Technology Update

Terrell Russell, Ph.D.
@terrellrussell
Chief Technologist, iRODS Consortium

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In The Last Year

iRODS Release	Issues Closed
4.1.12	36
4.2.4	31
4.2.5	57
4.2.6	27

Plugins

- Python Rule Engine Plugin
- Storage Tiering Rule Engine Plugin
- Auditing (AMQP) Rule Engine Plugin
- Update Collection Mtime Rule Engine Plugin
- S3 Resource Plugin
- GSI Authentication Plugin
- Kerberos Authentication Plugin
- Curl Microservice Plugin

Clients

- Python iRODS Client
- Cloud Browser
- MetaInx
- NFSRODS
- Automated Ingest Framework

In The Last Year

```
~/irods $ git shortlog --summary --numbered 4.1.11..4.1.12
    27  Alan King
    11  Terrell Russell
     1  Justin James


~/irods $ git shortlog --summary --numbered 4.2.3..4-2-stable
    39  Alan King
    20  Kory Draughn
    20  Terrell Russell
    14  Andrew Kelly
     6  Jason Coposky
     5  Justin James
     5  Zoey Greer
     5  d-w-moore
     3  Hao Xu
     2  Felix A. Croes
     2  jkgill
     1  Kyle Ferriter
     1  Matt Watson
```

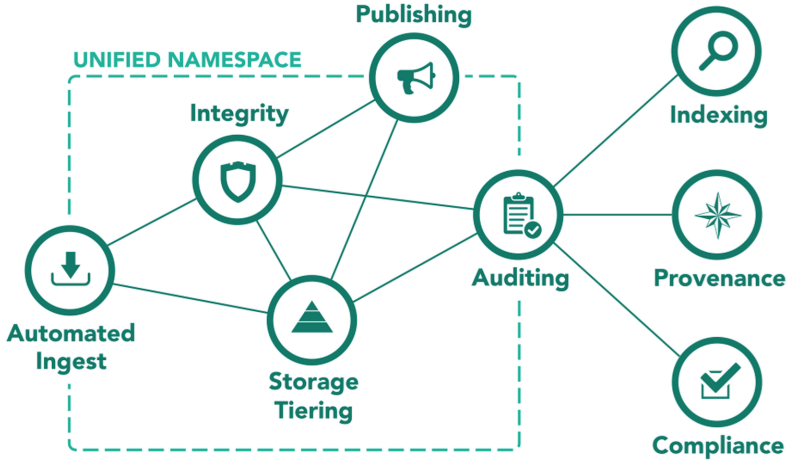
Ongoing Development Work

- iRODS 4.2.7
- iRODS 4.3.0
- Automated Ingest Capability
- Storage Tiering Capability
- Indexing Capability
- Publishing Capability
- Python iRODS Client (PRC)
- MetaInx
- NFSRODS
- Lustre Integration
- NetCDF Extraction
- Ceph RADOS Resource Plugin
- Cacheless S3 Resource Plugin
- Multipart Transfer, v5 API
- Testing Infrastructure

Policy Advancement

Steadily filling out the iRODS Data Management Model...

- Auditing - 2017
- Automated Ingest - 2018
- Storage Tiering - 2018
- Indexing - 2019
- Publishing - 2019
- Provenance
- Integrity
- Compliance



Working Groups

Technology Working Group

- Goal: To keep everyone up to date, provide a forum for roadmap discussion and collaboration opportunities

Metadata Templates Working Group

- Goal: To define a standardized process for the application and management of metadata templates by the iRODS Server
  - NIEHS / Data Commons
  - Utrecht / Yoda
  - Maastricht / DataHub+
  - Arizona / CyVerse

Changelog Working Group (Upcoming...)

- Goal: To define a standardized log format from parallel file systems
  - OpenSFS / Lustre
  - IBM / GPFS
  - Panasas / PanFS
  - ThinkParQ / BeeGFS
  - Red Hat / GlusterFS

Last Year and Next Year

- New Libraries
  - Kory Draughn
- irodsDelayServer and Intermediate Replicas
  - Alan King
- Build and Test
  - Jaspreet Gill

New Libraries, Oh My!

Goal: Provide standardized interfaces that simplify common iRODS tasks

Six new libraries (so far):

- **iRODS Query Iterator**
  - Abstracts the GenQuery API making it very easy to fetch information from the catalog
- **iRODS Thread Pool**
- **iRODS Connection Pool**
  - Built with iRODS Thread Pool
- **iRODS Filesystem** (experimental)
  - Implements the ISO C++17 Standard Filesystem Interface for iRODS
- **iRODS IOStreams** (experimental)
  - Provides standardized interfaces and facilities for reading/writing data objects using different transport protocols (e.g. TCP, UDT, RDMA)
- **iRODS Query Processor**
  - Built with iRODS Query Iterator and iRODS Thread Pool

Benefits:

- Usable in client-side and server-side code
- Developers can accomplish more with less code
- Developers introduce fewer bugs
- Developers can focus on the objective they want to accomplish
- Makes fixing bugs easier

Originally planned for 4.3.0.

