

An Introduction to Campus Grids

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&

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Outline

- Definition of a Campus Grid
- Why do Campus Grids
- Drawbacks of Campus Grids
- Examples of Campus Grids
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 - Purdue
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 - Nebraska
- FermiGrid
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- Evolution & Other Considerations
- Cloud Computing
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- Conclusions

Definition

- A Campus Grid is a distributed collection of [compute and storage] resources, provisioned by one or more stakeholders, that can be seamlessly accessed through one or more [Grid] portals.

Why Do Campus Grids ?

- Improve utilization of (existing) resources – don't purchase resources when they are not needed.
 - Cost savings.
- Provide common administrative framework and user experience.
 - Cost savings.
- Buy resources (clusters) in "bulk" @ lower costs.
 - Cost savings.
- Lower maintenance costs.
 - Cost savings.
- Unified user interface will reduce the amount of user training required to make effective use of the resources.
 - Cost savings.

What are the drawbacks ?

- Additional centralized infrastructure to provision and support.
 - Additional costs.
 - Can be provisioned incrementally to manage buy-in costs.
 - Virtual machines can be used to lower buy-in costs.
- Can make problem diagnosis somewhat more complicated.
 - Correlation of multiple logs across administrative boundaries.
 - A central log repository is one mechanism to manage this.
- Not appropriate for all workloads.
 - Don't want campus financials running on the same resources as research.
- Have to learn (and teach the user community) how to route jobs to the appropriate resources.
 - Trivially parallel jobs require different resources than MPI jobs.
 - I/O intensive jobs require different resources than compute intensive jobs.
- Limited stakeholder buy-in may lead to a campus grid that's less interoperable than you might like.

GLOW

- Grid Laboratory of Wisconsin
- See Dan Bradley's talk immediately following mine
- Multiple department based clusters all running Condor.
- Departments have priority [preemptive] access to their clusters.
- Clusters interchange workloads using Condor "flocking".
- Approximately 1/3 of jobs are opportunistic.

Purdue

- 3 big MPI-capable clusters running PBS, largest is (Purdue-Steele)
- Centrally managed "Steele" cluster.
- 15000 Slots
- Departments purchase "slots" on the cluster.
- Primary batch scheduler is PBS for purchased slots.
- Secondary batch scheduler is Condor for opportunistic computing.
- Condor is configured to only run jobs when PBS is not running a job on the node.
- See Preston Smith talk just given at condor week last week.
- Now expanding condor-based campus grid to other departmental clusters, using condor green computing

University of California

- Multiple campuses.
- Each campus has a local campus Grid portal.
- Overall Grid portal in addition.
- Access is Web portal based.

Nebraska

- 3 Campuses across Nebraska.
- Being commissioned now.
- Using Condor GlideinWMS to present virtual view of 3 campuses plus OSG
- Otherwise they find that people just submit to biggest one.
- See Derek Weitzel talk, Condor Week

