Western Analysis Facility

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US-ATLAS Tier2/Tier3 Workshop
University of Chicago
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SLAC
NATIONAL ACCELERATOR LABORATORY

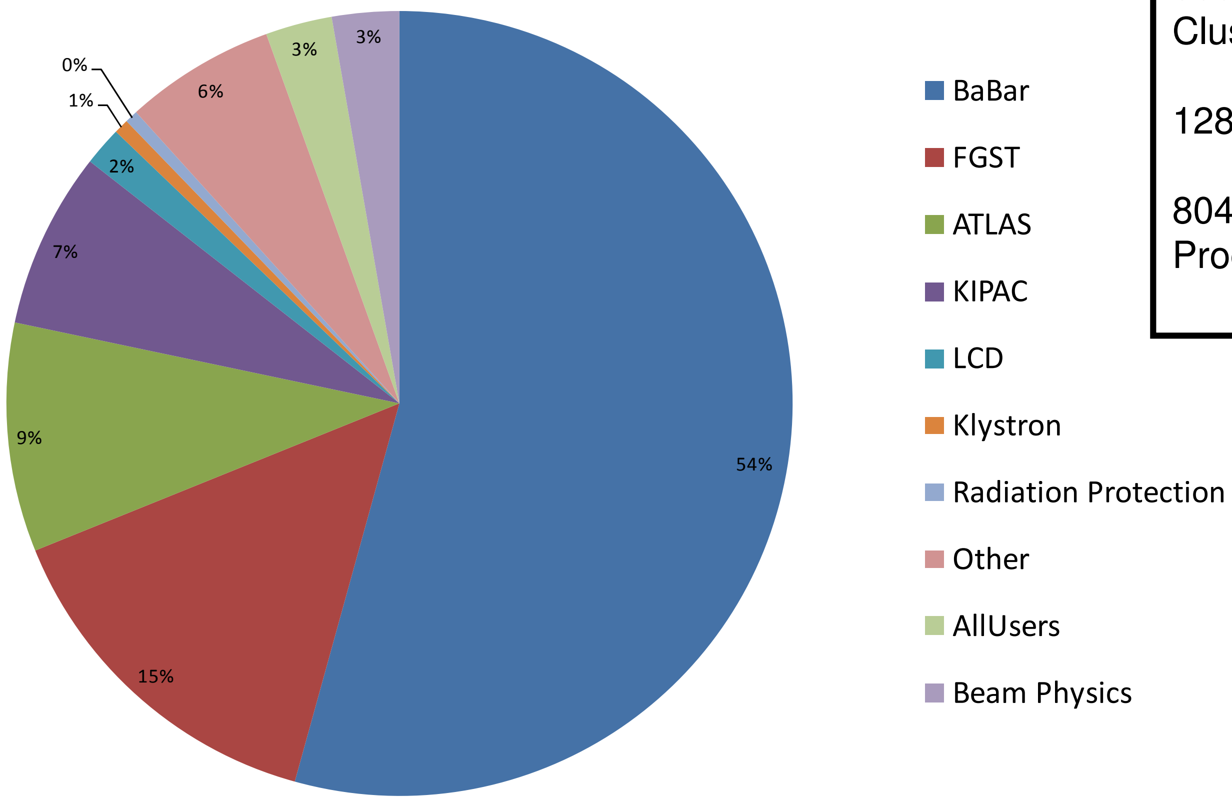
PPA Particle Physics & Astrophysics

Outline

- SLAC HEP Computing Facilities
- SLAC Power and Cooling Infrastructure
- Hosting University Equipment
- SLAC Strengths
- Longer-Term Goals