Backported to 4.2.5 and 4.2.6 due to their ease of use and immediate impact.

irodsReServer -> irodsDelayServer

Old irodsReServer (pre-4.2.5)

- Fork-exec model for synchronous work distribution
  - Maximum of 256 rules processed per wake-up
  - Rules to be run later may block other rules
  - Long-running rules may block entire RE server process

New irodsReServer (4.2.5+)

- Rebuilt with iRODS Query Iterator, Thread Pool, and Connection Pool
- Single-Producer/Multi-Consumer
  - Uses query iterator to page over results
  - Limits query to rules ready to execute
  - Rules execute asynchronously using in-memory queue and thread pool

Rename to irodsDelayServer (4.3.0)

- iRODS Query Processor, distributed rule execution, ...

The Missing Link: Intermediate Replicas

Intermediate replica

- Replica is registered in ICAT, but data is not yet at rest
- Indicated with '?' via ils

Putting a data object into iRODS

- Register all required replicas (per voting) as intermediate before any data movement
- Finalize info in ICAT upon transfer completion

```
# Intermediate state of all replicas - an iput to a replication resource with 3 leaves
$ ils -l
/tempZone/home/rods:
  rods              0 repl;ufs0           0 2019-04-08.15:38 ? foo
  rods              1 repl;ufs1           0 2019-04-08.15:38 ? foo
  rods              2 repl;ufs2           0 2019-04-08.15:38 ? foo

# After initial put is complete and before synchronous replication has completed
$ ils -l
/tempZone/home/rods:
  rods              0 repl;ufs0       12345 2019-04-08.15:38 & foo
  rods              1 repl;ufs1           0 2019-04-08.15:38 ? foo
  rods              2 repl;ufs2           0 2019-04-08.15:38 ? foo

# After replication has succeeded
$ ils -l
/tempZone/home/rods:
  rods              0 repl;ufs0       12345 2019-04-08.15:38 & foo
  rods              1 repl;ufs1       12345 2019-04-08.15:38 & foo
  rods              2 repl;ufs2       12345 2019-04-08.15:38 & foo
```

Stale replicas will now be indicated with 'X'

```
$ ils -l
/tempZone/home/rods:
  rods              0 resc1       54321 2019-04-08.15:38 & bar
  rods              1 resc2       12345 2019-04-08.15:38 X bar
```

