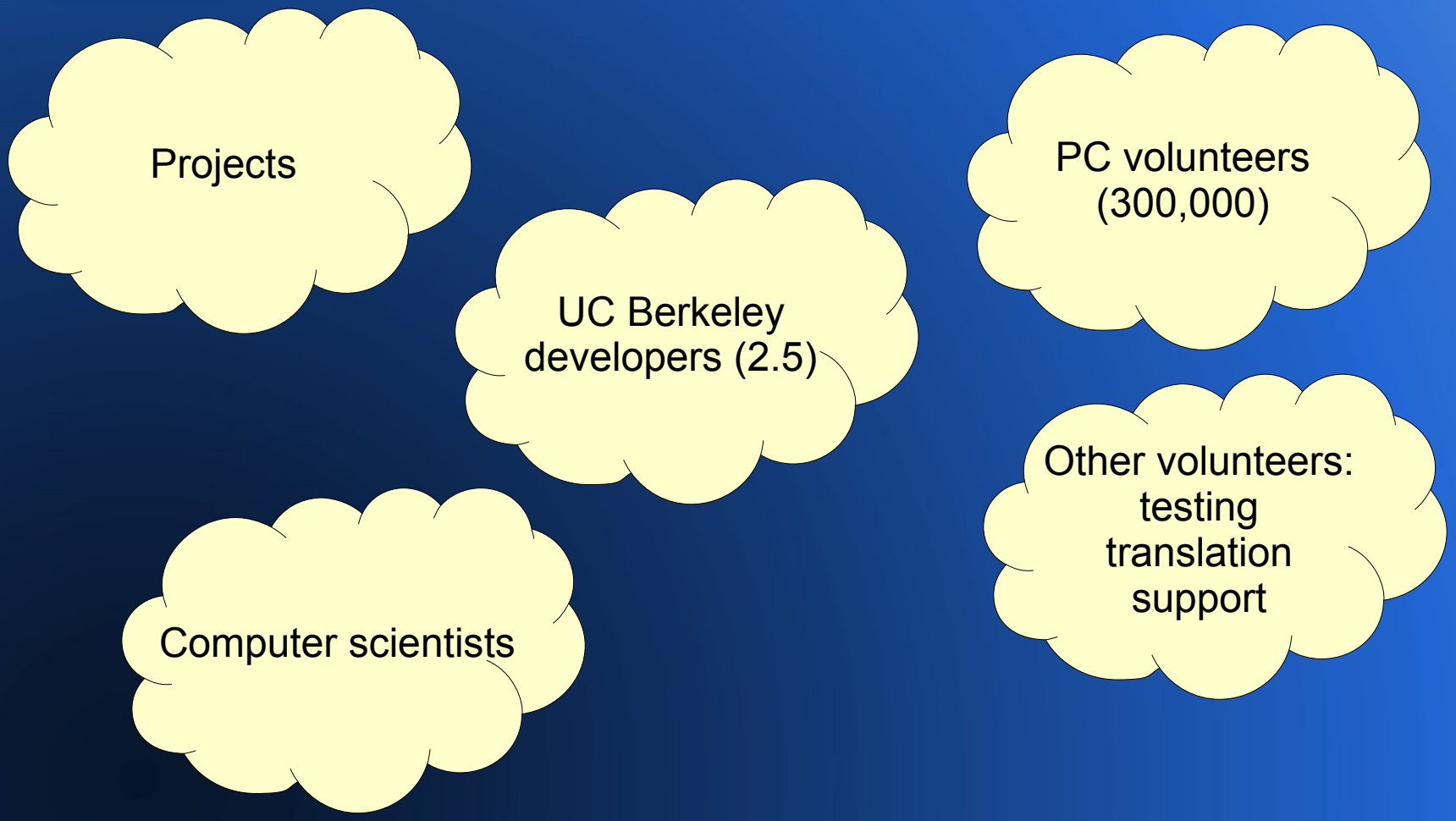
The 8th Annual BOINC Workshop

London, England
27-28 Sept. 2012
http://boinc.berkeley.edu/trac/wiki/WorkShop12

The BOINC community



Workshop goals

- Learn what everyone else is doing
- Form collaborations
- Steer BOINC development
  - tell us what you want

Hackfest (tomorrow)

- Goal: get something concrete done
  - Improve docs
  - design and/or implement software
  - learn and use a new feature

The state of volunteer computing

- Volunteers: stagnant
  - BOINC: 290K people, 450K computers
- Science projects: stagnant
- Computer science research: stagnant
- Let’s keep trying anyway

Requests to projects

- Do outreach
  - notices
  - automated emails
  - mass emails
  - message boards
  - mass media
- Use current server code

