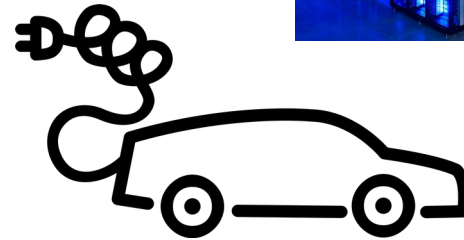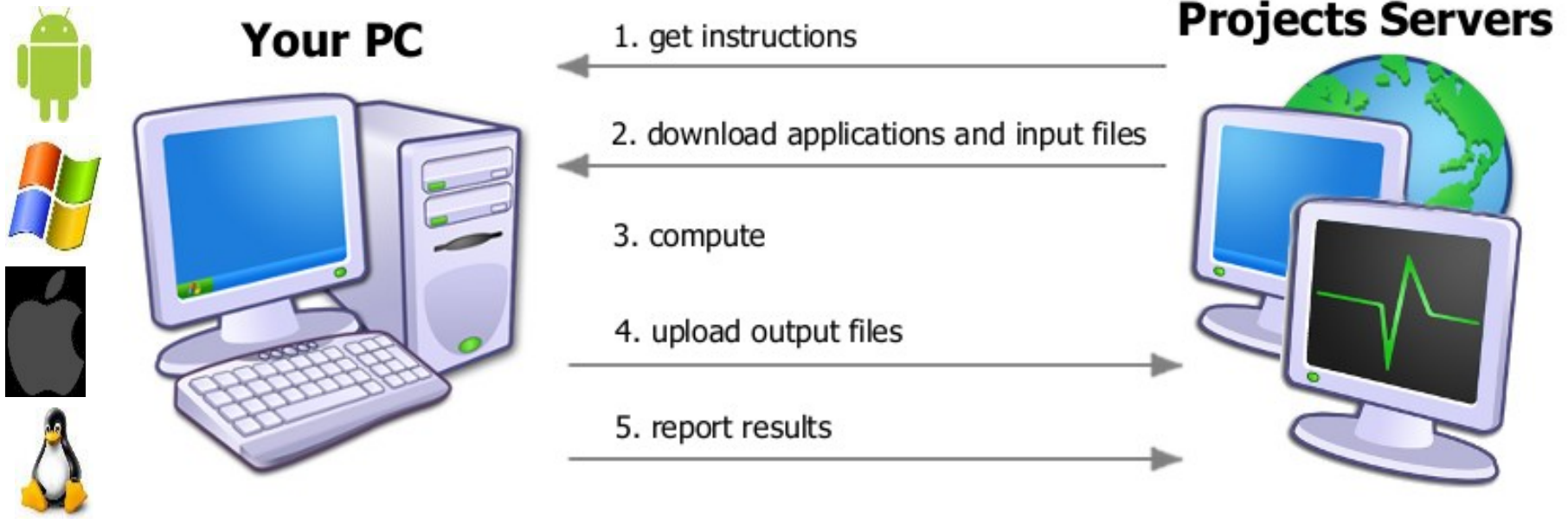# Open Source: BOINC

Laurence Field

Volunteer Computing

- Computer owners donate computing capacity
  - To a cause or project
- Spare cycles on computers
  - Away from office/desk, unused cores
- Other opportunistic resources
  - Idle machines in data centers
  - IoT?
  - Opportunistic energy?
  - Cars e.g. V2G?

How It Works

- Download and run the client
- Select a project
- Enter an email address and password
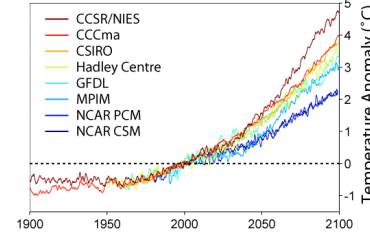- Run the application and earn credit

Your PC

Projects Servers

1. get instructions
2. download applications and input files
3. compute
4. upload output files
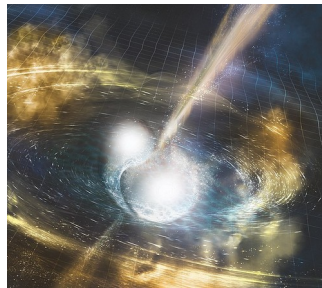5. report results

