Running Rucio: A Facilities Perspective

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Software & Computing Round Table
Contributors
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Rucio Instance Information Contributors

• ATLAS: CERN – Martin Barisits
• Belle II: BNL (* also see: Cédric’s earlier talk)
• CMS: CERN – Eric Vaandering
• DUNE, ICARUS: FNAL – Brandon White
  • Also: Rubin: SLAC
• EGI, GRIDPP, SWIFT-HEP: RAL – Tim Noble, Wenlong Yuan
• SKA: Rosie Bolton (* also see: Rosie’s earlier talk)
• sPHENIX: BNL – Matt Snyder
Rucio Instances
Rucio for ATLAS: CERN

(Almost) everything running in Kubernetes

- Exceptions (4 CPU, 8GB memory VMs):
  - Load balancers: 3 HAProxy VMs
  - Authentication: 3 VMs
- Server & daemon Kubernetes clusters:
  - 3 production clusters: x16 VMs each (4-Core, 8Gb)
  - 1 integration cluster: 6 VMs
- Database:
  - Oracle 19c cluster
  - 8TB in table & index space
Rucio for CMS: CERN

Kubernetes via OpenStack
- 2 k8s clusters:
  - 4 development machines
  - 8 production machines
    - Includes all Rucio functionality, except monitoring
- All CC7-based
- All accessible via lxplus8
- Database: Oracle CMSR (offline)
Rucio for DUNE, ICARUS: FNAL

Kubernetes via OKD
  • Cluster provided by FNAL Computing
  • Containers:
    • Rucio 1.26.9 (LTS)
    • FNAL, OKD, policy customizations
  • 2 production instances for replica management with different, custom FNAL metadata solutions:
    • DUNE: Metacat
    • ICARUS: Sequential Access via Metadata
  • Database: FNAL Computing cluster
  • Deployment framework
    • https://github.com/bjwhite-fnal/rucio-fnal
Rucio for EGI, GRIDPP, SWIFT-HEP: RAL

Current deployment
- Amazon Cloud VMs
  - Servers:
    - Rucio 1.23.17
    - c1.xlarge VM (4 CPU, 16GB RAM)
  - Daemons:
    - Rucio 1.27.3
    - m2.medium VM (4 CPU, 4GB RAM)
- Future: Kubernetes deployment
Rucio for EGI, GRIDPP, SWIFT-HEP: RAL (2)
Rucio for EGI, GRIDPP, SWIFT-HEP: RAL (3)
Rucio for SKA: RAL

Kubernetes deployment
- Maintained by SKA
- Deployed in UK STFC cloud
- CERN pilot FTS
- Production auth via x509
  - In development: tokens via ESCAPE’s IAM at INFN
Rucio for sPHENIX: BNL

Currently deployed on VMs in RHEV
- Testing on 1 front-end VM, 1 daemon VM
  - May scale to 2+ VMs each
- Rucio v1.27.4 via Python pip
- Separate PostgreSQL database VM on separate RHEV cluster
  - May move to HW hosting if necessary
- RHEL 8.4 VMs
- New deployment framework:
  - Foreman (v2.3.5)
  - Gitea (v1.14.2)
  - Puppet (v6.24)
Rucio for Belle II
Belle II Rucio Infrastructure & Deployment

Mostly RHEV VMs
- 2 VM clusters:
  - 5 RHEL 7 production machines
    - 2 servers, 2 daemons, 1 UI
  - 4 integration machines
- Database: PostgreSQL (HW)
- Mostly Puppet via Git code
- Daemons fully integrated with systemd/journald
- Migrated from Python2 to Python3 (pip)
Belle II Rucio Front-End Service Network

LHCONE is virtual network connecting Belle II sites around the world. All Belle II specific, publicly accessible services need to be on this network.