iRODS Build and Test - History

July 2011

- Python → Node.js → RabbitMQ → Celery → Eucalyptus

October 2012

- Python → Node.js → ssh → OpenStack

January 2013

- Hudson → Python → OpenStack

October 2013

- Hudson → Python → vSphere long-running VMs

Spring 2015

- Jenkins → Python → Ansible → zone_bundles → vSphere dynamic VMs

Spring 2017

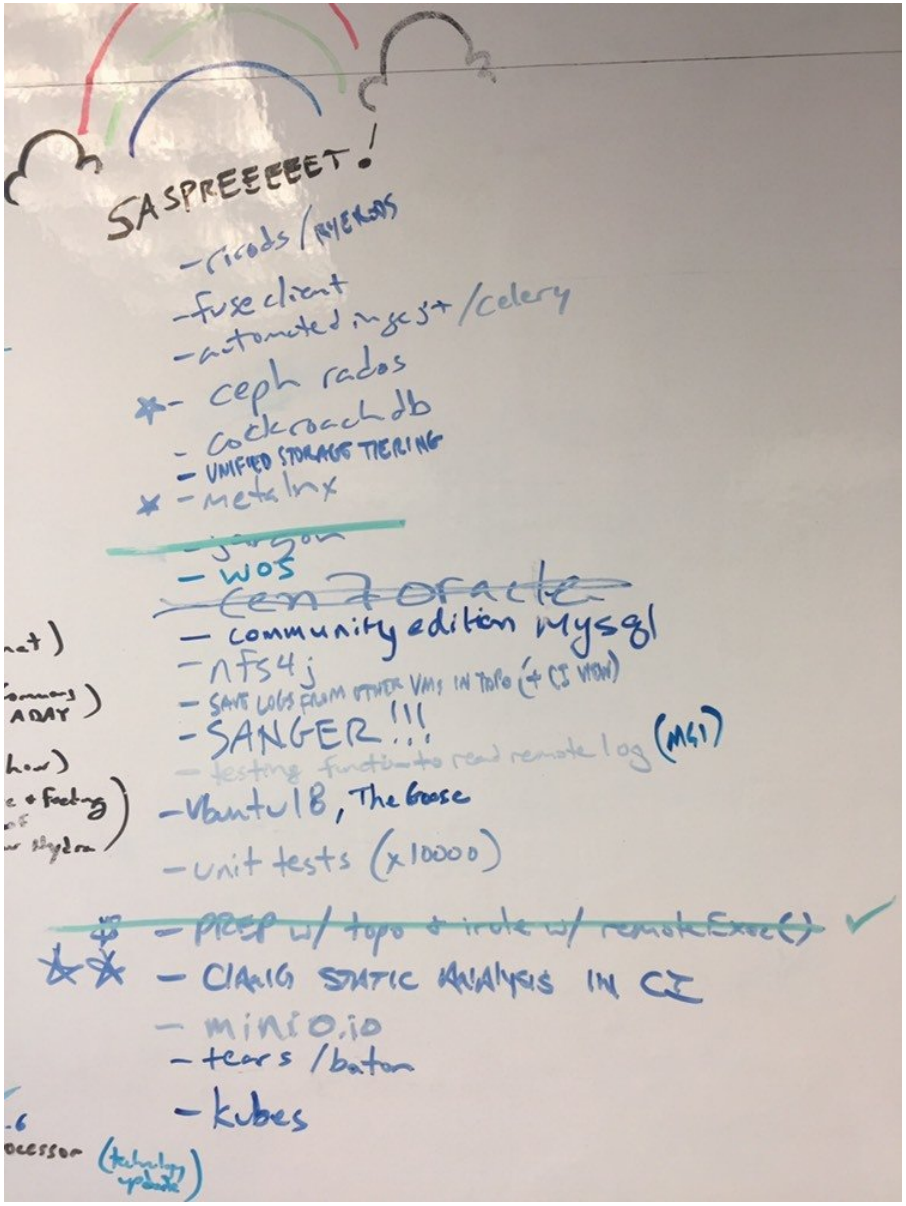
- Moved iRODS build/test logic from Ansible to python modules (per-repository)
- Consolidated to two parameterized Jenkins jobs

iRODS Build and Test - 2018 Promises

- Increase coverage (more plugins in CI)
- Move pipeline scripts to GitHub (no logic in Jenkins)
- Address inconsistency (false reds / pyvmomi errors)
- Containerize Jenkins (easier to test / update / redeploy)
- Possibly move from VMs to containers (speed / fewer moving parts)