Fermilab – Pre Grid

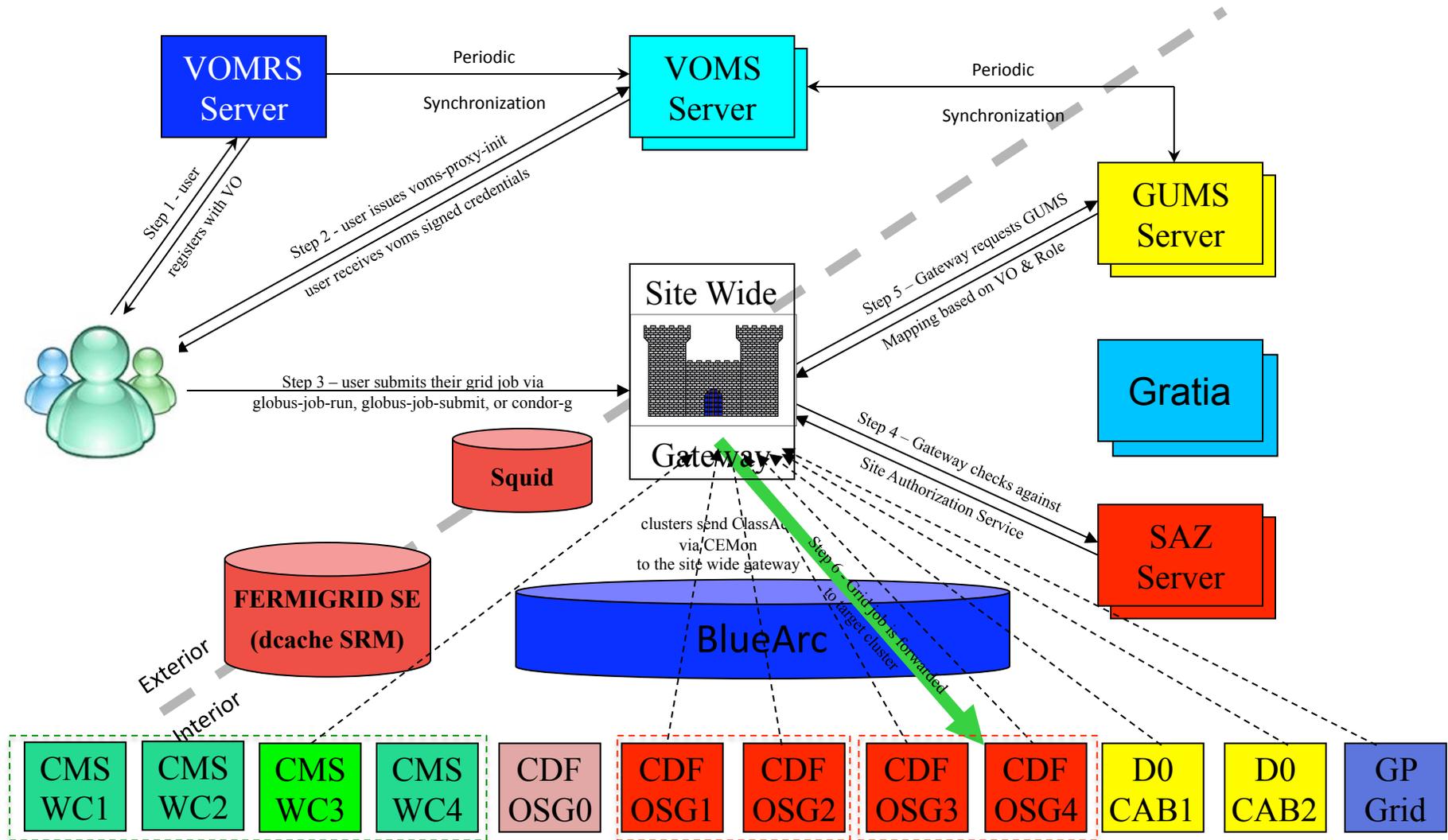
- Multiple “siloes” clusters, each dedicated to a particular stakeholder:
 - CDF – 2 clusters, ~2,000 slots
 - D0 – 2 clusters, ~2,000 slots
 - CMS – 1 cluster, ~4,000 slots
 - GP – 1 cluster, ~500 slots
- Difficult to share:
 - When a stakeholder needed more resources, or did not need all of their currently allocated resources, it was extremely difficult to move jobs or resources to match the demand.
- Multiple interfaces and worker node configurations:
 - CDF – Kerberos + Condor
 - D0 – Kerberos + PBS
 - CMS – Grid + Condor
 - GP – Kerberos + FBSNG