SLAC HEP Computing Facilities

SLAC HEP Batch CPU 8600 Cores



72 Cores: SMP (SGI Altix)

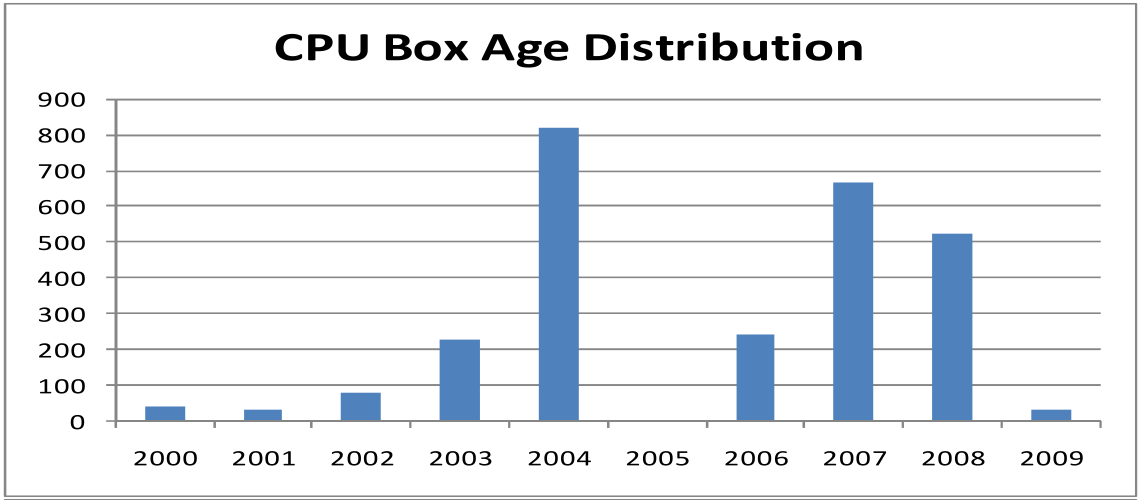
360 Cores: Infiniband Cluster

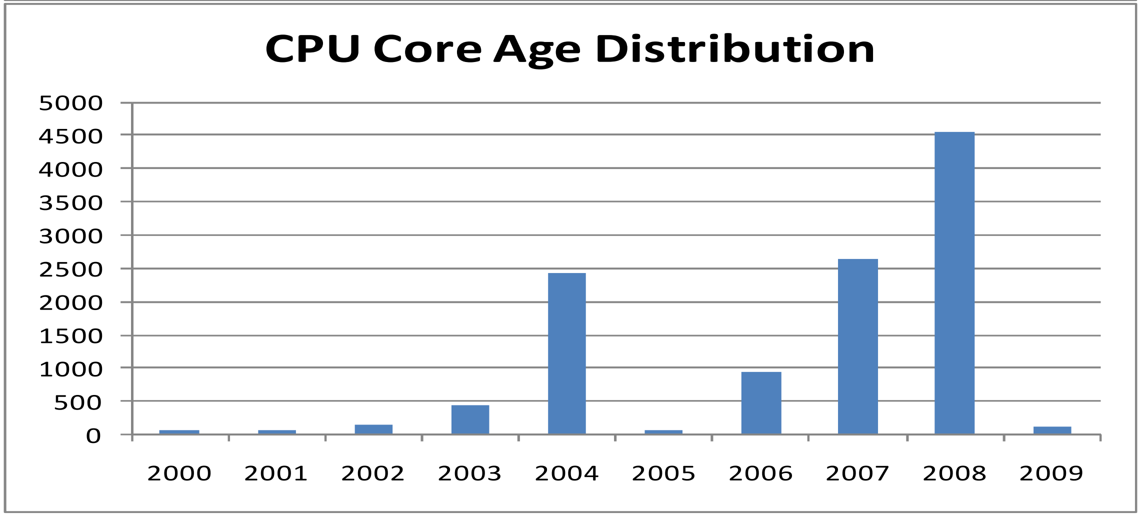
128 Cores: Myrinet Cluster

8040 Cores: HEP Data Processing