Microbiome Immunity Project   OpenZika   Help Stop TB

FightAIDS@Home - Phase 2   Mapping Cancer Markers

Motivation

- Free* resources
  - 100K hosts achievable for large projects
  - Actual job slot count (number of cores) is higher
- Community engagement
  - Outreach channel
    - Explaining the purpose and value of the science
  - Participation
    - Offering people a chance to contribute
    - Engagement forms a strong bond
- Community support

*There are costs associated with their use

Challenges

- The cost of using the free resources
  - Initial integration requires investment
- Operations and Maintenance
  - Public facing support on all levels
    - Lowered by community supports
- Attracting and retention of volunteers
  - Advertisement and engagement
  - Communications cost for capacity building
- Low level of trust
  - Anyone can register as a volunteer
  - Not the same as internally owned systems
- Running scientific software on Windows
  - ~80% of the resources

Computing Workflow

Detector

Online trigger and filtering

Selection & reconstruction

Offline Reconstruction

Event reprocessing

Event simulation

Offline Simulation w/GEANT4

Event summary data

Processed Data (Active tapes)

Batch physics analysis

Offline Analysis

Analysis objects (extracted by physics topic)

Interactive analysis
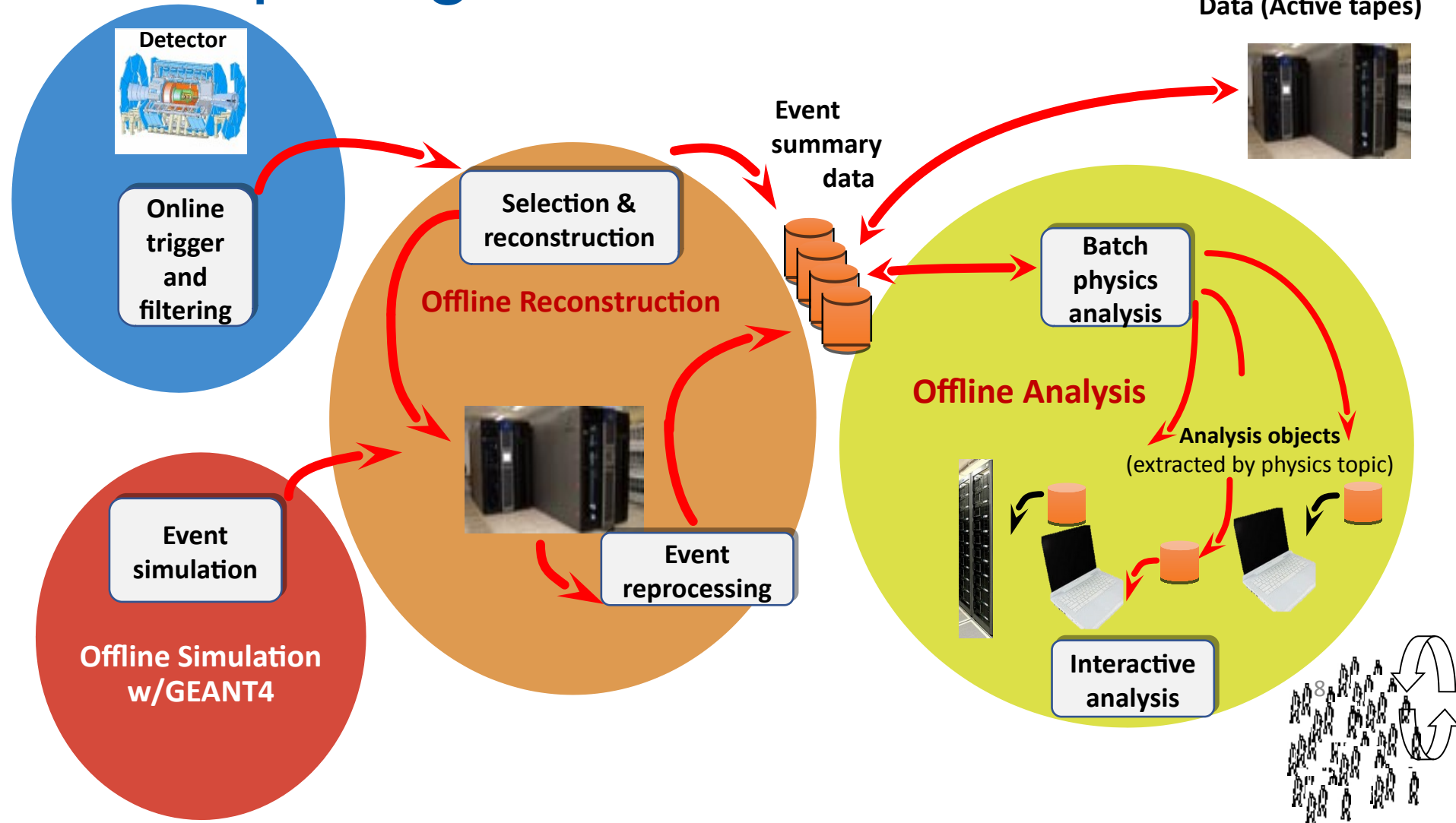
Applications

|	
	ATLAS@home "Known" physics and "new" phenomena - want to create alternative models of the universe?
	Beauty "b" is for "Beauty" - the gorgeous little particle in antimatter physics.
	CMS@Home CMS is on the lookout for completely new, unpredicted phenomena.
	SixTrack Help CERN accelerator engineers to run intensive simulations to check the stability of the twin proton beams circulating in the LHC machine.
	Test4Theory Simulate high-energy particle collisions and help tune the theory to the experimental results.

Our Usage of BOINC

- One project with multiple applications
  - Reduce operational costs
    - Single forum
    - One service
  - Simplify for the volunteers
    - One project
    - Single user name and password
- Classic and virtualized applications
  - Sixtrack
  - Test4thoery, ATLAS, CMS, LHCb and ALICE
    - Because HEP software only runs on Linux