To developers/researchers

- Talk with me before starting anything, especially if it's of general utility

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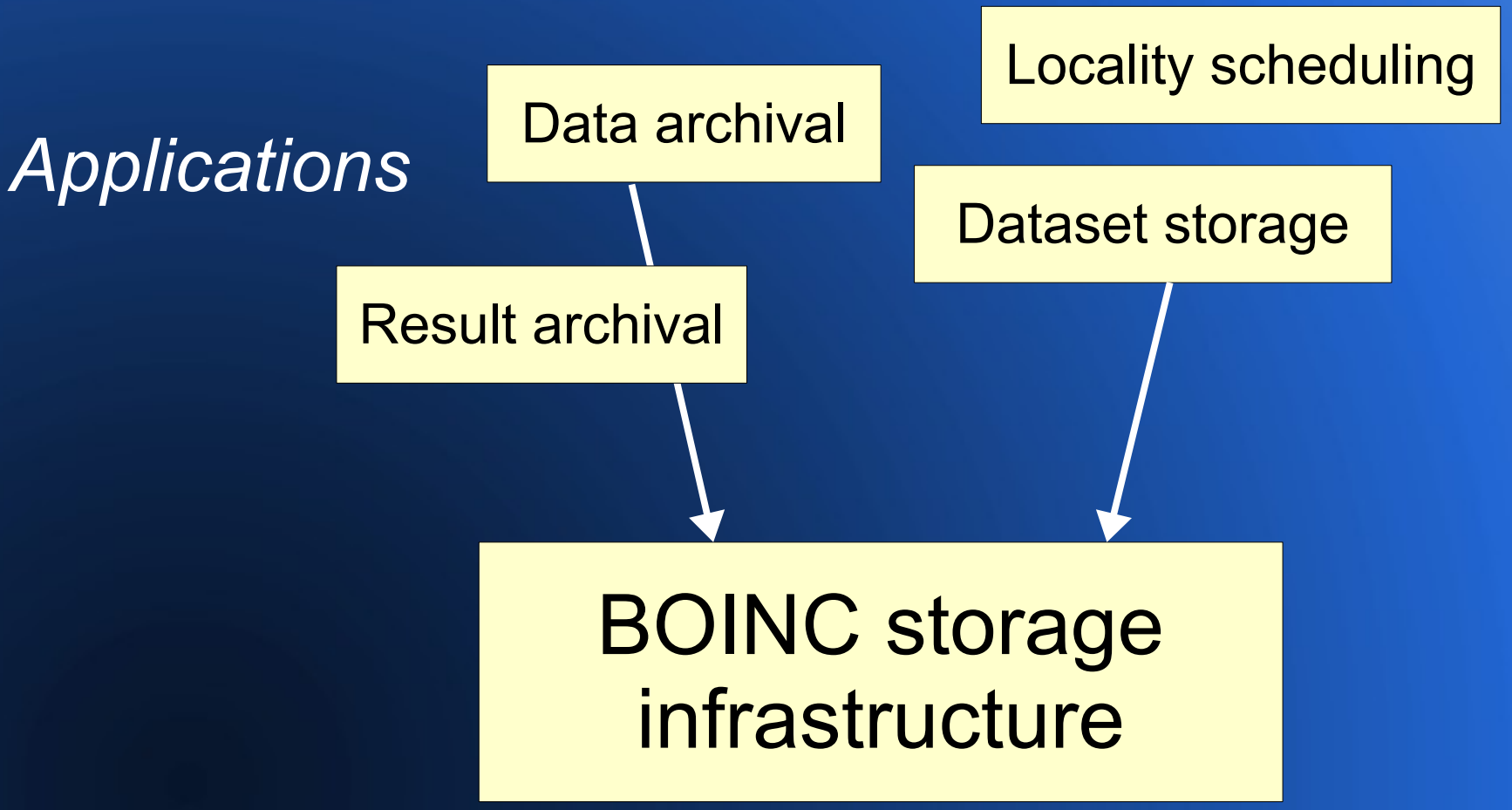
What's new in BOINC?

- Storage and data-intensive computing
- Virtual machine apps
- GPU apps
- Scheduling
- Remote job submission
- Other

Storage and data-intensive computing

- Disk space
  - average 50 GB available per client
  - 35 Petabytes total
- Trends
  - disk sizes increasing exponentially, faster than processors
  - 1 TB * 1M clients = 1 Exabyte

