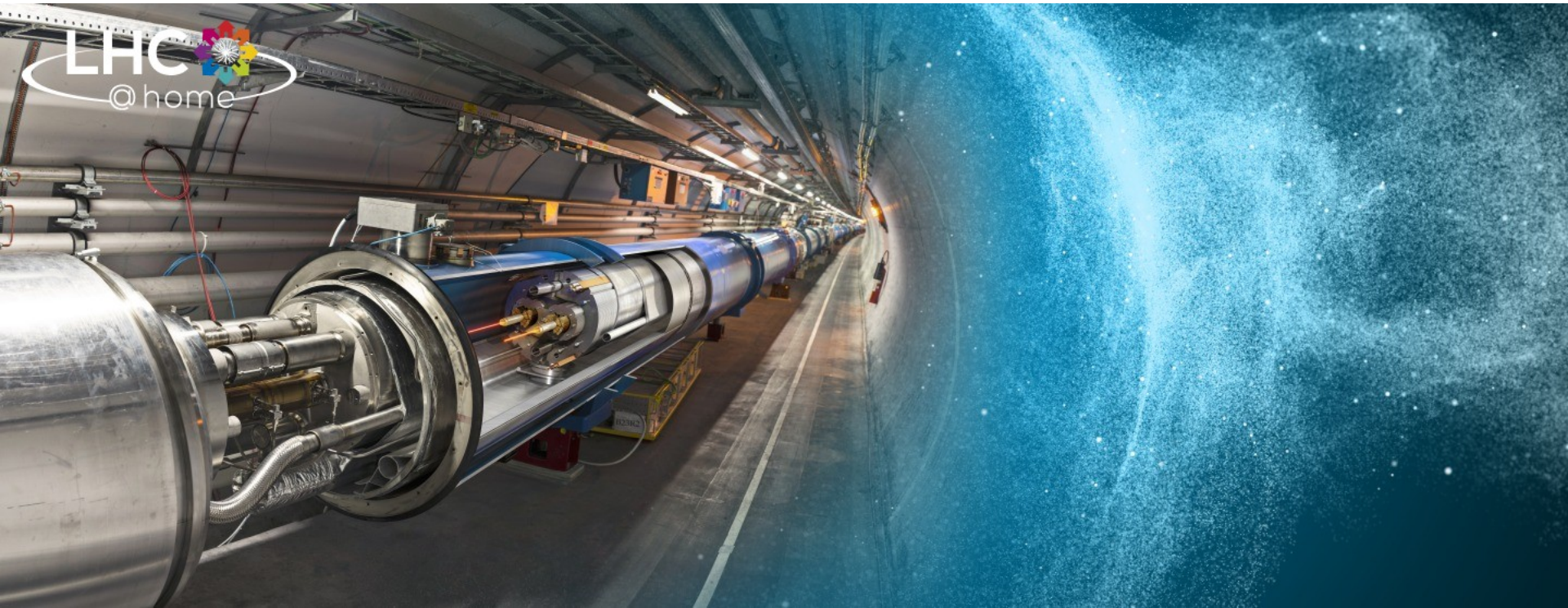# Extending CERN computing to volunteers
LHC@home consolidation and outlook

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CHEP 2018, Sofia

Outline

- Why volunteer computing?
- BOINC overview
- LHC@home
  - History and applications
  - Consolidation
  - Server infrastructure
- Challenges and outlook

Why volunteer computing?

- The WLCG has limited resources
  - Fully committed to LHC data reconstruction and analysis
  - Still need a lot more computing for simulations on smaller data sets

- Use additional free* resources
  - 100K hosts achievable for large projects
    - Support for virtualisation - CernVM

- Community engagement
  - Outreach channel
 - Community participation and support

* Attracting and interacting with volunteers has a cost

BOINC

"Berkeley Open Infrastructure for Network Computing"

- Software platform for distributed computing using volunteered computer resources
- Client – server architecture
- Free and open source
- Used for