BOINC with Virtualization
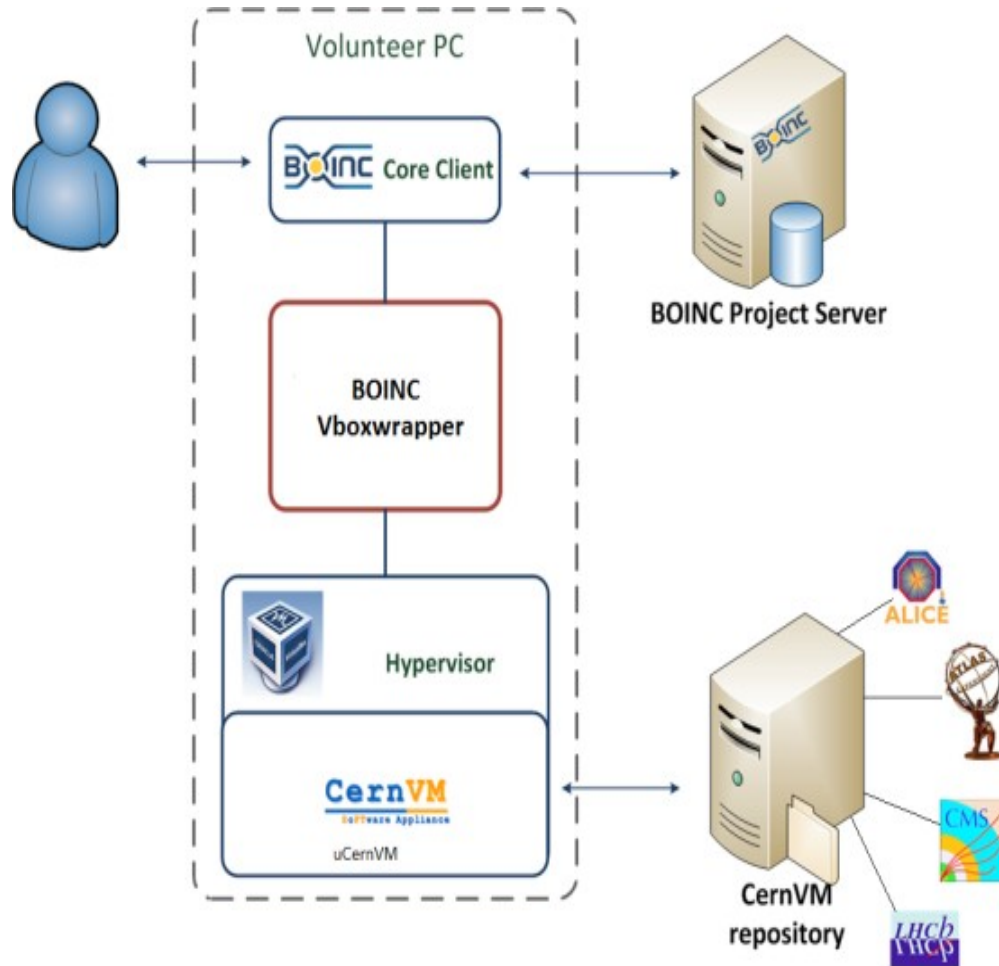
CernVM and CVMFS