BOINC storage architecture

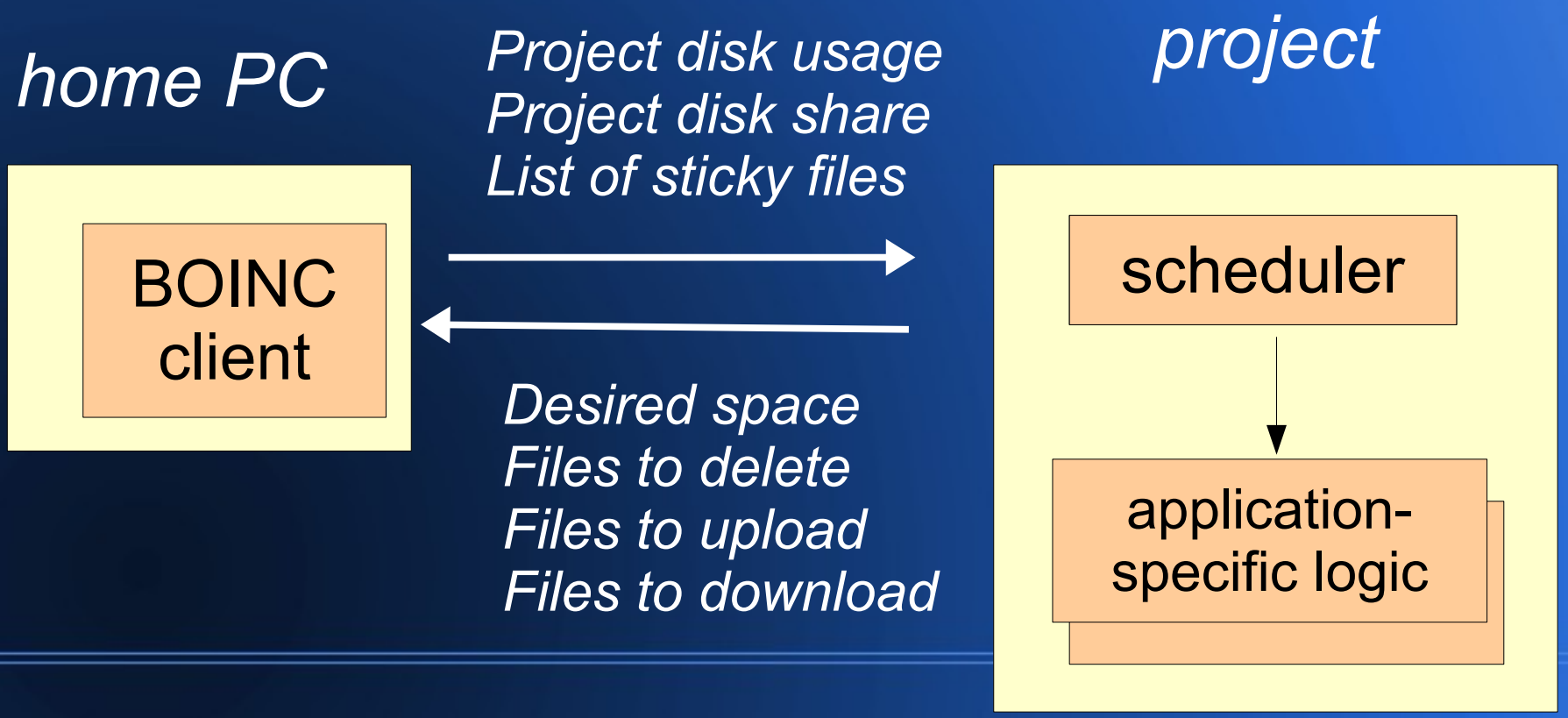


BOINC storage infrastructure: managing client space

- Volunteer prefs determines BOINC's allocation
- Allocation to projects is based on resource share

BOINC storage infrastructure: RPC/server structure

- "Sticky file" mechanism



Volunteer data archival

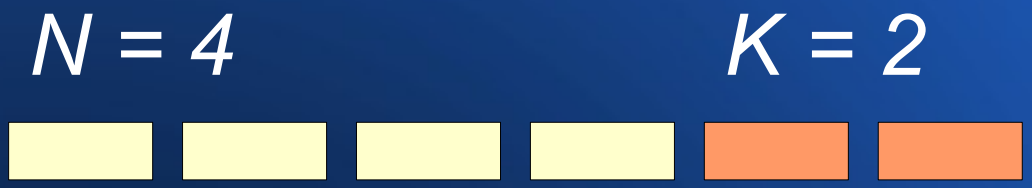
- Files originate on server
- Chunks of files are stored on clients
- Files can be reconstructed on server (with high latency)
- Goals:
  - arbitrarily high reliability (99.999)
  - support large files

Replication

- Divide file into N chunks
- Store each chunk on M clients
- If a client fails
  - upload another replica to server
  - download to a new client
- Problems
  - high space overhead

