SDCC Tech Talk: CVMFS at BNL

John Steven De Stefano Jr
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BROOKHAVEN NATIONAL LABORATORY
U.S. DEPARTMENT OF ENERGY
BROOKHAVEN SCIENCE ASSOCIATES

John De Stefano, CDCE — RAC

https://www.racf.bnl.gov/about/photos/2015/D0600915-jo

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RHIC relativistic heavy ion collider

RHIC & ATLAS Computing Facility
at Brookhaven National Laboratory

ATLAS EXPERIMENT

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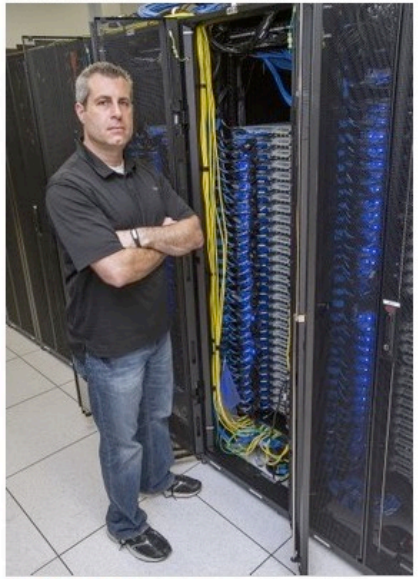
John De Stefano, CDCE

by John S. De Stefano Jr. — last modified Sep 30, 2015 09:52 AM

John S. De Stefano Jr. of the RACF stands without any discernible purpose or intent next to a rack of Dell servers in the CDCE.



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« January 2020 »

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What's New in the RACF

New Services at the SDCC

Retirement of daya0001-0012 and lbne0001-0010

BNLBox Downtime for Update

HPSS Services Have Been Restored

Access to the HPSS Tape Libraries Interrupted

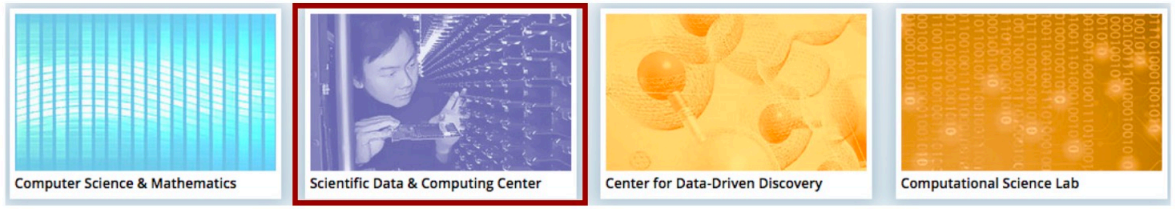
More…

ATLAS VO administration (VOMRS, VOMS)
Belle II computing operations (DDM, AMGA, monitoring)
certificate authority (DigiCert, DOEGrids, InCommon)
conference organization (ATLAS, CHEP, HEPiX)
Confluence
CVMFS
database administration
documentation
ELOG
Frontier (global ATLAS coordinator & site administrator)
grid middleware & services
hardware deployment & administration
httpd web servers, proxies, SSL mitigation (Apache)
Hypernews
Indico
ITD mitigation (certificates, conduits, mail, network, proxies, web)
Jira
load balancing
MySQL
Nagios
Oracle
OSG & US ATLAS VO registration authority
OSG documentation
OSG Technical Investigation
Plone
proposal writing & editing
Puppet
RHIC computing operations
RT
Squid caching
SSO
TeraPaths
TWiki
US ATLAS computing operations
user & experiment support
version control (CVS, Subversion, Git)
web development

The SDCC

Source: O. Rind, BNL Box: Cloud Storage for Scientists

- The Scientific Data and Computing Center (SDCC) is a shared multi-program facility in Bldg. 510/515 serving ~2500 users from more than 20 projects with ~41 FTE
- A component of the Computational Science Initiative (CSI) that includes the RHIC & ATLAS Computing Facility (RACF) from the Physics Dept.



