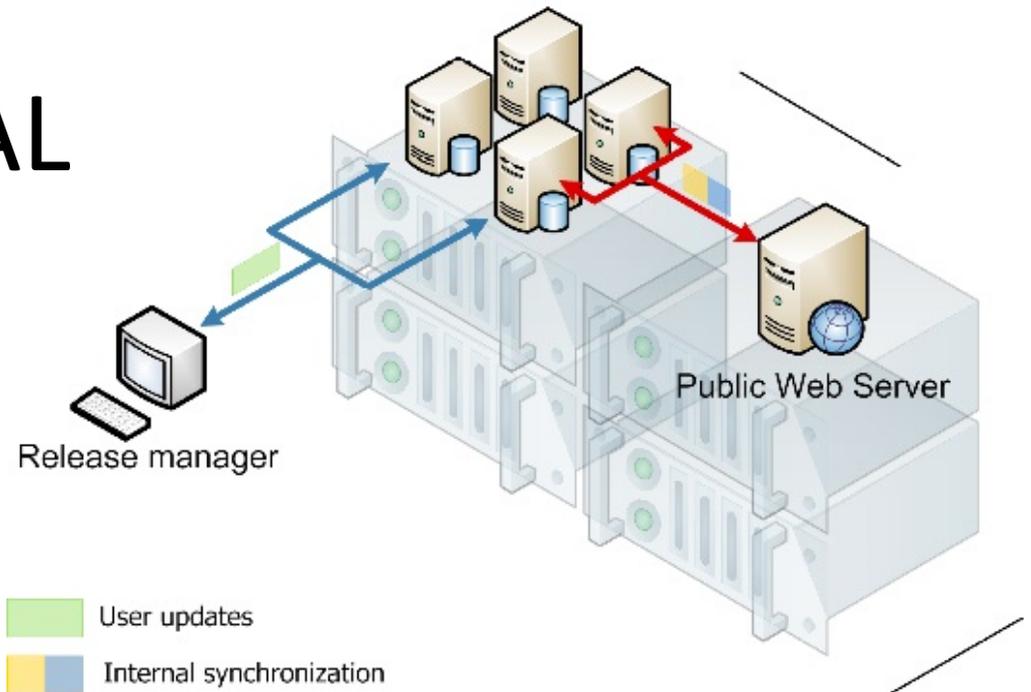




CVMFS @ FNAL

Status & Plans



A.Norman (NOvA), A.Lyon (g-2)
REX Data Handling Group



- Problem:
 - Need to to distribute large (170-200 GB) experiment specific software/code distributions to:
 - Worker nodes within FNAL computing clusters
 - Remote computing facilities
 - Individuals doing code development and analysis
 - Must be scalable (1000's of concurrent clients)
 - Must be sustainable/maintainable



- Current Solution:
 - Bluearc Central Disk Services
 - Experiments deploy “master” code distribution to bluearc
 - Bluearc volumes are mounted (NFS) on computing resources that are local to FNAL
 - Scalability issues
 - Does not work for remote sites
 - Does not work for individual developers (i.e. laptops)



What is CVMFS?

- The Cern Virtual Machine File System (CVMFS) is:
 - A method of distributing a large software/code distributions over a network
 - Provides Read-Only images of a distribution as a pseudo file system
 - Distributions are served via a Web API from a set of servers
 - Clients see a “fuse” based file system
 - Files are transmitted to clients only when they are accessed
 - Transmitted files are cached locally on the client
- Developed & maintained by CERN for Atlas/CMS