Plus 106 Interactive/ Build Cores

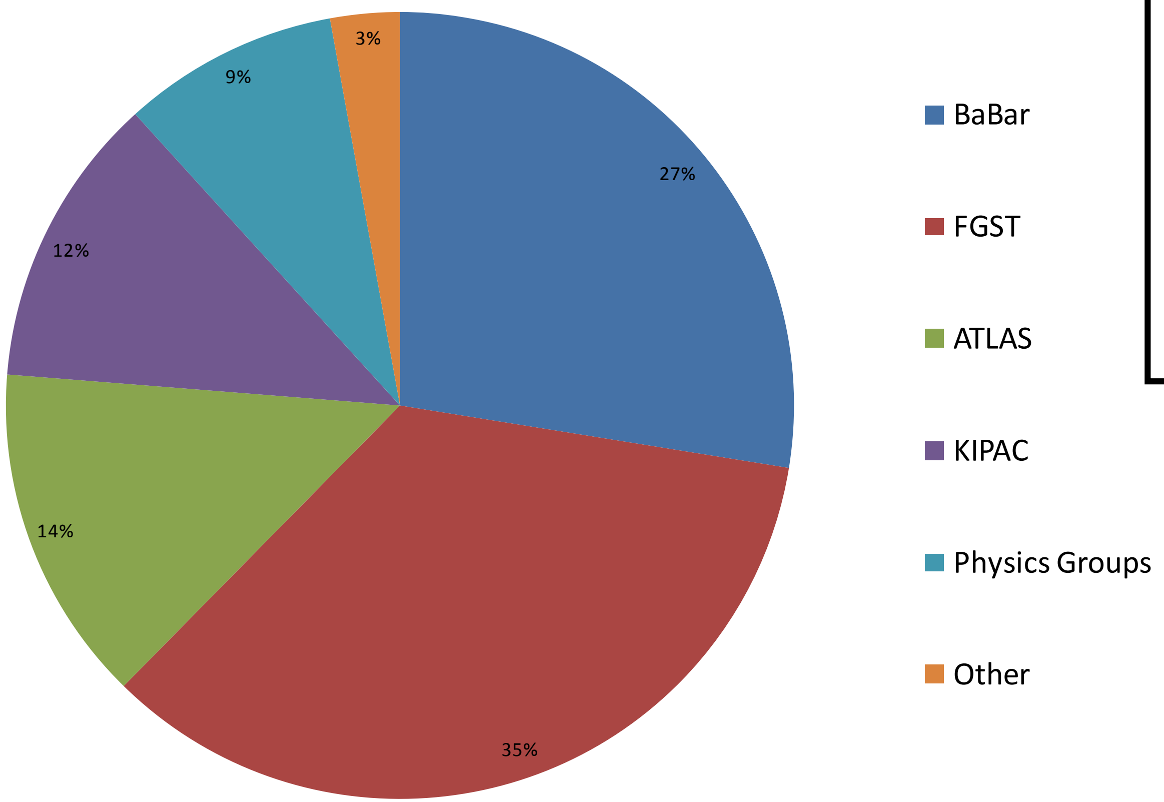
SLAC HEP Computing Facilities





SLAC HEP Computing Facilities

SLAC HEP Disk Space **2052 Terabytes**



34 TB: AFS

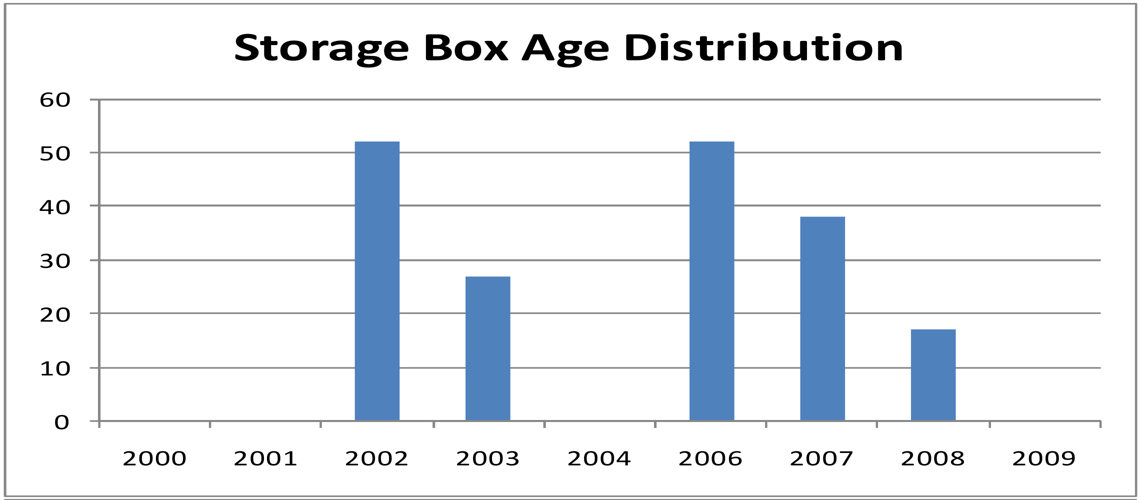
47 TB: NFS-Network Appliance