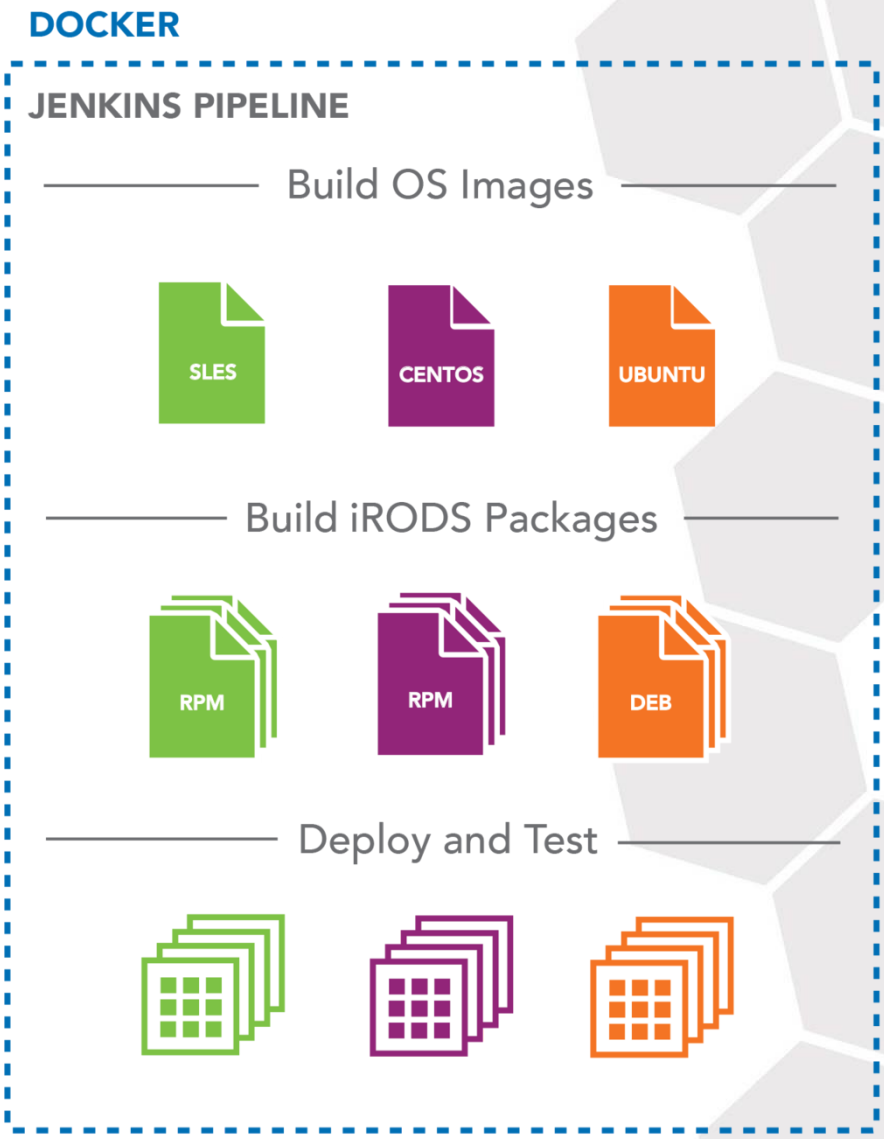
iRODS Build and Test - Reality

- Everything would need a custom pipeline and logic
- Need externalized infrastructure for some of the tests



iRODS Build and Test - 2019 Architecture

- Dockerized Jenkins
- All configuration and setup in git
- Launches sibling Docker containers
  - Build OS Images
  - Build iRODS Packages
  - Deploy and Test
    - core, plugins, topology, federation
- Development is same as production



iRODS Build and Test - Demo

	OS	Database	Containers	Total
Core	2	1	2 test suites	4
Plugins	2	1	2 plugins (1 suite each)	4
Federation	2	1	2 providers (1 suite each)	4
Topology	2	1	4 (1 provider + 3 consumers)	8
TOTAL				**20**

- An additional DB would increase this test run by 20 containers (8+8+8+16 = 40)

- Dockerized equivalent of the current 4-2-stable release process:
  - 3 OS, 3 Databases, 31 test suites, 8 Plugins
    - 3 x 3 x 31 = 279 core containers
    - 3 x 3 x 8 = 72 plugin containers
    - 3 x 3 x 2 x Federation subset = ? containers
    - 3 x 3 x 4 x Topology subset = ? containers

iRODS Build and Test - Future

- Make iRODS Jenkins publicly accessible
- Investigate scaling up
- Increase coverage
- Approachable for community developers
  - Confidence
  - Acceptance Criteria

4.3.0 Update

- Checksums moving down into resource plugins
- JSON configuration/schema consolidation
- Use latest releases of irods-externals
- Logging overhaul

4.3.0 Logging Update

Today

- Quiet for well-behaved systems
- Inconsistent formatting
- Incomplete (syslog support)
- Not very helpful in tracking a root cause for errors
- Not very helpful when multiple servers are involved

Design Goals

- Reduce code - Leverage an existing logging library (spdlog, etc.)
- Enable admins to easily capture, process, and analyze activity
- Consistent formatting
- Easily track errors across multiple servers (hostname, timestamp, PID, plugin, etc.)
- Tie into existing infrastructure
- Provide more options for controlling output

	Local Files (rsyslog)	**Remote (rsyslog)**	**--stdout**
Packaged	default	centralized logging	Docker-friendly
Non-Package Install	probably n/a	probably n/a	HPC and development

Policy Composition

With the new libraries, we can rewrite 90% of the internals, and then fix the things that depend on them later, with little expectation of regression, because the interfaces remain the same.

Internally

- We will have a new API... but not really
- Instead, we stepped back and built good tools
  - Allows us to refactor and go faster without breaking the 4.x API
  - This has turned out to be more powerful than expected

Externally

- It's a good story, the ability to compose policy into capabilities
- Can build smaller pieces of functionality which can be composed to help solve larger problems
- We don't have to worry about side effects

Continuation within the Rule Engine Plugin Framework allows administrators to break apart monolithic PEP implementations into reusable components.

Big Picture

Core

- 4.3.0 - Harden and Polish
- 5.0.0 - Simplify API, Drop federation with 3.x

Clients

- GUIs (Metalnx, et al.)
- Onboarding and Syncing (Automated Ingest)
- File System Integration (NFSRODS / CIFSRODS)
- iRODS Console (alongside existing iCommands)

Continue building out policy components (Capabilities)

We want installation and management of iRODS to become about policy design, composition, and configuration.

Please share your:

- use cases
- pain points
- hopes and dreams

Open Source Community Engagement

iRODS

Get Involved

- Working Groups
- GitHub Issues
- Pull Requests
- Chat List
- Consortium Membership

Tell Others

- Publish, Cite, Advocate, Refer