FermiGrid - Today

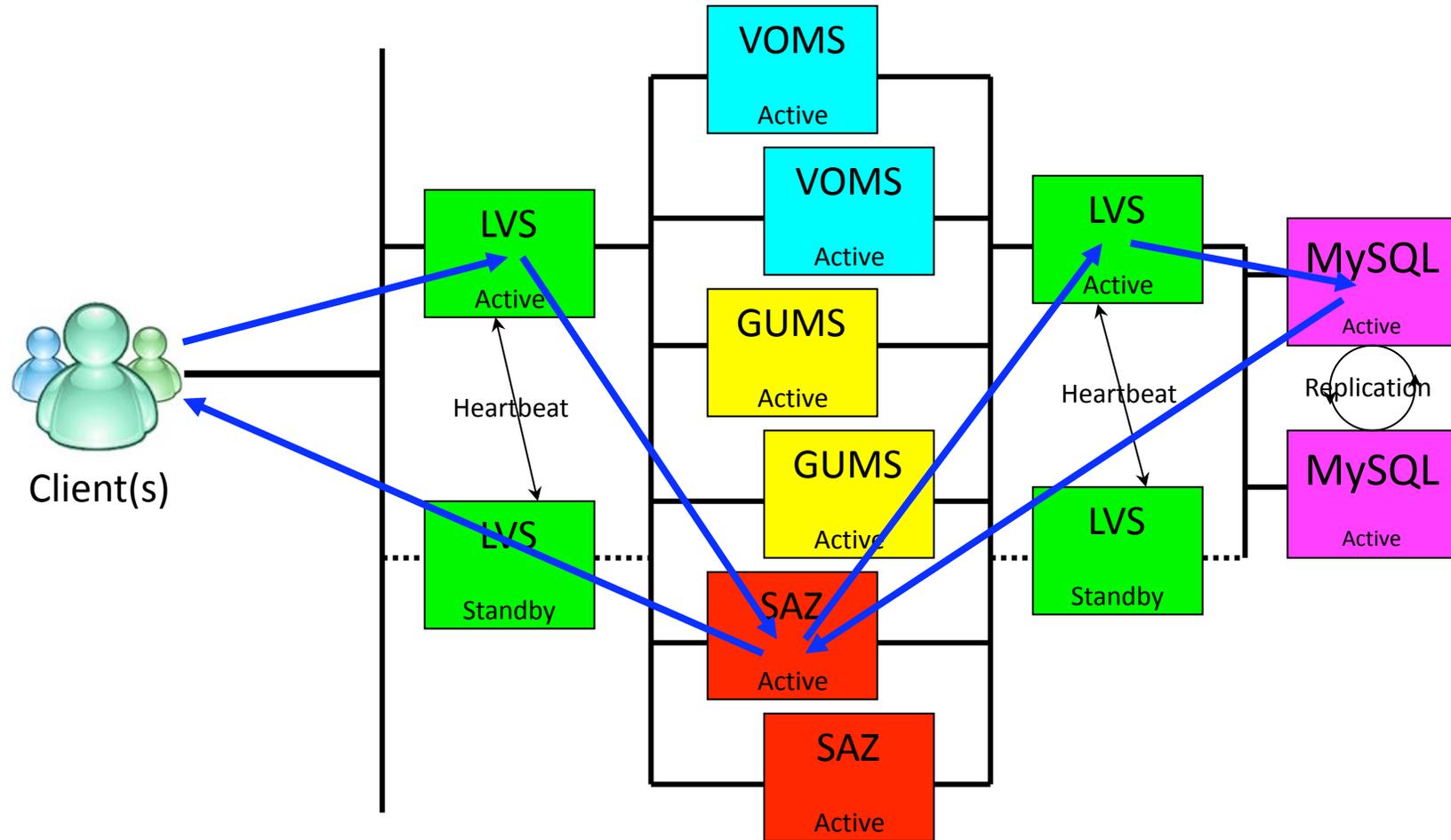
- Site Wide Globus Gatekeeper (FNAL_FERMIGRID).
- Centrally Managed Services (VOMS, GUMS, SAZ, MySQL, MyProxy, Squid, Accounting, etc.)
- Compute Resources are "owned" by various stakeholders:

Compute Resources	# Clusters	# Gatekeepers	Batch System	# Batch Slots
CDF	3	5	Condor	5685
D0	2	2	PBS	5305
CMS	1	4	Condor	6904
GP	1	3	Condor	1901
Total	7	15	n/a	~19,000
Sleeper Pool	1	2	Condor	~14,200