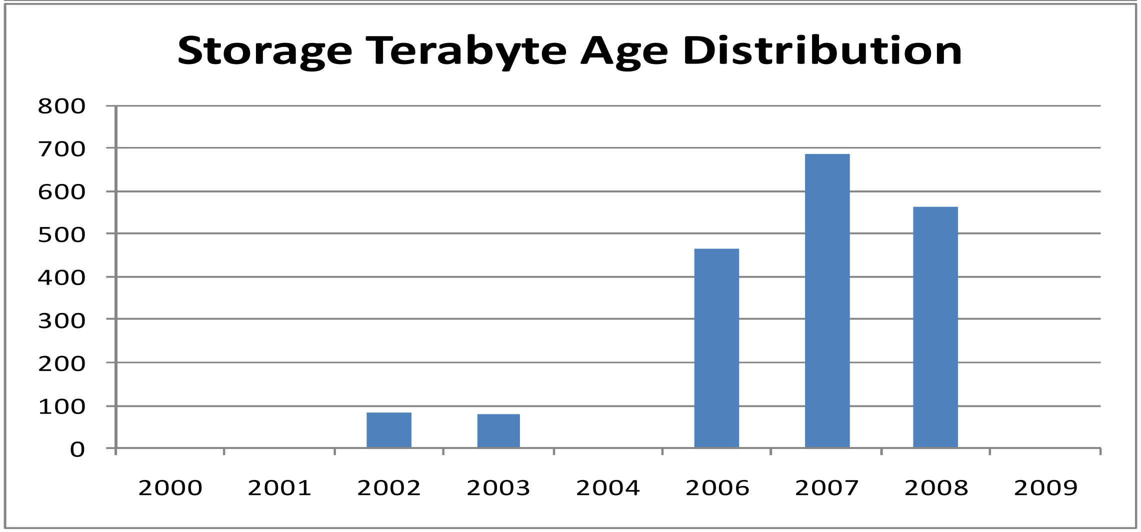
700 TB: NFS

1200 TB: xrootd

74 TB: Lustre, Objectivity …

SLAC HEP Computing Facilities





SLAC HEP Computing Facilities

Mass Storage Managed by HPSS

Upgrade in Progress

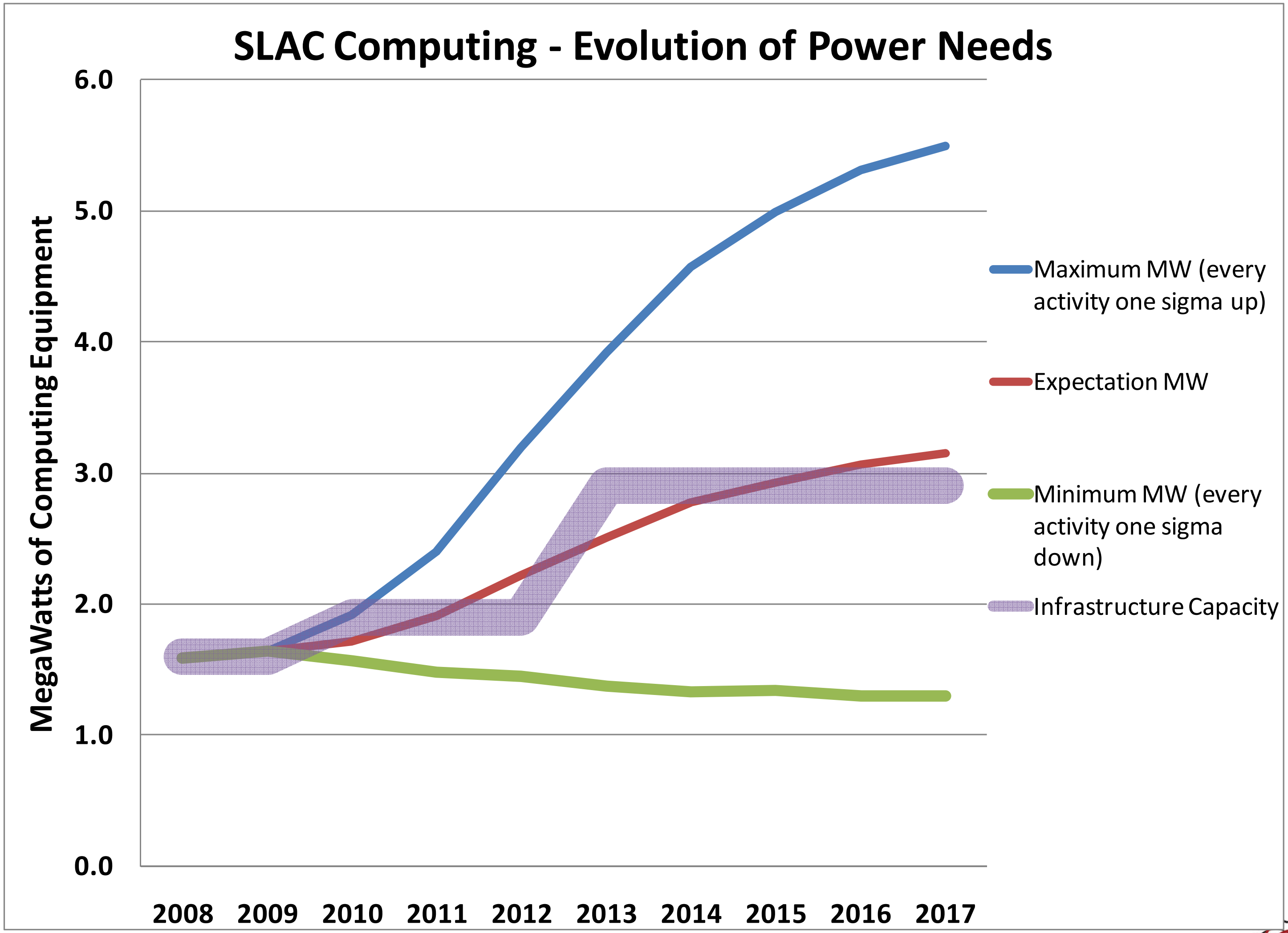