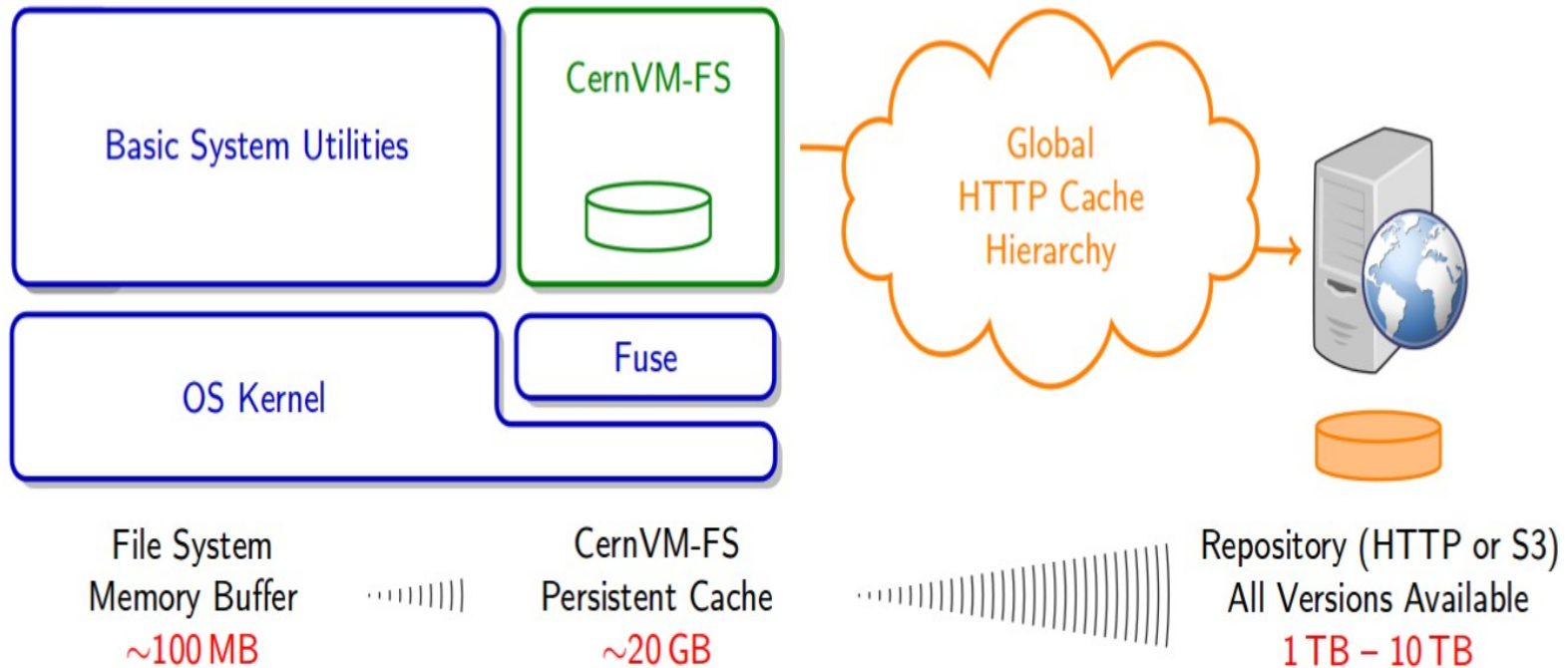
Small image size but need to "bake" the images to reduce unnecessary downloads