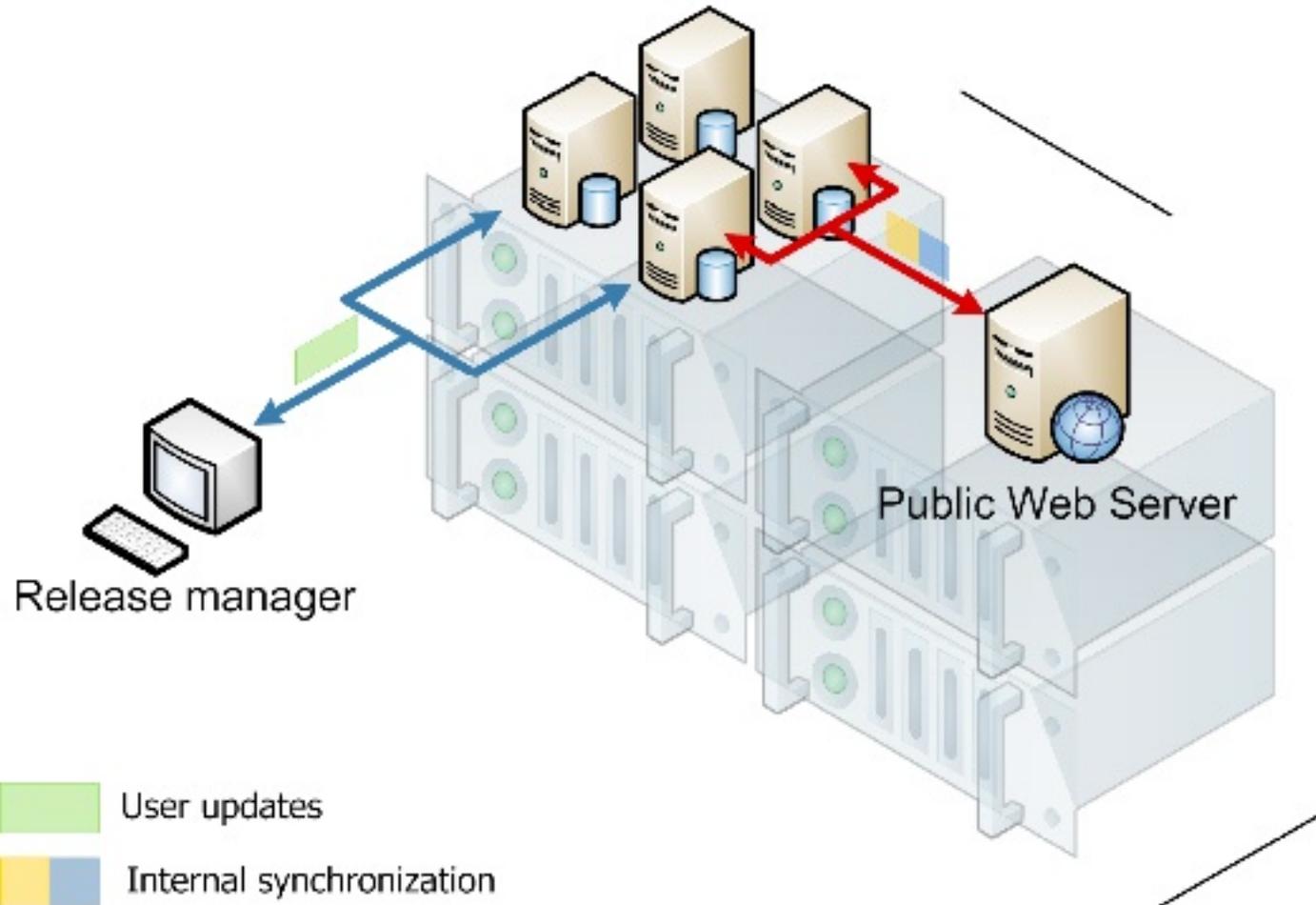
REX CVMFS Project



- Goal:
 - Determine if CVMFS based file distribution can be used for Intensity Frontier (IF) experiments
 - Setup and deploy CVMFS code distributions for select IF experiments
 - Test the operation of the distributions against:
 - Operation at FNAL
 - Operation outside FNAL
 - Perform scalability and performance tests
 - Obtain measurements of infrastructure requirements (cache requirements, squids setups etc...) using “real” use cases (i.e. experiment’s analysis and production jobs)
 - Work towards a production CVMFS service



CVMFS @ A glance





Test Setup



- Test Server
 - Host: `cms.hep.wisc.edu`
 - Maintained by U. Wisconsin
 - Provides interactive login via `gssissh`
 - Sufficient disk to host full experiment code distributions
 - Provides automated sync/build of working areas into published CVMFS images
 - Provides web servers for actual distribution