x 6 → 2 x

Transfer ~ 3 Petabytes

30,000 Slots Total

13,000 Slots Total

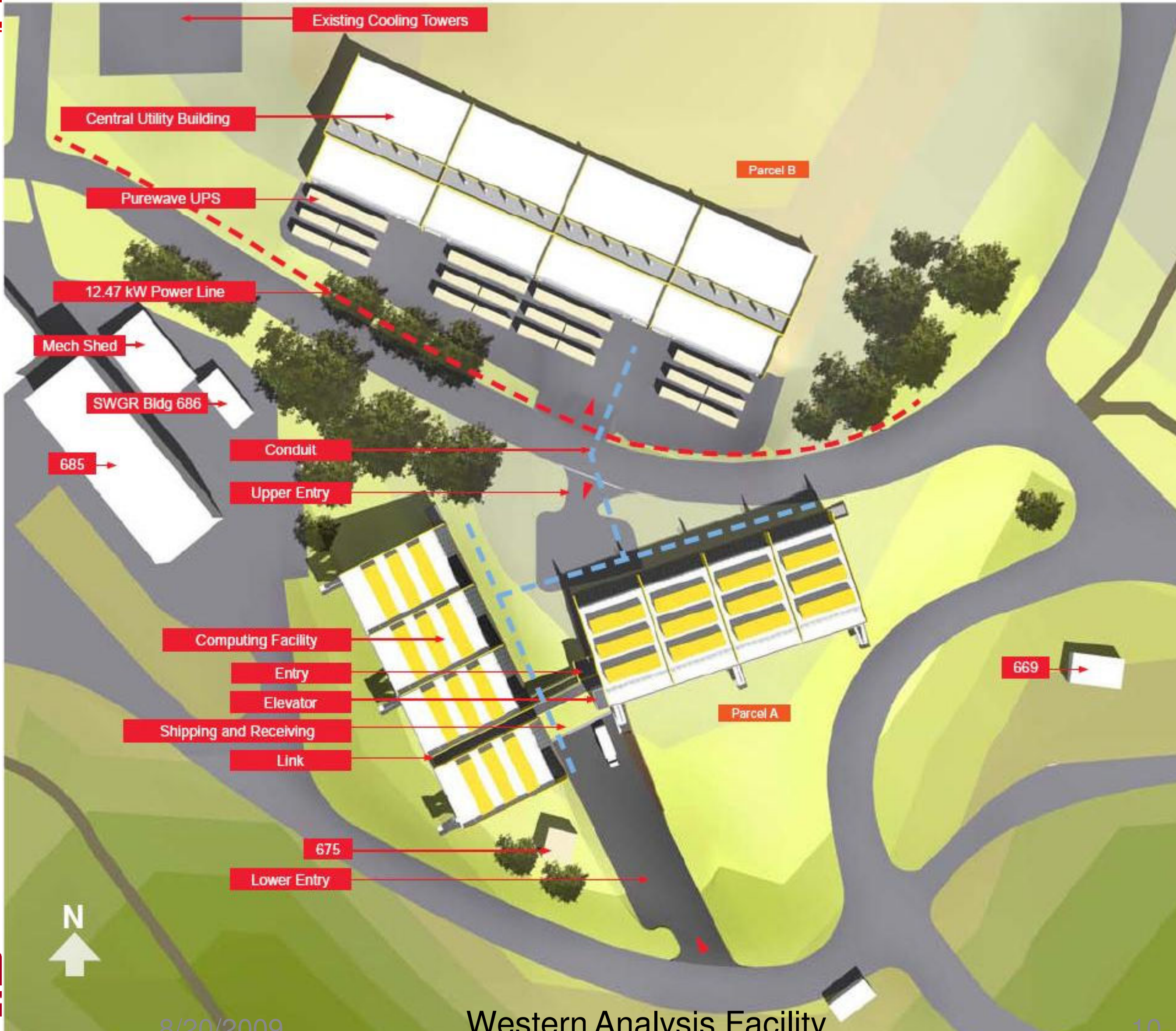
Power and Cooling for Computing at SLAC



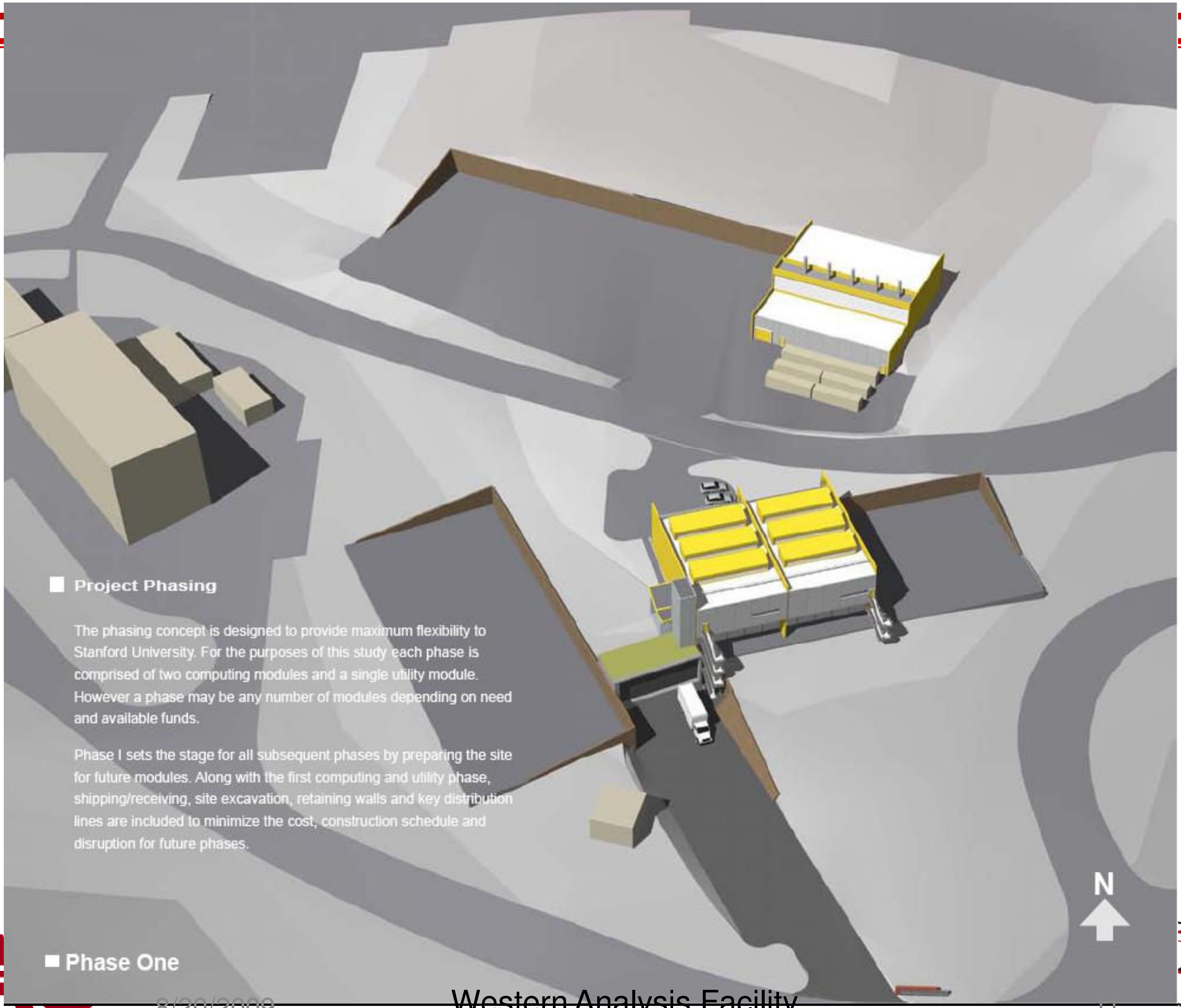
Infrastructure: 2013 on

- Proposed (Stanford) Scientific Research Computing Facility
- Modular – up to 8 modules
- Up to 3MW payload per module
- Ambient air cooled
- Cheaper than Sun BlackBoxes
- But not free! (~$10 per W capital cost)

Concept for a Stanford Research Computing Facility at SLAC (~2013)