Erasure Coding

- A way of dividing a file into N+K chunks

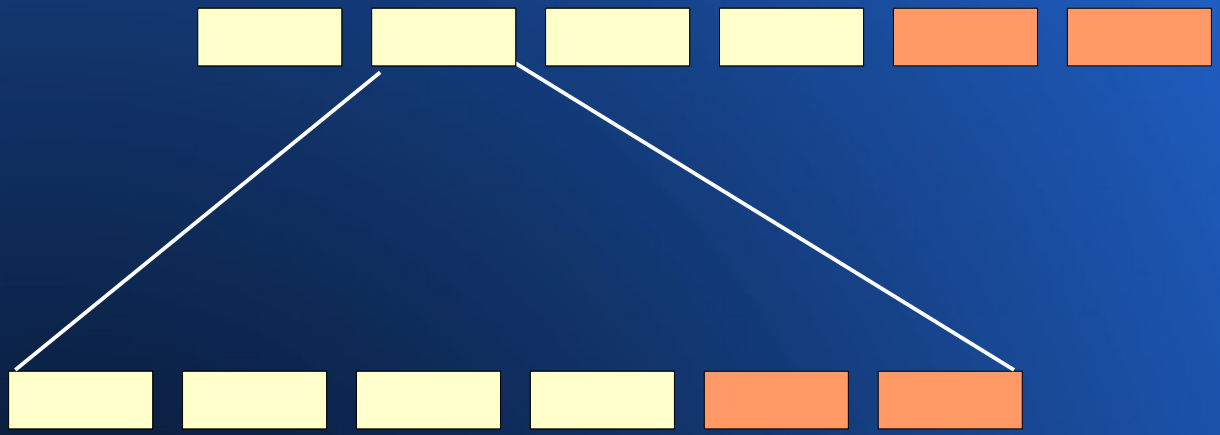


- The original file can be reconstructed from any N of these chunks.
- Example: N=40, K=20
  - can tolerate simultaneous failure of 20 clients
  - space overhead is only 50%

Problems with erasure coding

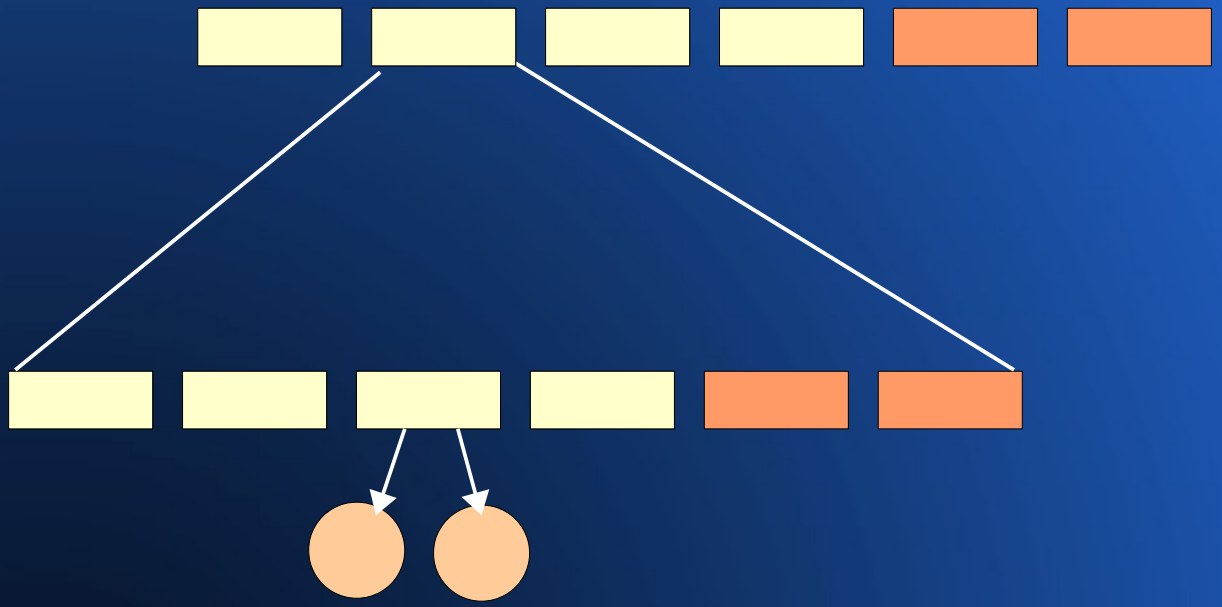
- When any chunk fails, need to upload all other chunks to server
- High network load at server
- High transient disk usage at server