Server Side Deployments



- Currently have deployed:
 - Full NOvA code distribution
 - All releases to date
(17 separate releases + development)
 - All external packages (packaged as UPS products) to support the releases
 - Total size: \approx 170 GB
 - Full g-2 code distribution
 - 29 GB
- Both installed as:
 - `/cvmfs/repository/osg/app/experiment`
 - Simple installation procedure
(just unwind a tar ball and wait for the server to catch up)



Clients Deployments



- Currently have operational clients at multiple sites:
 - Fermilab
 - novagpvm10 (gpcf)
 - SMU
 - smuhpc cluster
 - User laptops
 - SLF5, Ubuntu, Mac OSX (snow leopard and lion)
- Fermilab & SMU sites have dedicated squids to protect the Wisc server
- Machine have local cache configurations:
 - FNAL=50 GB
 - SMU=4 GB
 - Laptops (tunable by user, default = 4 GB)



GPCF Client

```
anorman@novagpvm10:/afs/fnal.gov/files/home/room1/anorman — ssh
[anorman@novagpvm10 ~]$ hostname
novagpvm10.fnal.gov
[anorman@novagpvm10 ~]$ df -h
Filesystem                Size      Used Avail Use% Mounted on
/dev/vda2                  15G       7.0G   6.9G  51% /
/dev/vda7                  17G      173M    16G   2% /scratch
/dev/vda6                  2.0G      37M    1.9G   2% /tmp
/dev/vda3                   3.9G     315M    3.4G   9% /var
/dev/vda1                   122M      51M    65M  45% /boot
/dev/vdb1                   40G      2.8G    35G   8% /var/cache/cvmfs2
tmpfs                      5.9G         0   5.9G   0% /dev/shm
gpcf015.fnal.gov:/scratch/nova
                          10T       1.8T   8.3T  18% /scratch/nova
blue3:/nusoft/app          512G     411G   102G  81% /nusoft/app
blue3:/nusoft/data         10T       3.5T   6.6T  35% /nusoft/data
blue3:/nova/app            3.0T       2.7T   361G  89% /nova/app
blue3:/nova/data           140T      100T    41T  72% /nova/data
blue2:/fermigrid-fermiapp  1.1T     835G   266G  76% /grid/fermiapp
blue2:/fermigrid-app       300G     243G    58G  81% /grid/app
blue2:/fermigrid-data      24T       13T    12T  52% /grid/data
blue3:/nova/ana            60T       23T    38T  39% /nova/ana
AFS                         8.6G         0   8.6G   0% /afs
cvmfs2                      9.8G     2.6G   7.3G  26% /cvmfs/cms.hep.wisc.edu
[anorman@novagpvm10 ~]$
```

Cache partition
(required for each client station)

Bluearc Volumes

CVMFS File system
(/osg/app/nova)



Testing



- Initial testing has been with *current* NOvA offline analysis and production jobs
- Initial tests have been single jobs
 - Required significant work to disentangle all bluearc dependencies (i.e. hard coded paths by users)
 - NOvA @ FNAL
 - ✓ baseline **analysis** job on gpcf client
 - ✓ baseline **reconstruction** job on gpcf client
 - ✓ Full **Monte Carlo** generation job
 - ✓ Full **production** job
 - ✓ Full **production** job w/ Library Event Matching (LEM)
 - SMU
 - ✓ baseline Monte Carlo (single particle gen)
 - ✓ baseline unpack (evtdump/evtdisplay)