CDN: Cloudflare/OpenHTC.io

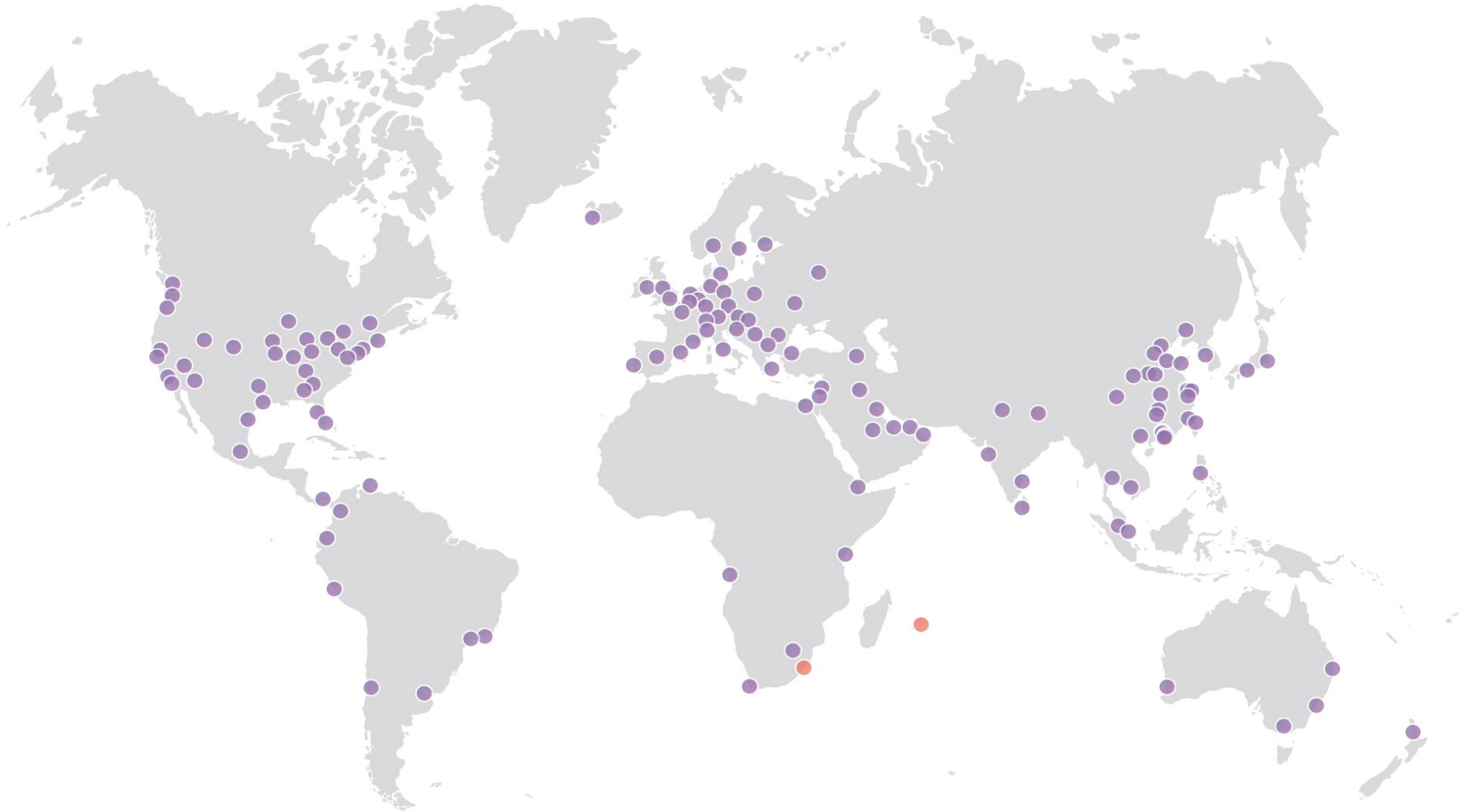# CMS@home Job Speedup

CloudFare
