

Try it out! Hide Response

Curl

```
curl -X GET --header 'Accept: application/json' 'http://localhost:8080/objects/27119224-78ff-42f6-8e99-a64d39e092ec/acc
```

Request URL

```
http://localhost:8080/objects/27119224-78ff-42f6-8e99-a64d39e092ec/access/irods-rest
```

Request is for GUID and Access id

Request Headers

```
{
  "Accept": "application/json"
}
```

Response Body

```
{
  "url": "http://example.com/irods-rest/fileStream?path=/zone1/home/test1/jargon-scratch/ExplodedDosBundleManagement
  "headers": [
    "Authorization : Bearer IxXb42lajFdNsAr"
  ]
}
```

iRODS Ticket is generated on demand, can be shared

Next Steps

- Complete packaging and unit tests
- Validation with GA4GH
- Incorporate the ability to attach descriptions to bundles and data objects
- Beta release
- Implement https download access as first service in new irods-rest REST API revision
- Possible command line tool or rule set:
  - CRUD on bundles
  - Rules enforcing optional immutability?
- Possible ‘quick download’ util that can download irods:// URIs via high speed transfer

What iRODS needs!

- Focus on i/o performance of streaming.
- Standard way of computing MIME type (via extension inspection or optional file content scanning) and storing computed MIME type for subsequent query.
- Possible iCommand support for irods:// URI download
- Work with GA4GH to put iRODS semantics into the mix in DRS, add to CI.
- Standard notion of a file ‘Description’, is it the ‘comment’? Is it a standard AVU?
- Mark as ‘immutable’ at collection level?

Thank You!

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GitHub:
https://github.com/michael-conway/irods-ga4gh-dos