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**blrucio.sdcc.bnl.gov**
- **Alias:** 192.33.128.41 blrucio01-vrpp
- 192.33.128.42 blrucio02-vrpp

**Virtual and Floating IPs**
- LHCONE network
- Outside of BNL Firewall

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**blrucio01**
- 192.33.128.96
- LHCONE/Outside
- 10.42.34.96
- Local/Inside

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**blrucio02**
- 192.33.128.97
- LHCONE/Outside
- 10.42.34.97
- Local/Inside

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**KeepAliveD**
- **alias:** 10.42.34.116 blrucio01-vrpp
- 10.42.34.117 blrucio02-vrpp

**Virtual and Floating IPs**
- Local Network
- Inside BNL Firewall

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**blruciodb01**
- 10.38.5.25
- Primary DB

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**blruciodb02**
- 10.38.5.26
- Backup DB

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Use of KeepAliveD with VRRP and single alias allows redundancy and scalability. More hosts, blrucioXY, can be added seamlessly via RHEV.

IPv6 address should be added for external/LHCONE side. All publicly accessible services at BNL should have IPv6 address (DOE).

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BNL Site Firewall

Outside BNL

Inside BNL

Dual Network is required due to the sitewide firewall.
Belle II Rucio Full Service Network

Additional agent hosts (blrucioXY) can be created via RHEV
Belle II Rucio Infrastructure Tests

Pre-production validation and scaling tests

- ~650 concurrent clients
- ~2.5 hours
- 550Hz of RUCIO operation
- 2M write
- 2M read
- 1M delete

Scaling tests of the Rucio infrastructure
Belle II Rucio Infrastructure Tests (2)

- Submitting 1K jobs.
- ~ 470 clients total
- 2M entries in 100 min

470 job slots vs 700 slots earlier
Via opportunistic queue

2M / 100 min ~ 330 Hz

100 minutes
2M entries
Belle II Rucio Monitoring

Consolidation and improvement

- Another development done was to simplify the monitoring stack:
  - The monitoring stack used by LHC experiments indeed relies on a complex machinery
  - Cost/benefit analysis was conducted to setup the same infrastructure for Belle II. Decision to simplify it
  - The simplification was done by introducing a new component within Rucio
Belle II Rucio Monitoring (2)

Rucio Request Count per 5 minutes by HTTP Category

Counts per 5 min by Client Host

Rucio Server Requests Counts per 5 minutes

Brlucio01.sdfc.bnl.gov CPU Usage

Brlucio02.sdfc.bnl.gov CPU Usage
Belle II Rucio Service Request Monitor

- Log parsing, input to PostgreSQL TimescaleDB for analysis
- Logs all HTTPs requests
- Sophisticated alarm to identify problematic requests

1 user has very large requests
Belle II Rucio Database

- PostgreSQL
- History table grows rapidly
- Requires monthly partitioning
Belle II Rucio Issues & Challenges

Rucio was originally built for one experiment (ATLAS) and one deployment (CERN)

- Server requires a core config file in a non-default path
  - Expects file in `/opt/rucio/etc/`
  - Installs to `/usr/rucio/etc/` (and `/usr/local/etc/`, and also `/usr/local/rucio/etc/` for UI)
- UI had “ATLAS” burned into header (despite config var)
  - Since changed to “Rucio UI”
  - `
    class="name"
  ` in `web/ui/templates/base.html`
- UI requires direct DB access for read-only data
- Daemons don’t all support “supported” options
Belle II Rucio Issues & Challenges (2)

Things are improving – especially when we communicate and report them!

• “Server certificate expired” client error for valid server certificate (#5021)
  • Related: Rucio client error on server CRL refresh delay/hang
• Server test tool dependency issue (#5023)
• Daemons missing sleep option (#3987)
Next Steps

• Continue to improve monitoring
• Continue to improve Belle II DDM integration (DIRAC)
• Improve deployment automation
  • Puppet-ize more service components
• Test, implement token-based auth
Thank you

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