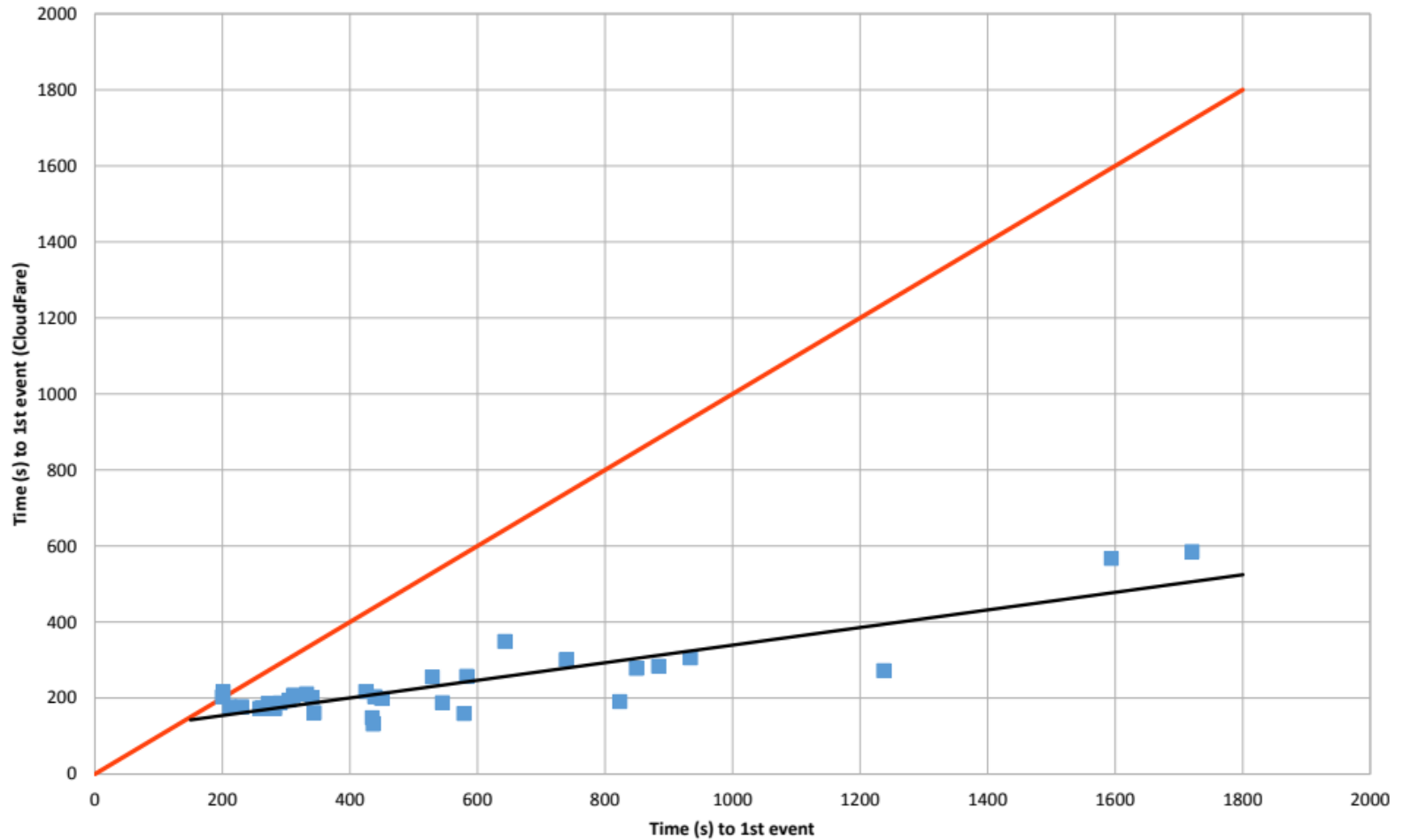
VM Capacity Gap
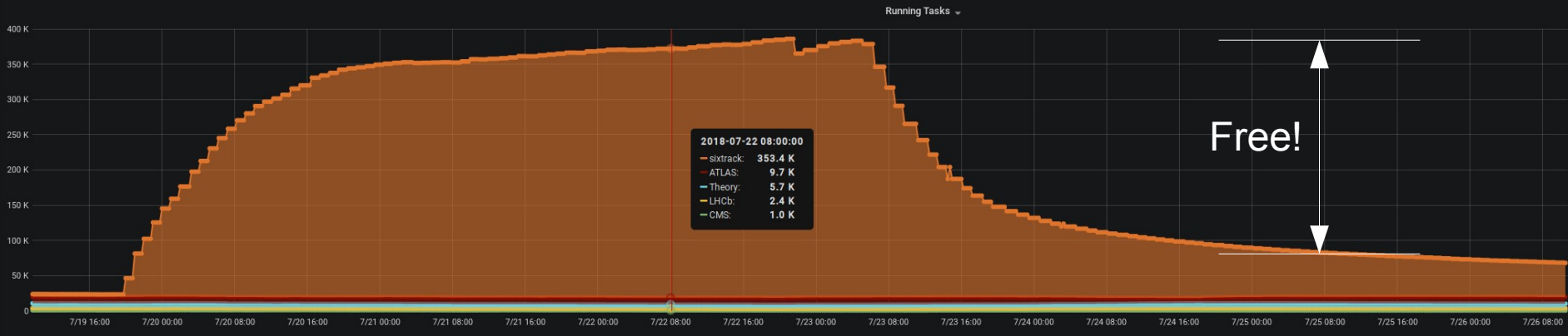
July 2018