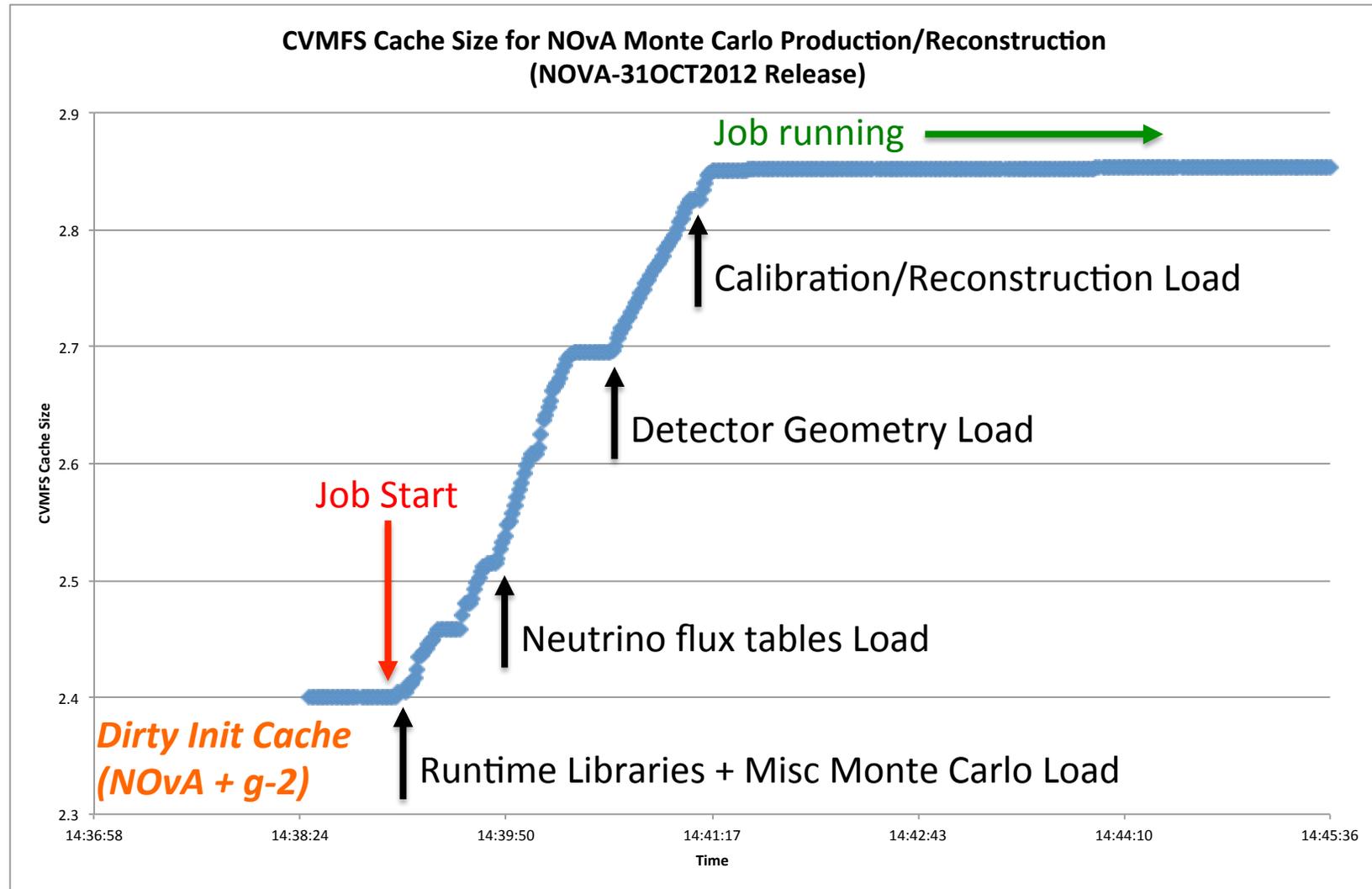


Performance & Cache

- CVMFS behaves as expected
 - On GPCF (for baseline analysis)
 - Initial job startup (with clean cache) took < 2 minutes
 - Cache was monitored to grow from < 300 MB to 1.7 GB.
 - Job started and ran normally
 - Subsequent jobs (with cache populated) started immediately
 - Cache is hit essentially 100%
 - Remains populated across multiple NOvA jobs
 - Squid logs indicate minimal misses after initial job run
 - g-2 jobs have cache footprint ≈ 0.5 GB
 - Does not conflict with NOvA jobs
 - On SMUHPC
 - Cache foot print ≈ 1.5 GB for simple MC
 - Do not have stats on squid or initial population of cache



Performance & Cache





Plans



- Starting on larger scale client testing
 - Scaling up with Fermigrid ITB (14-28 node)
 - Mid November using Wisc. server
 - Large scale with new worker nodes in test config (1000 nodes)
 - End November, 1st week December with Wisc. server
- Migration to OSG-GOC hosting of distros
 - Server available end Nov/1st week Dec.
 - FNAL/NOvA will be beta testers
 - Specification document in internal review for general OSG hosting of server