- Tier-0 for RHIC, US Tier-1 for ATLAS, US Data Center for Belle-II, plus photon sciences, neutrino, astrophysics, LQCD, biology, EIC, ….
- High-Throughput and High-Performance computing including 90K+ CPU cores, ~90 PB disk storage, 180 PB tape storage, 3x100 Gbps network (ESNET)
- New data center under construction in Bldg. 725 (2021)
- Increasingly involved in adapting, developing and deploying collaborative tools

The CernVM File System (CernVM-FS)

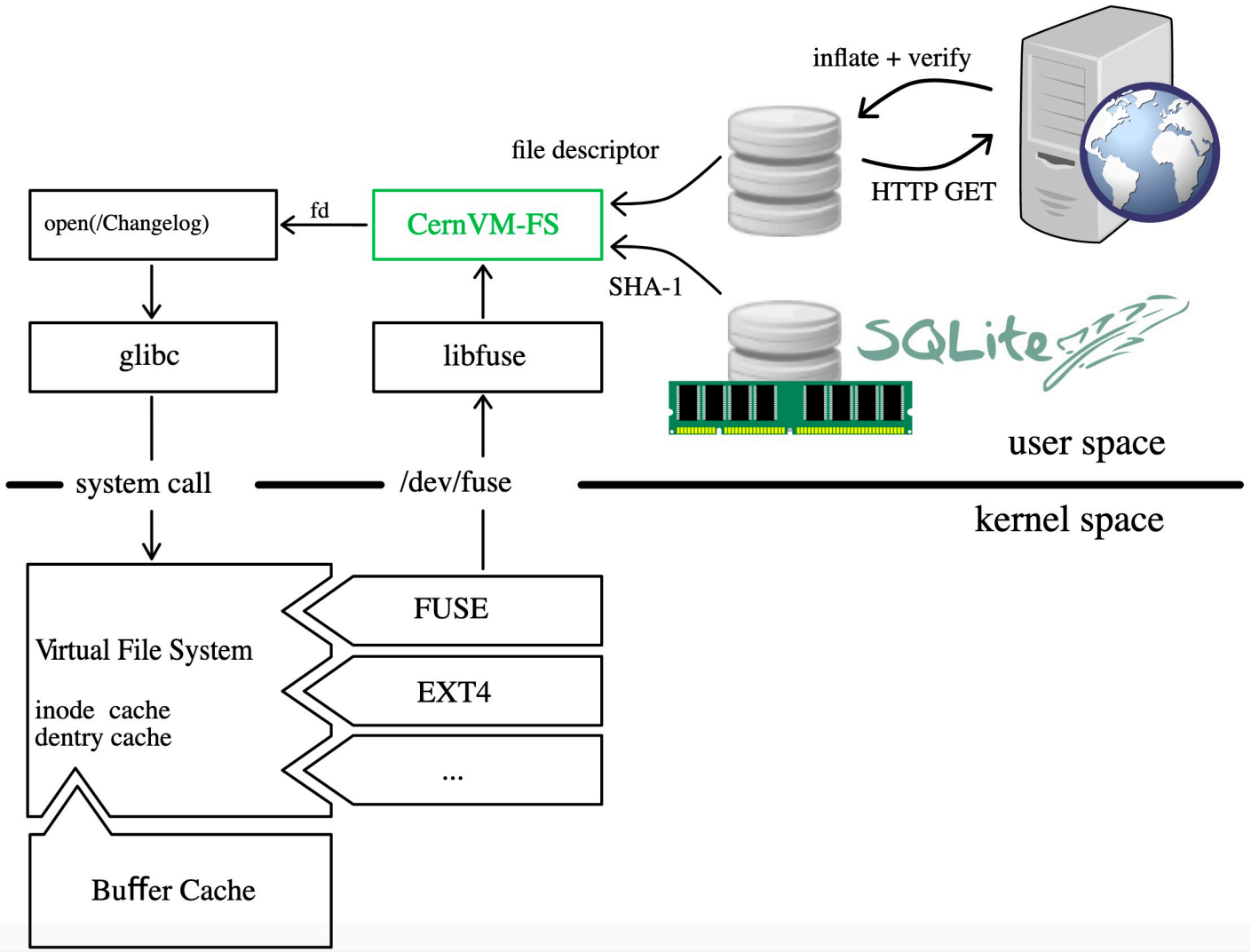
- Read-only software delivery file system
- Files and metadata downloaded via HTTP
- Multi-level caching exploited between client and server
- Ensures data authenticity and integrity
- Built for fast, scalable software distribution