Two-level coding



- Can tolerate K^2 client failures
- Space overhead: 125%

Two-level coding + replication



M = 2

- Most recoveries involve only 1 chunk
- Space overhead: 250%

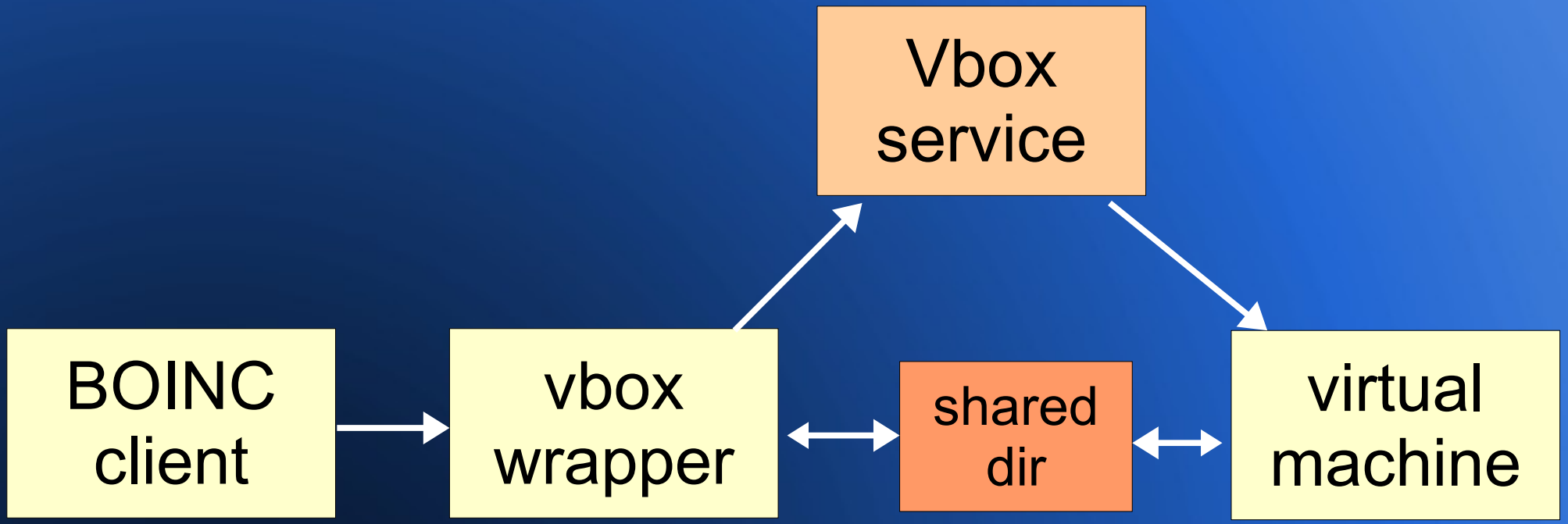
VDA Implementation

- DB tables
  - vda_file
  - vda_chunk_host
- Scheduler plugin
  - handle transfers, sticky file list
- VDA daemon
  - process files needing update, dead hosts
- Emulator
  - compute performance metrics

Support for large files

- Restartable download of compressed files
  - include <gzip/> in <file_info>
  - currently only for app version files
- Combine uncompress, verify
- Asynchronous file copy, uncompress/verify
  - 10MB threshold
- Handle > 2GB files; use stat64()

VM app support



VM app support

- Use Vbox “snapshot” mechanism for checkpointing
- Report non-ancestral PID (VM) to client
- Report network traffic to client
- Use Remote Desktop Protocol to allow user to view console
- CPU throttling
- Multicore

GPU app support

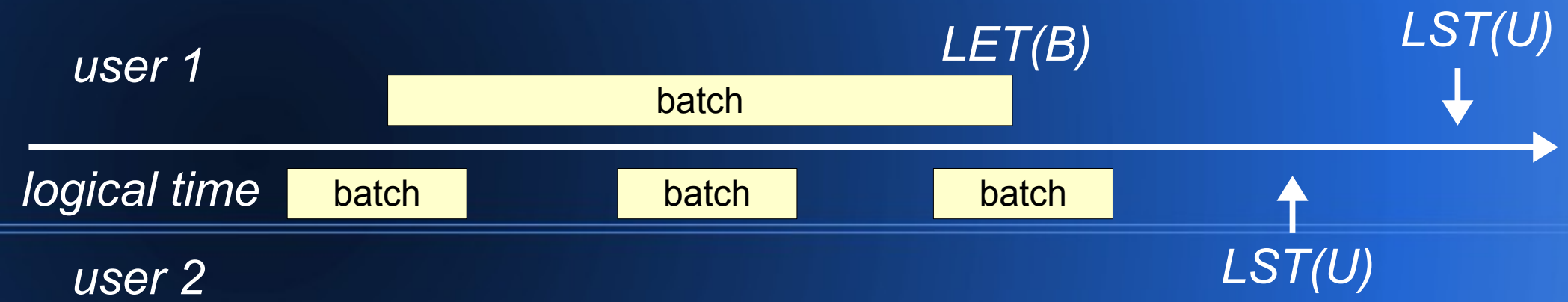
- Pass device type and number in init_data.xml
- OpenCL initialization: boinc_get_opencl_ids()
- Plan classes configurable in XML file

Scheduling: batch-level (proposed)