Native App

- Remove the VM layer for Linux

  - Requires CVMFS and Singularity

- Persistent CVMFS Cache

  - Jobs directly from the BOINC sever

    - No additional infrastructure required

- Run native on internal resources

- Windows and Mac

  - Run in a Linux VM

    - Provide one pre-configured

  - No local resource management

Platform

- Berkeley Open Infrastructure for Network Computing
  - Started in 2002
    - By a team based at the Space Sciences Laboratory
    - University of California, Berkeley
    - Led by David Anderson
  - Now an open source project
- Provides the toolkit for volunteer computing
  - Client (Mac, Windows, Linux, Android)
  - Graphical User Interface
  - Application runtime system
  - Server software
  - Project Web site

BOINC Community

- Transforming into an open community

  - https://github.com/BOINC/boinc-policy

- Meetings

  - Quarterly projects calls

  - Biweekly dev calls

- GitHub

  - Focal point

  - Facilitating communications

  - Merge Requests from more individuals

    - Actively included

- New server release

  - boinc-docker-server

Open-Source ≠ Open Source

- Open-Source is more than provision
  - It's about empowering
- BOINC Transistion
  - Master → Branch→ Release
  - Branch → Master → Release
  - Managed Team → Collaborating Community
- Community forced change
  - Desired open-source best-practice approach
    - Community defined policies
- More information
  - https://opensource.guide
  - https://www.youtube.com/watch?v=uzxcILudFWM

The Merge Request

- Every change can be peer-reviewed
  - Branch the code from Master
  - Make an atomic change
  - Create a Merge Request
  - Request can be discussed
  - Request accepted/rejected
- Communication
  - Suggestion contribution clearly shown
    - Can add explanations
  - Discussion linked to suggested change
    - Code can be annotated
    - Block changes and make requests
    - Archived for future reference

People Before Code

- Build a community first
  - They will build the code
- Code of Conduct
  - Be respectful
- Create a welcoming environment
  - Clear policies and adherence
    - Documentation!
- Welcome contributions
  - Provide prompt feedback on merge requests
- Quickly identify contentious issues
  - Process for achieving consensus
    - Or have a zero-consensus process

Open-Source As A Model

- Global citizens collaborating to achieve a common goal
  - Demonstrates what is possible
  - Not just volunteers but people from organizations
- How can this be applied to other areas?
  - People
  - Commodity
  - Process
  - Tooling

Summary

- Volunteer Computing can and is providing
    - Significant additional computing resources
        - Potentially O(100K) machines
- Virtualization, Containers and CVMFS enable HEP applications
    - VM capacity gap
- Using CernVM
    - Baked VM to reduce downloading each time the VM is restarted
        - Use openhtc.io for better CVMFS performance
- BOINC is a healthy Open-Source community
    - The Merge Request
    - People Before Code
- Come and join the fun!
    - http://lhcathome.web.cern.ch/join-us
-