The CVMFS Code Base

- 15,250 commits
- 45 contributors
- 547,063 lines
- Predominantly written in Go (C, C++)
- estimated 150 years of effort (COCOMO model)

(as of 22 Jul 2020, per https://www.openhub.net/p/cvmfs)

Opening a CVMFS File



Opening a CVMFS File

```
[0:957] 11:38:19 Wed Jul 22 [jdestefa@acas1008.usatlas.bnl.gov:/dev/pts/0 +1] ~
$ ll /cvmfs/atlas.cern.ch/repo/
total 5
drwxrwxr-x 20 cvmfs cvmfs 24 Jul 22 05:04 ATLASLocalRootBase
drwxr-xr-x  8 cvmfs cvmfs  3 Mar 14  2019 benchmarks
lrwxrwxrwx  1 cvmfs cvmfs 42 Mar  8  2012 conditions -> /cvmfs/atlas-condb.cern.ch/repo/conditions
drwxrwxr-x  6 cvmfs cvmfs  3 Apr 29  2019 containers
drwxr-xr-x  5 cvmfs cvmfs  3 Feb  7  2019 dev
drwxr-xr-x 27 cvmfs cvmfs  4 Jul 22 10:03 sw
-rw-r--r--  1 cvmfs cvmfs 20 Dec  5  2019 test
drwxrwxr-x 11 cvmfs cvmfs  4 Jun  3  2016 tools
drwxr-xr-x  3 cvmfs cvmfs  3 Feb 29 05:27 tutorials
```

Publishing Changes in CVMFS (server)

```
cvmfs_server transaction myrepo.mydomain
vim /cvmfs/myrepo.mydomain/myfile
cvmfs_server publish myrepo.mydomain
```

Distributing Changes in CVMFS (replica)