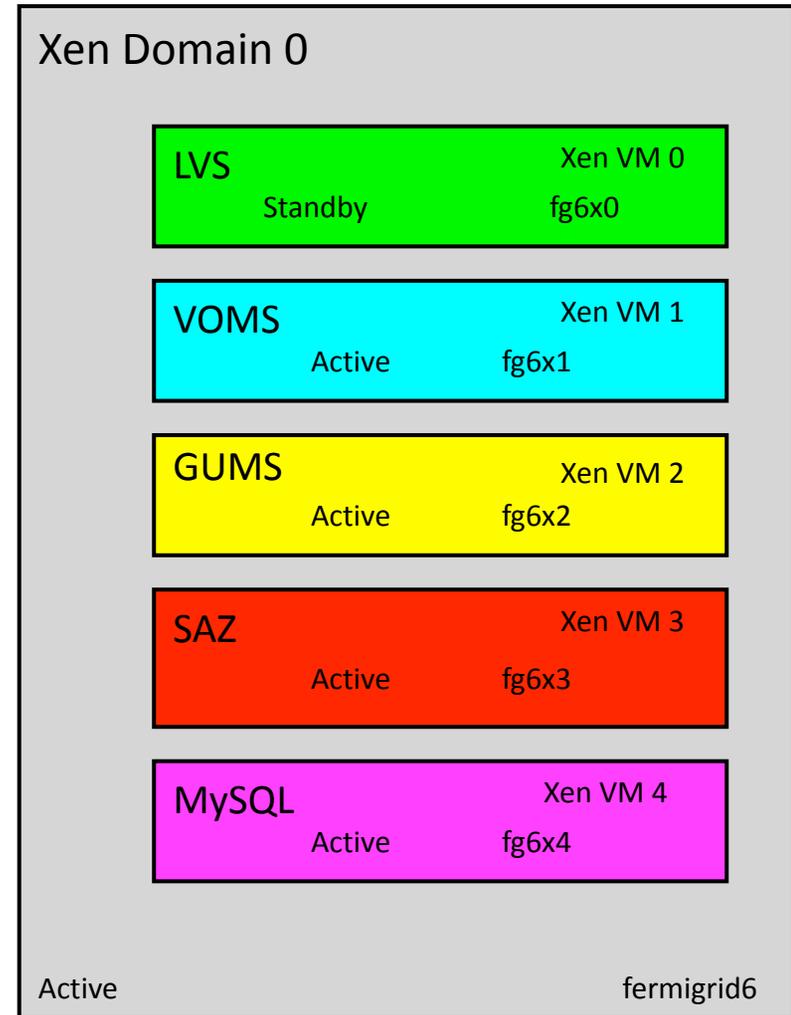
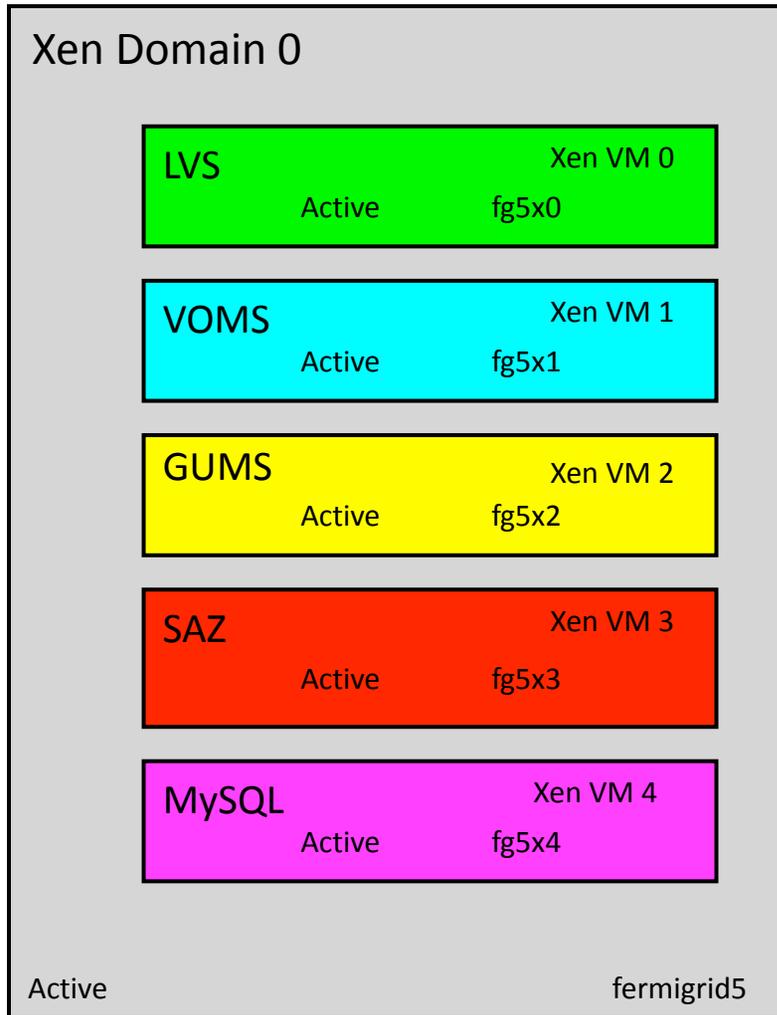
FermiGrid - Architecture