- Policy: feeder enumeration order
- Goals
  - Give short batches priority over long batches
  - But don’t let a stream of short batches starve long batches
  - enforce user quotas over long term

Scheduling: batch-level

- Each user has “logical start time” LST(U)
  - when submit batch, increment by expected runtime / share(U)
- Each batch has “logical end time” LET(B)
  - set to LST(U) + expected runtime
- Give priority to batch for which LET(B) is least



Scheduling: job-level

- Policies
  - feeder enumeration order
  - job selection from shared mem cache
  - choice of app version
  - deadline assignment
- QoS types
  - non-batch, throughput-oriented
  - Long-deadline batches
  - As fast as possible (AFAP) batches
  - short-deadline batches

Scheduling: job-level

- Goals
  - accelerate batch completion
  - avoid tight job deadlines
  - avoid long delays between instances
  - minimize server configuration

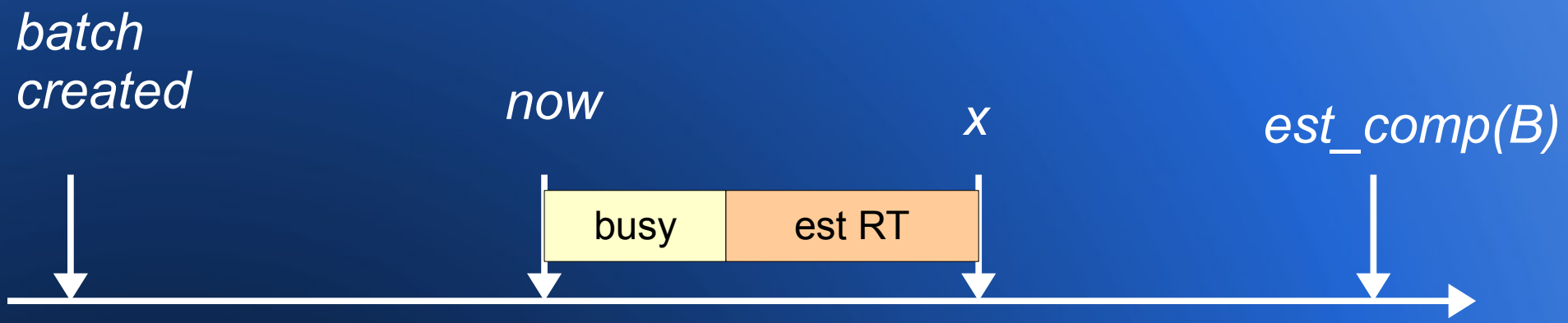
Scheduling: job-level

- For each (host, app version) maintain percentile incorporating
  - average turnaround time
  - consecutive valid results
- Dynamic batch completion estimation
  - based on completed and validated jobs

Scheduling: job-level

- Feeder enumeration order
  - LET(J) ascending, # retries descending

Scheduling: job-level

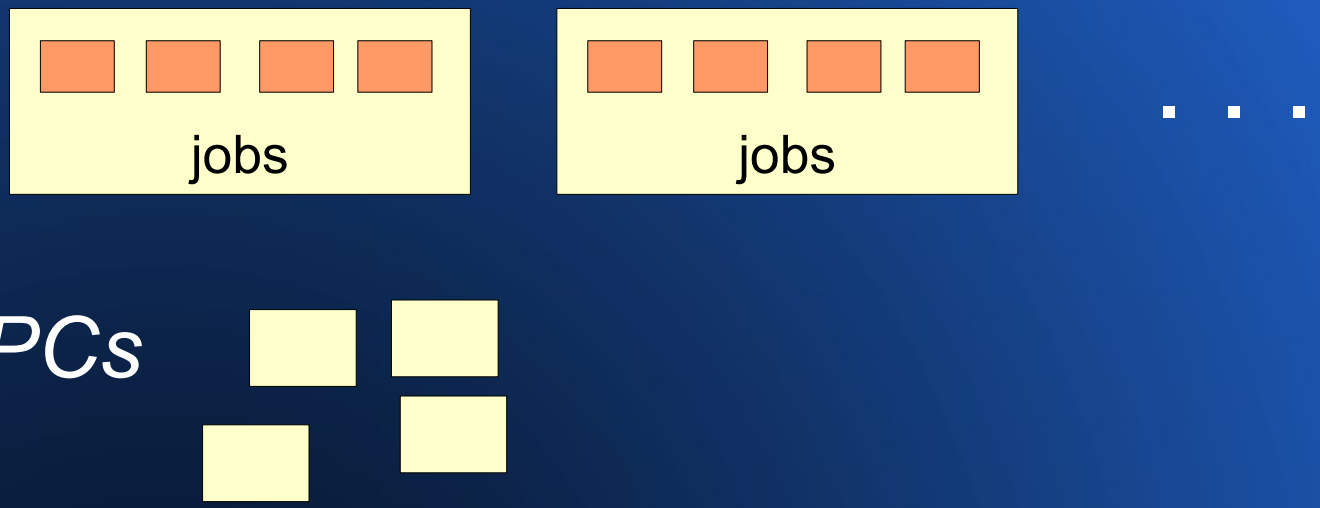


- For each job
  - for each usable app version AV
    - if x < est_completion(B)
      - send job using AV with deadline est_completion(B)
    - else if percentile(H, AV) > 90%
      - send job using AV with deadline x