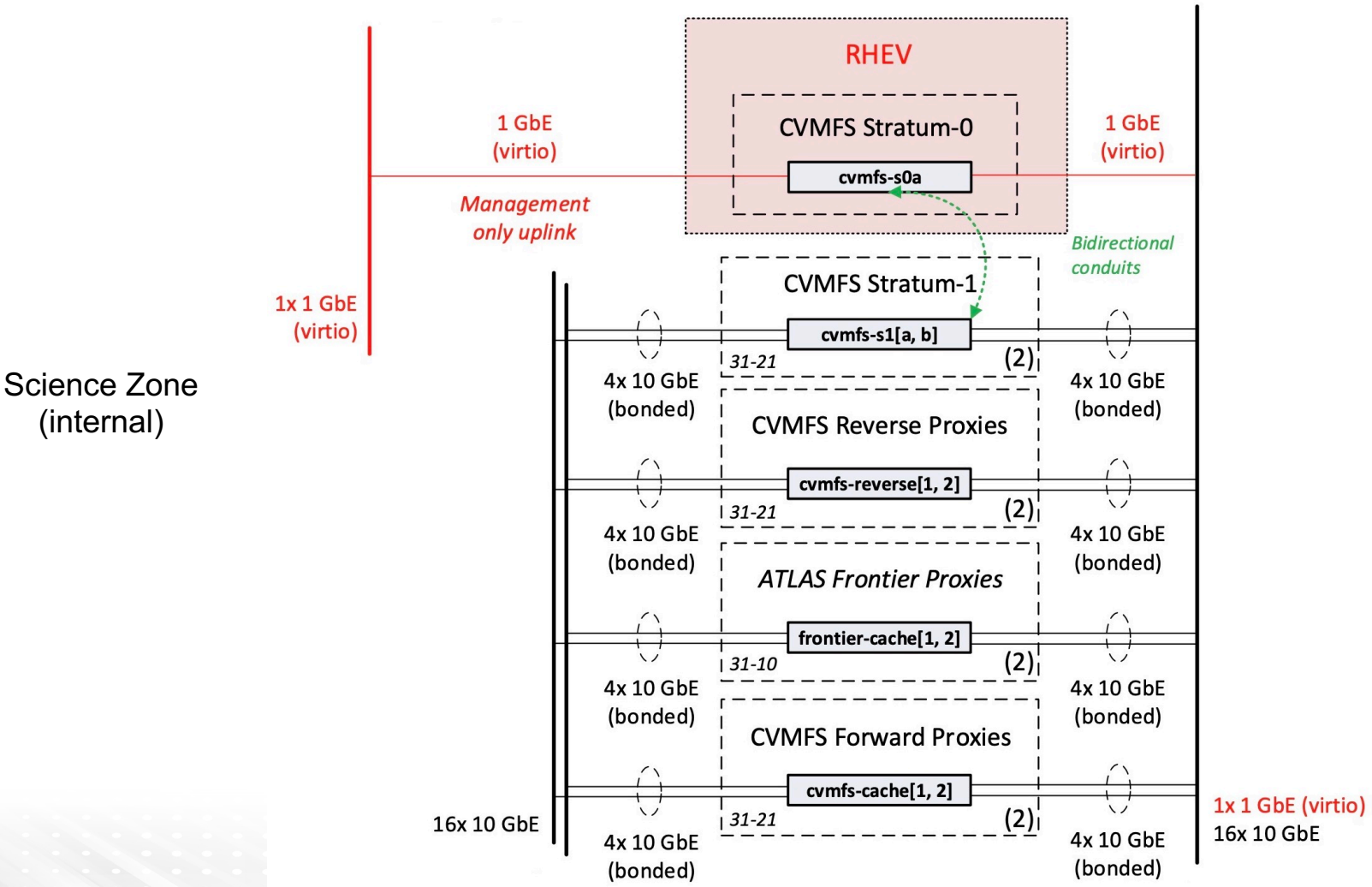
`cvmfs_server` **`snapshot`** `myrepo.mydomain`

```
[root@cvmfs-s1a ~]# cvmfs_server snapshot sw-nightlies.hsf.org
CernVM-FS: replicating from http://cvmfs-stratum-zero.cern.ch:8000/cvmfs/sw-nightlies.hsf.org
CernVM-FS: using public key(s) /etc/cvmfs/keys/cern.ch/cern-it1.cern.ch.pub, /etc/cvmfs/keys/cern.ch/cern-it4.cern.ch.pub, /etc/cvmfs/keys/cern.ch/cern-it5.cern.ch.pub, /etc/cvmfs/keys/cern.ch/cern.ch.pub
Found 15 named snapshots
Uploading history database
Starting 16 workers
Replicating from trunk catalog at /
  Catalog up to date
Checking tagged snapshots...
Stopping 16 workers
Uploading manifest ensemble
Serving revision 86
Fetched 0 new chunks out of 0 processed chunks
```

CVMFS at SDCC: Architecture

- One production Stratum Zero server (internal)
- One production Stratum One replica, one “hot” backup (external)
- Two reverse proxy caches (external/internal, main service target)
- Two forward proxy site caches (internal w/external access)
- (Related) Two forward Frontier Squid site caches (external/internal, connect clients to WAN service)
- Server, replica, caches all updated to latest stable versions

CVMFS at SDCC: Architecture



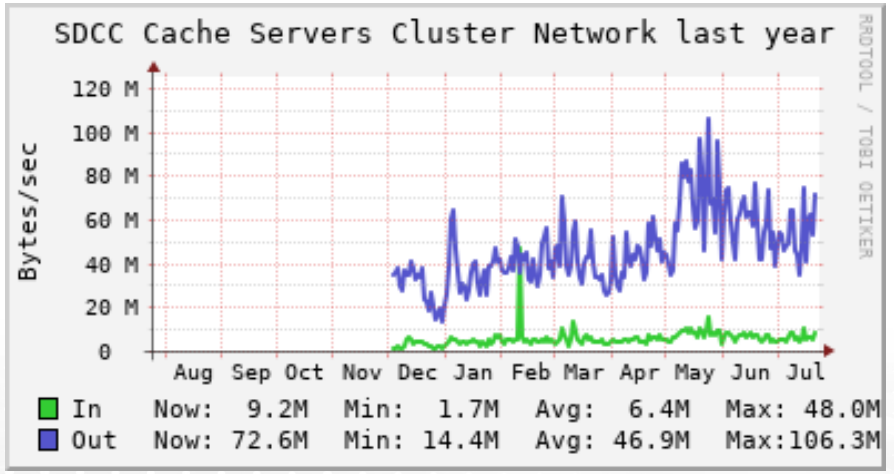
Science Zone
(internal)