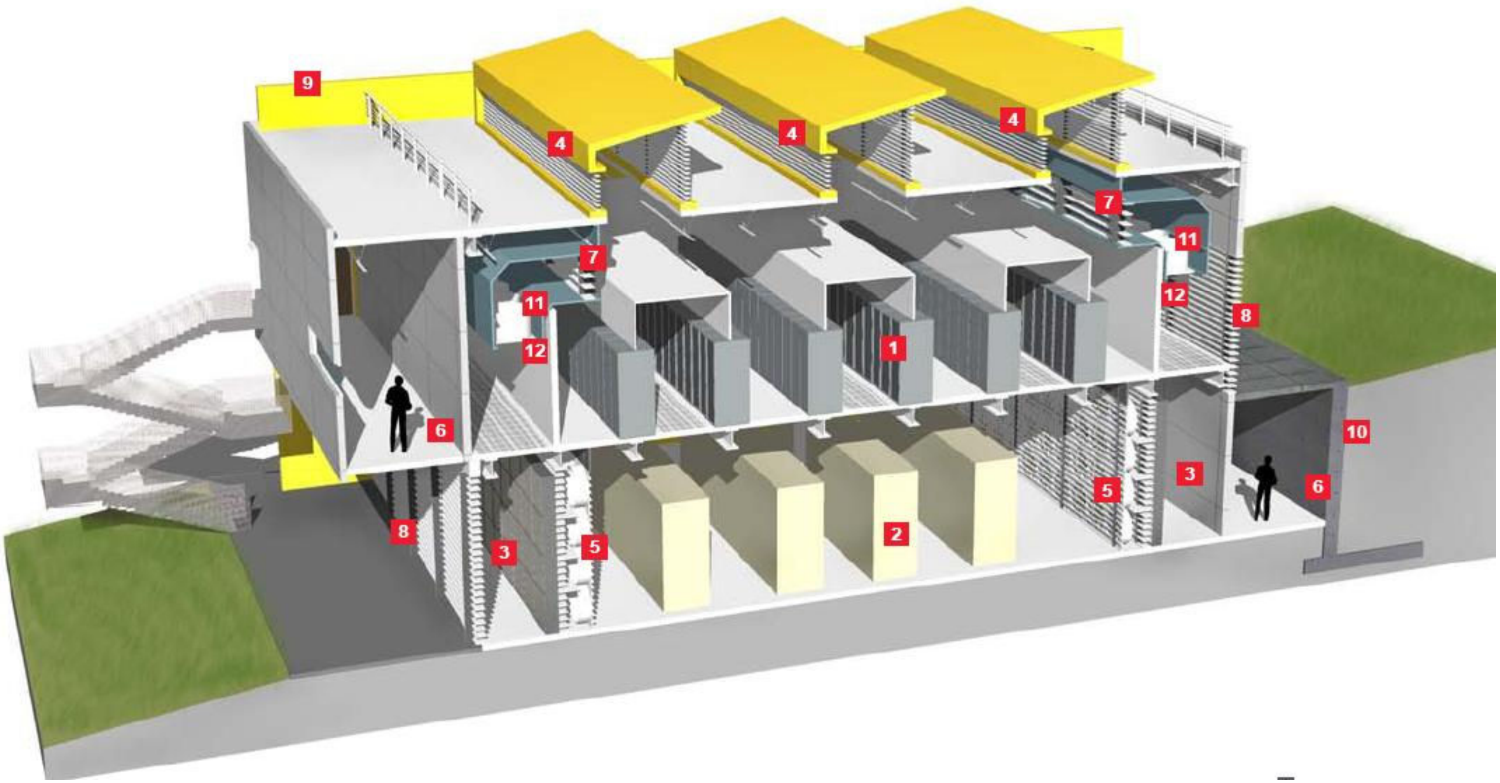


First Two Modules



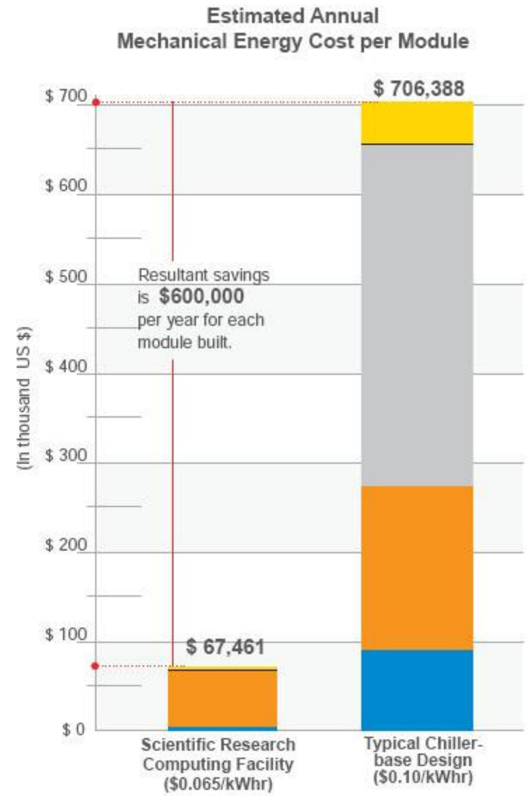
Module Detail

1 Computing Facility
2 Electrical Room
3 Return Air Shaft
4 Hot Air Exhaust
5 Fan Wall
6 Corridor
7 Damper
8 Air In-take Louvers
9 Load Bearing Wall
10 Retaining Wall
11 Return Air Fan
12 Humidifier



Green Savings

	Scientific Research Computing Facility	Typical Chiller-Based Design
IT Load	$2,207,520	$2,207,520
Elec. Conversion	$551,880	$551,880
Cooling Tower	$3,211	$45,329
Humidification	$2,065	$48
Chiller	$0	$367,180
Fans	$59,632	$207,157
Pumps	$2,553	$86,674
Total	$2,826,861	$3,465,788



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Fans	$59,632	$207,157
Pumps	$2,553	$86,674
Total	$67,461	$706,388

Ideas on Hosting Costs (1)

Model the acquisition costs, power bill + infrastructure maintenance + support labor for:

1. CPU boxes:
   - Acquisition

Raw Box (Dell R410, 8*2.93 GHz, 24GB, 500GB)	$3776
Network (data + management), rack, cables	$981