Locality scheduling

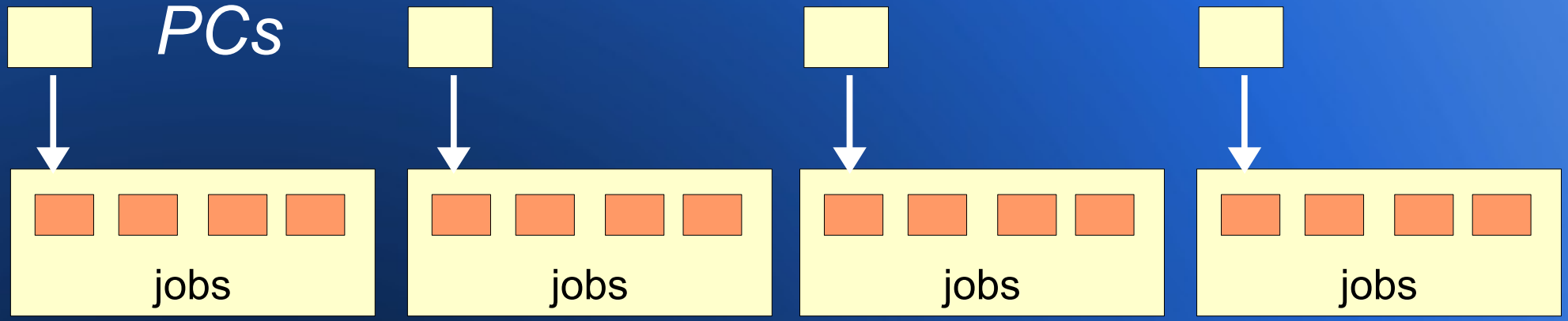
- Have a large dataset
- Each file in the dataset is input for a large number of jobs
- Goal: process the dataset using the least network traffic
- Example: Einstein@home analysis of LIGO gravity-wave detector data

Locality scheduling



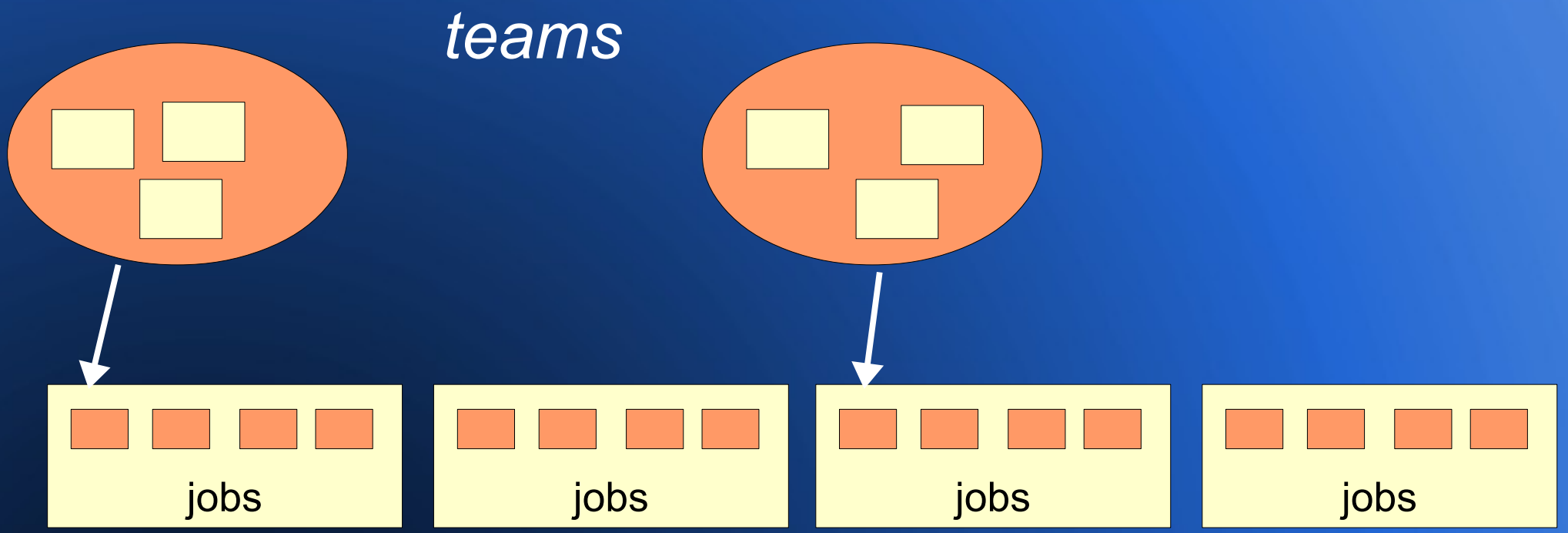
- Processing jobs sequentially is pessimal
  - every file gets sent to every client