Science DMZ
(WAN)

Source: A. Zaytsev, CVMFS Network Layout

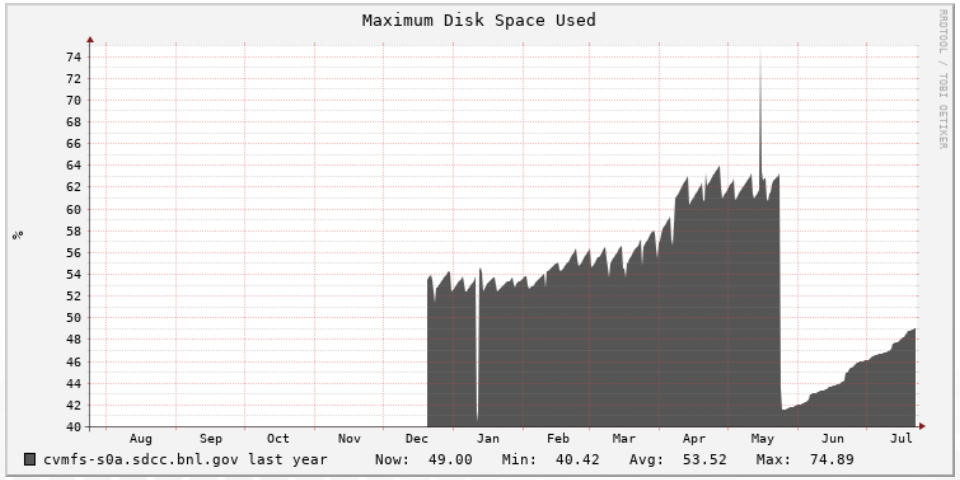
CVMFS at SDCC: Replica

- 102 replicated repositories
- From 10 domains and four sources (BNL, CERN, OSG, RAL)
- Occupying 28 TB local disk
- Served 790 TB in external client bandwidth to date in 2020 (Jan 1, 2020 - Jul 22, 2020 [A. Zaytsev])



CVMFS at SDCC: Server

- Stratum Zero for 13 hosted repositories
- Occupying 490 GB local disk
- For facility and experiment use:
  - ASTRO, DayaBay, DUNE, EIC, PHENIX, SDCC, sPHENIX, STAR



CVMFS at SDCC: How to Use

- As a **client**:
  - Access your repository on our worker nodes:
    `ls -l /cvmfs/myrepo.mydomain`
  - Install your own local CVMFS client, define a local cache, and point your client at our service:
    cvmfs.sdcc.bnl.gov

CVMFS at SDCC: How to Use

- As a **repository**:
  - Obtain liaison or representative access to our CVMFS service write hosts: *cvmfswrite0{1,2}.sdcc.bnl.gov*
  - Stage your changes directly to your mounted CVMFS repository: `/cvmfs/myrepo.mydomain`
  - Create a flag file to indicate the change to our publishing mechanism: `CVMFSRELEASE`
  - Your changes will be published automatically

Details: https://www.racf.bnl.gov/docs/services/cvmfs/stratum-zero

CVMFS at SDCC: How to Use

- For best results:
  - CVMFS is optimized for fast, scalable software distribution
    - works best with *small* software files and libraries
  - The CVMFS merging and publishing mechanism is atomic
    - all files and changes are versioned and recorded
    - not intended to store, stage, or distribute continuous software builds, or other frequently replaced data

The End

Original image source: http://www.sackoftroy.com/2016/02/10/neil-degrasse-tyson-rides-jet-ski-off-edge-of-earth/