   - Annual Costs

Power Bill (including cooling)	$475
Power/cooling infrastructure maintenance	$176
Labor (sysadmin, ATLAS environment)	$440

Ideas on Hosting Costs (2)

Model the acquisition costs, power bill + infrastructure maintenance + support labor for:

2. Disk Space:
    - Acquisition

Raw Box (Sun “Thor”, 2*6-core, 48*1TB = 33TB usable)	$25,400
Network (data + management), rack, cables	$3,500

    - Annual Costs

Power Bill (including cooling)	$1,381
Power/cooling infrastructure maintenance	$512
Labor (sysadmin, ATLAS environment)	$4,000

Hosting Terms

The historical approach:

1. Rich Uncle:
   - University buys or pays for some equipment
   - SLAC provides space/power/cooling/network/support for free.

Possible future scenarios:

1. Cash economy:
   - University buys or pays for some equipment and pays for the rack/network/cable acquisition costs;
   - University pays the annual operating costs to SLAC
2. Barter economy:
   - University buys or pays for some equipment
   - SLAC assigns some fraction of this equipment to meet SLAC HEP program needs
   - In exchange, SLAC installs, powers, cools and supports the equipment for 3 or 4 years

SLAC Strengths

1. Pushing the envelope of Data Intensive Computing e.g. Scalla/xrootd (in use at the SLAC T2)

2. Design and implementation of efficient and scalable computing systems (1000s of boxes)

3. Strongly supportive interactions with the university community (and 10 Gbits/s to Internet2).

Plus a successful ongoing computing operation:

- Multi-tiered multi-petabyte storage
- ~10,000 cores of CPU
- Space/power/cooling continuously evolving

SLAC Laboratory Goals

1. Maintain, strengthen and exploit the Core Competency in Data Intensive Computing;

2. Collaborate with universities exploiting the complementary strengths of universities and SLAC.

ATLAS Western Analysis Facility Concept

1. Focus on data-intensive analysis on a “major-HEP-computing-center” scale;

2. Flexible and Nimble to meet the challenge of rapidly evolving analysis needs;

3. Flexible and Nimble to meet the challenge of evolving technologies:
   - Particular focus on the most effective role for solid state storage (together with enhancements to data-access software);

4. Close collaboration with US ATLAS university groups:
   - Make best possible use of SLAC-based and university-based facilities.

5. Coordinate with ATLAS Analysis Support Centers.

ATLAS Western Analysis Facility
Possible Timeline

1. Today:
   1. Interactive access to SLAC computing available to US ATLAS
   2. Jobs may be submitted to (most of) the HEP funded CPUs
   3. Hosting possibilities for Tier 3 equipment

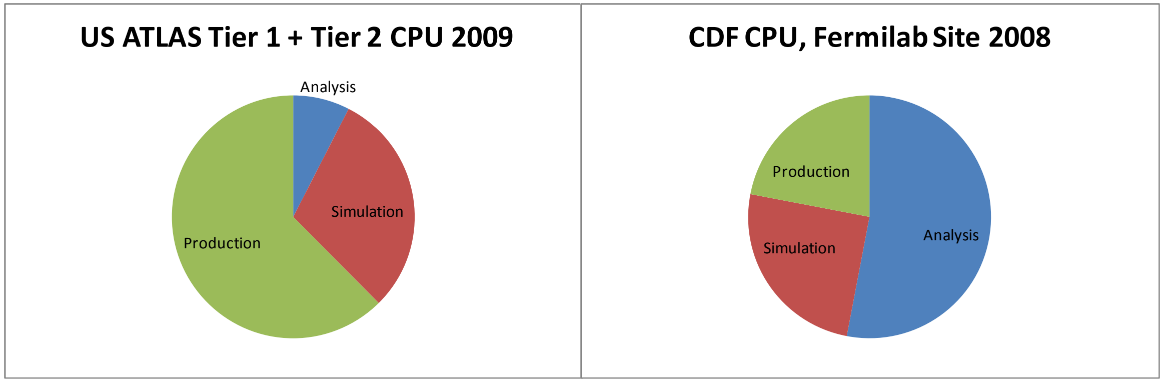
2. Today through 2010: Tests of various types of solid-state storage in various ATLAS roles (conditions DB, TAG access, PROOF-based analysis, xrootd access to AOD …). Collaborate with BNL and ANL.

3. 2010: Re-evaluation of ATLAS analysis needs after experience with real data.

4. 2011 on: WAF implementation as part of overall US ATLAS strategy.

Longer Term Goals

- There is a likelihood that US ATLAS will need additional data-intensive analysis capability:



- There is an even higher likelihood that there will be major software and architectural challenges in ATLAS data analysis.
- SLAC's goal is to address both issues as part membaer of of US ATLAS.