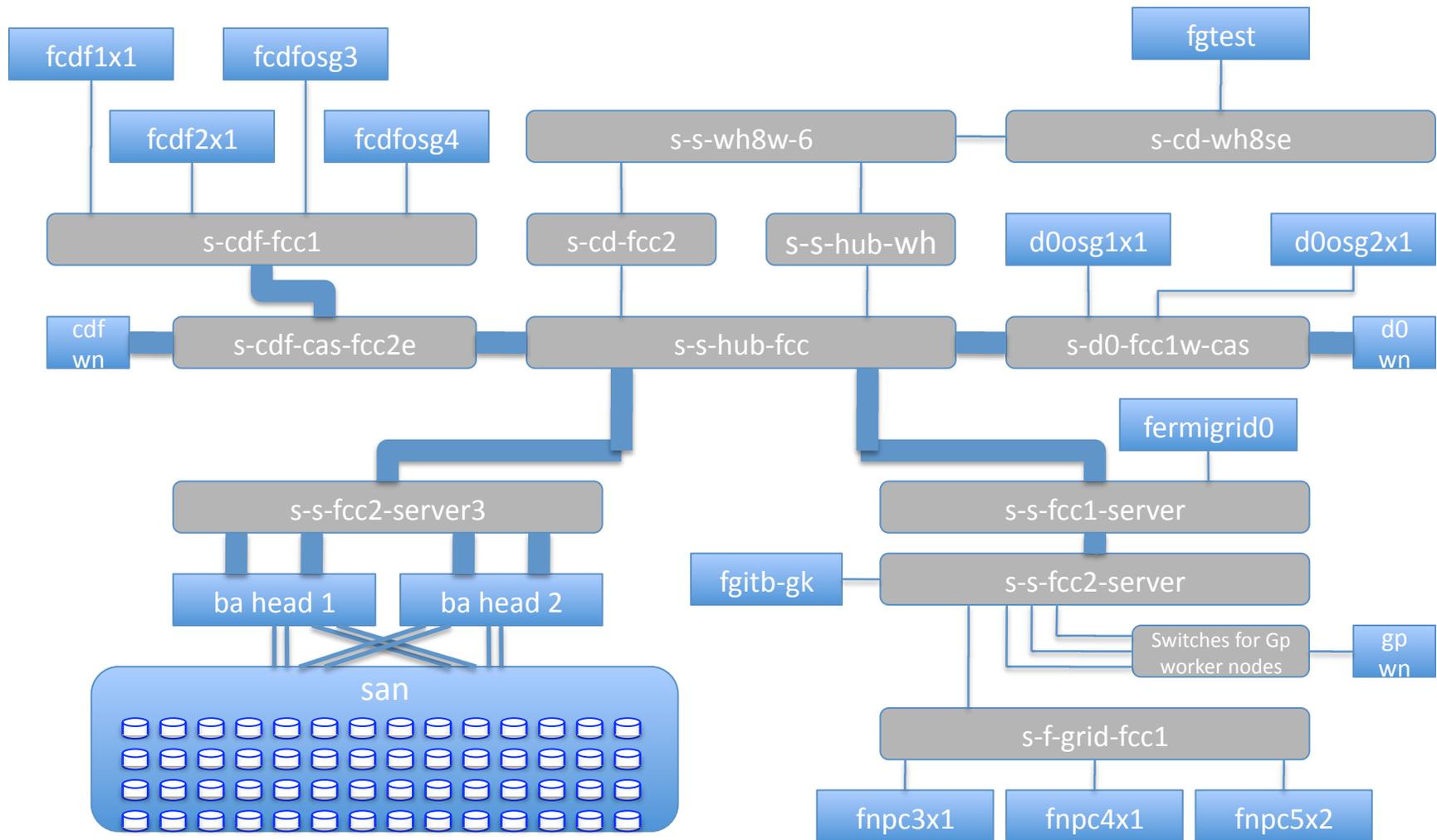
FermiGrid HA Services - 1



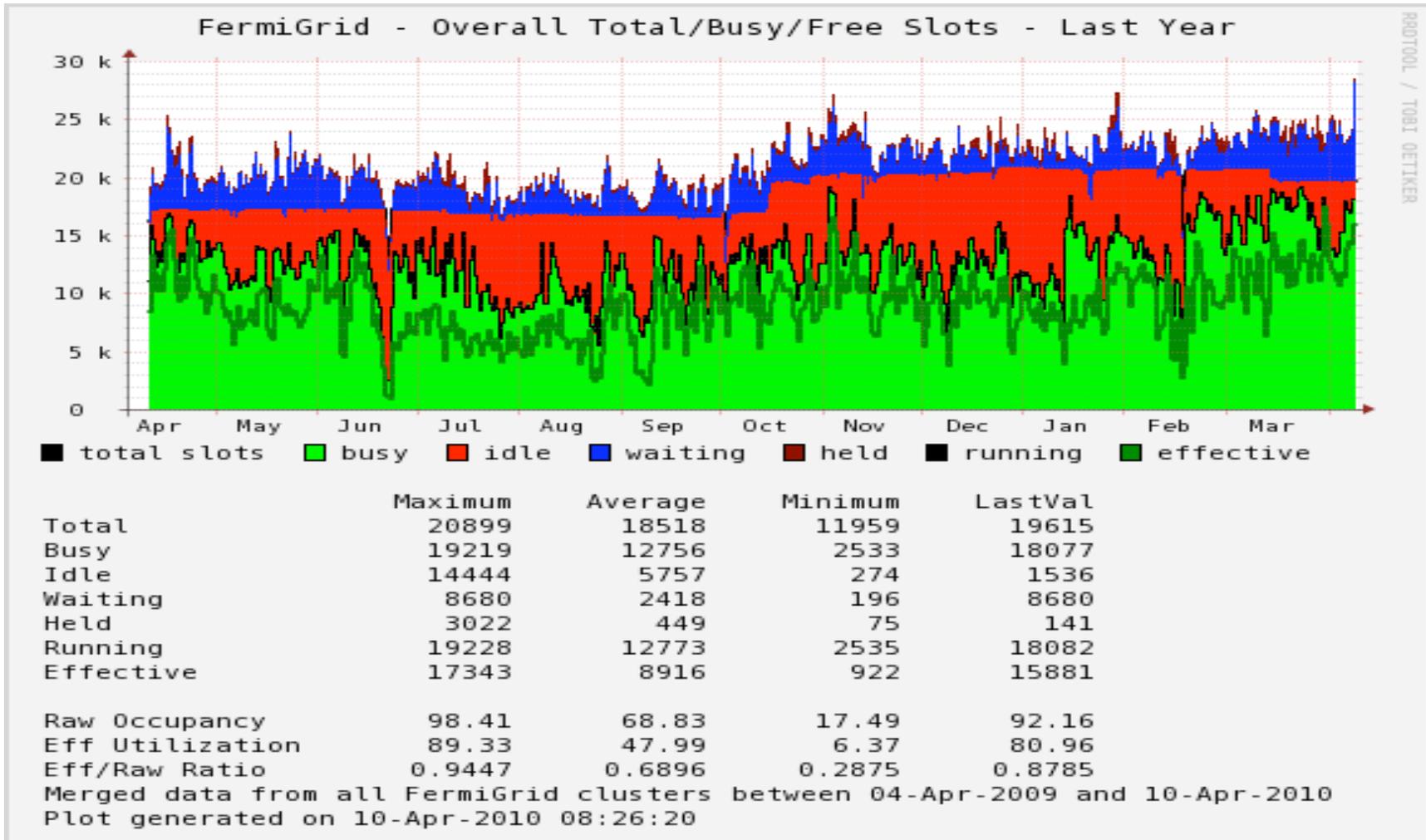
FermiGrid HA Services - 2



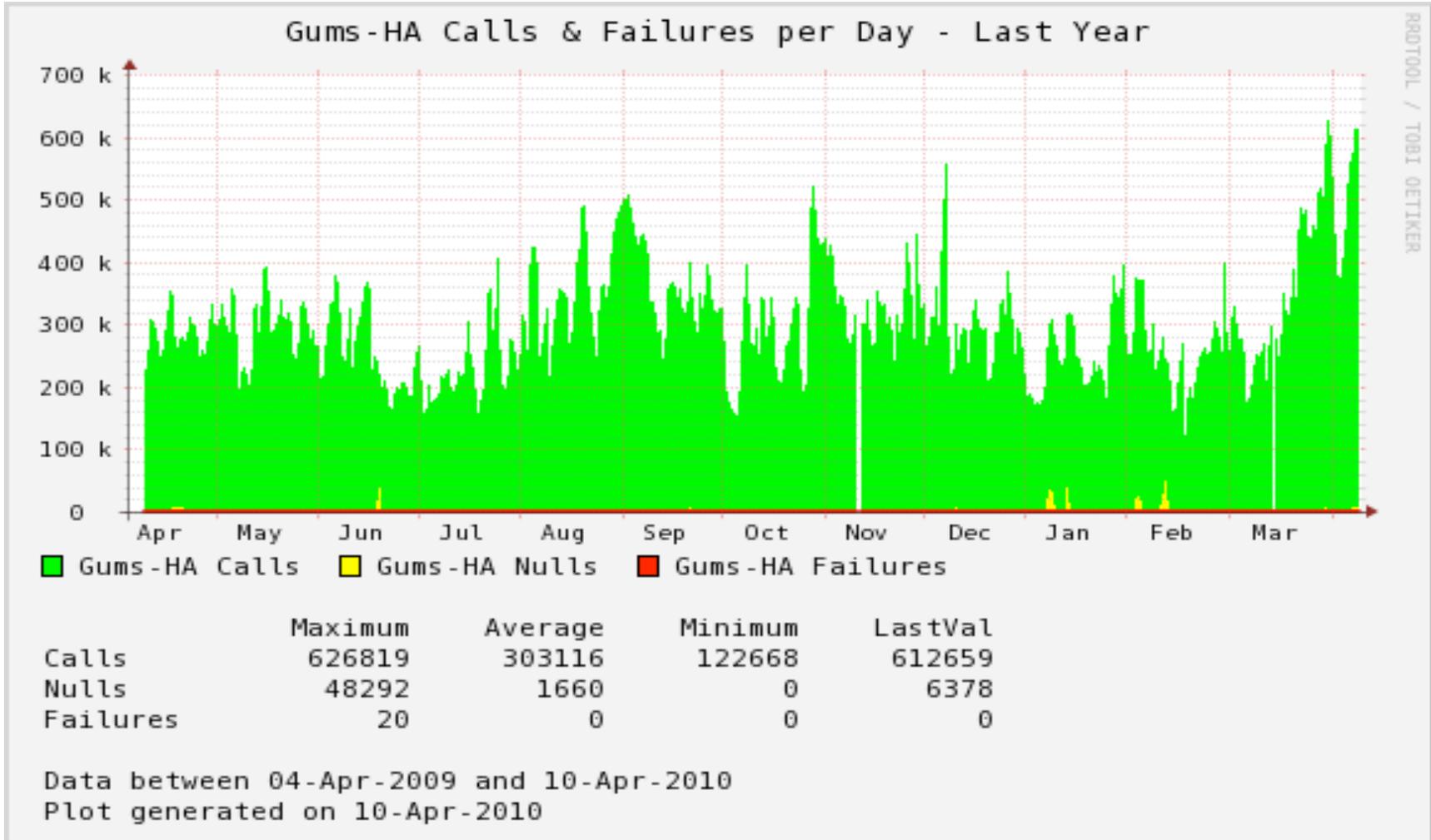
(Simplified) FermiGrid Network



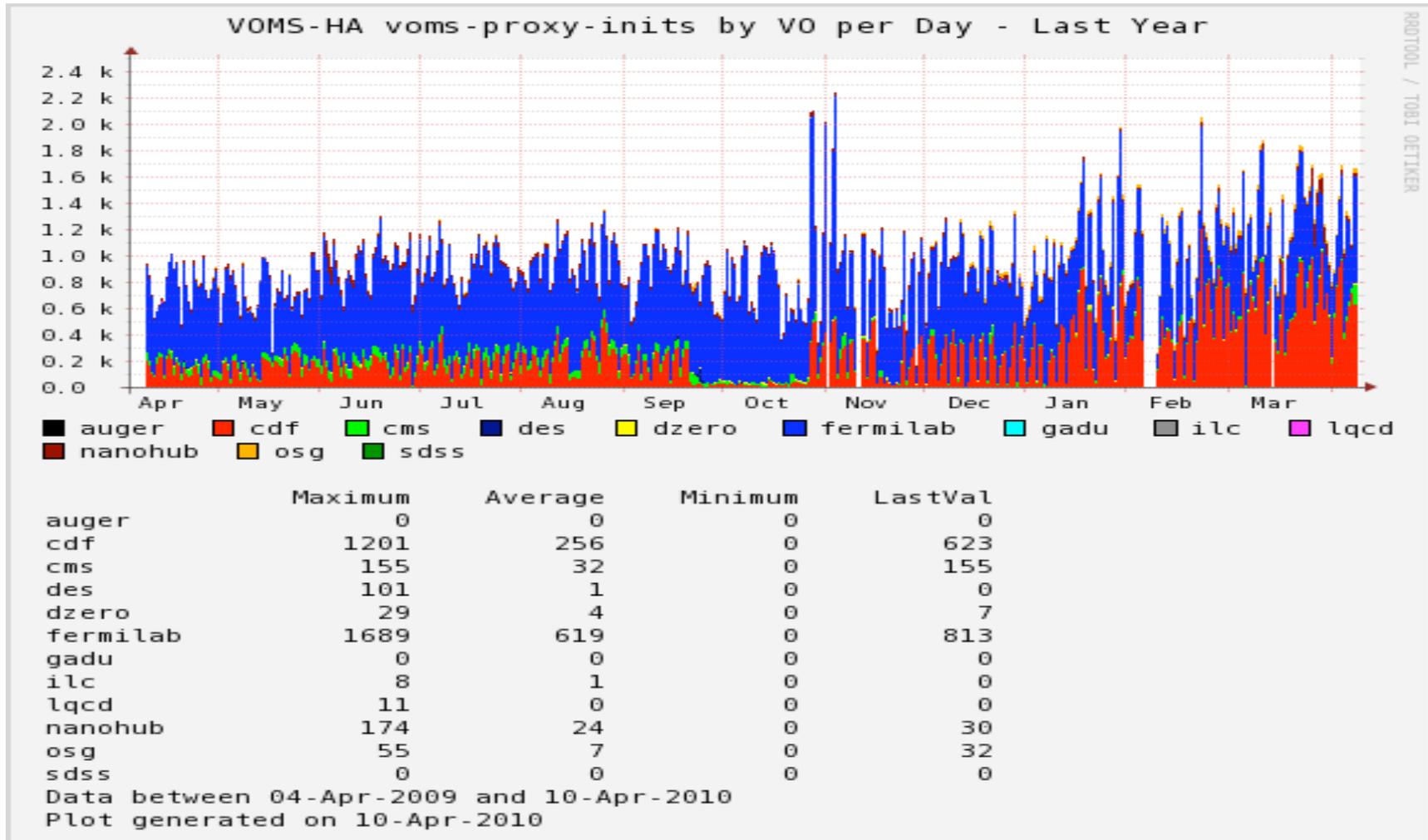
FermiGrid Utilization



GUMS calls



VOMS-PROXY-INIT calls



Evolution

- You don't have to start with a massive project to transition to a Grid infrastructure overnight.
- FermiGrid was commissioned over roughly a 18 month interval:
 - Ongoing discussions with stakeholders,
 - Establish initial set of central services based on these discussions [VOMS, GUMS],
 - Work with each stakeholder to transition their cluster(s) to use Grid infrastructure,