Locality scheduling: ideal



- Each file is downloaded to 1 host
- Problems
  - Typically need job replication
  - Widely variable host throughput

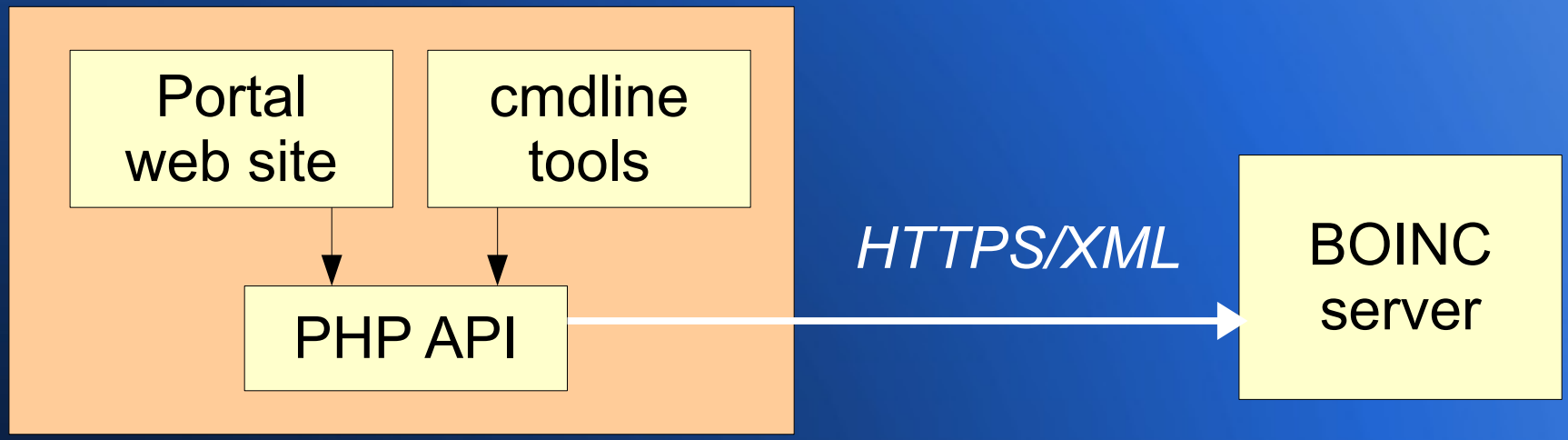
Locality scheduling: proposed



Locality Scheduling Lite

- Optional feature of existing scheduler
- Use when # files < # shared-mem slots

Remote job submission



- Operations
  - estimate, submit, query, abort, get result files, retire

Remote job submission

- Input file options
  - local: file already exists on server
  - inline: file is passed in request XML
  - semilocal: file is accessible via HTTP from server; server fetches and serves it
  - remote: file is on a server accessible to clients; must supply size and MD5

Broadcast and targeted jobs

- Broadcast jobs
  - run once on all hosts, present and future
  - can limit to user or team
  - Not handled by validator or assimilator
- Targeted jobs
  - targeted to a host, user, or team
  - handled by validator, assimilator
  - can do this when create job, or dynamically

Git migration

- Branches
  - master (development)
    - new code goes here
  - server_stable
    - hot fixes may go here
  - client_release_X_Y
    - hot fixes may go here

Other things for CERN T4T

- Web-based app graphics
  - app implements an HTTP server
  - port is conveyed to Manager
  - “app graphics” opens a browser window
- “need network” app version flag
  - don’t run if network not available

New OS support

- Windows 8
- Mac OS X 10.8
  - Xcode 4.5
- Debian 6.0
- Android

Large DB IDs

- SETI@home has done > 2B jobs
- made IDs unsigned (31->32 bits)
- eventually will need to move to 64 bit

Validator

- Runtime outlier flag
  - don’t use this job in runtime, credit statistics
- Test harness
  - validator_test file1 file2

BOINC in app stores

- Operated by OS vendors (Apple, MS, Google)
- Vendor screen apps and takes a cut
- Goal: package BOINC for app stores
  - and maybe project-specific versions

Didn’t get done

- OpenID support
- remodel computing preferences