 - Periodically review the set of central services and add additional services as necessary/appropriate [SAZ, MyProxy, Squid, etc.].

Other Considerations

- You will likely want to tie your (?centrally managed?) administration/staff/faculty/student computer account data into your Campus Grid resources.
 - FermiGrid has implemented automated population of the “fermilab” virtual organization (VO) from our Central Name and Address Service (CNAS).
 - We can help with the architecture of your equivalent service if you decide to implement such a VO.
- If you have centrally provided services to multiple independent clusters [eg. GUMS, SAZ], you will eventually need to implement some sort of high availability service configuration.
 - Don't have to do this right off the bat, but it is useful to keep in mind when designing and implementing services.
 - FermiGrid has implemented highly available Grid services & we are willing to share our designs and configurations.

What About Cloud Computing?

- Cloud Computing can be integrated into a Campus Grid infrastructure.

Additional Resources

- FermiGrid
 - <http://fermigrid.fnal.gov>
 - <http://cd-docdb.fnal.gov>
- OSG Campus Grids Activity:
 - <https://twiki.grid.iu.edu/bin/view/CampusGrids/WebHome>
- OSG Campus Grids Workshop:
 - <https://twiki.grid.iu.edu/bin/view/CampusGrids/WorkingMeetingFermilab>
- ISGTW Article on Campus Grids:
 - <http://www.isgtw.org/?pid=1002447>

Conclusions

- Campus Grids offer significant cost savings.
- Campus Grids do require a bit more infrastructure to establish and support.
 - This can be added incrementally.
- Many large higher education and research organizations have already deployed and are making effective use of Campus Grids.
- Campus Grids can be easily integrated into larger Grid organizations (such as the Open Science Grid or TeraGrid) to give your community access to larger or specialized resources.
 - Of course it's nice if you are also willing to make your unused resources available for opportunistic access.