  – SETI@home

  – Climateprediction.net

  – Einstein@home

  – LHC@home

  – …

http://boinc.berkeley.edu
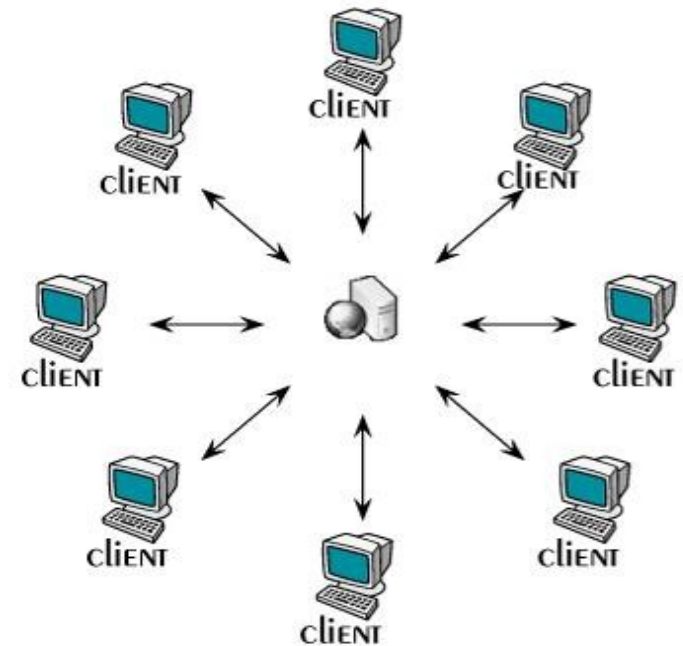
BOINC and Virtualisation
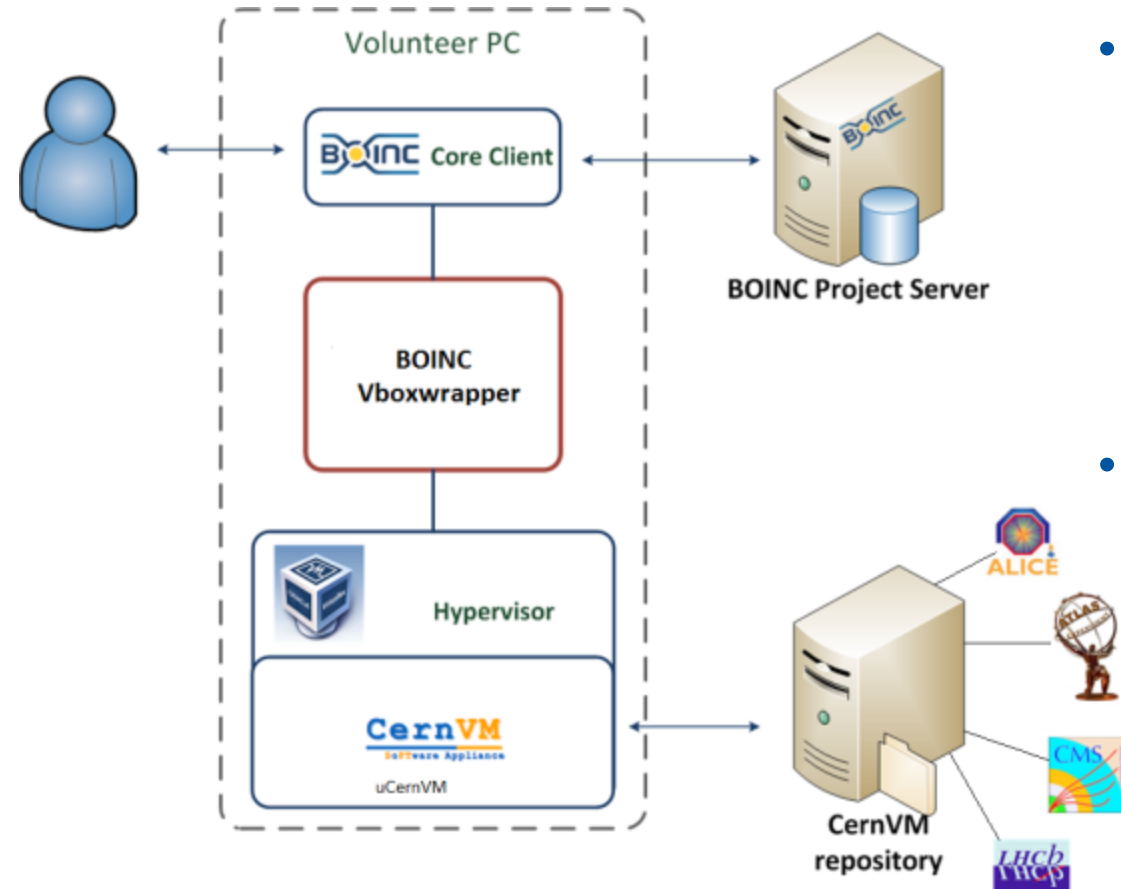
- BOINC distributes VMs to client machines along with a wrapper application

- The BOINC client installation for Windows now includes Virtual Box

- Started with in 2004 for the 50th anniversary of CERN. Running the Sixtrack application for beam simulations of the stability of proton orbits in the LHC accelerator

- Test4Theory was added as a new BOINC project in 2011, it pioneered the use of virtualisation to run physics simulations on a virtual machine (CernVM) on volunteer desktops

- Joined by ATLAS and other LHC experiments from 2014, also using CernVM and CernVMFS, a distributed http file system

- Effort to streamline and consolidate individual initiatives on separate BOINC projects to a common project and to integrate with regular simulation workflows as well as batch computing infrastructure

- ## LHC@home consolidated
  - A single BOINC project with multiple applications

    - Accelerator physics simulations (Sixtrack) as native BOINC app

    - Simulations from ATLAS, CMS, LHCb and Theory running under CernVM and VirtualBox

    - Job management backend integrated with HTCondor – potentially wide range of (low-IO/high CPU) applications

Applications

- **Sixtrack** (beam simulations) Native BOINC application, Linux, MAC, Windows and Android

- **Theory** (MC events) running under CernVM in Virtual Box on Linux, MAC and Windows

- **ATLAS** (Event simulations), available as native BOINC application for Linux, or under CernVM in Virtual Box on Linux, MAC and Windows

- **LHCb** (Beauty physics simulations) running under CernVM in Virtual Box on Linux, MAC and Windows

- **CMS** (Event simulations) running under CernVM in Virtual Box on Linux, MAC and Windows

LHC@home server setup

- Server setup now scalable
    - Load-balanced web front end

    - Dedicated file upload/download servers

    - Legacy assimilation and validator server for Sixtrack

- Remote submission from HTCondor
    - Implemented for Sixtrack using Boinc-Condor GAHP

    - Run Condor directly in VM for other applications

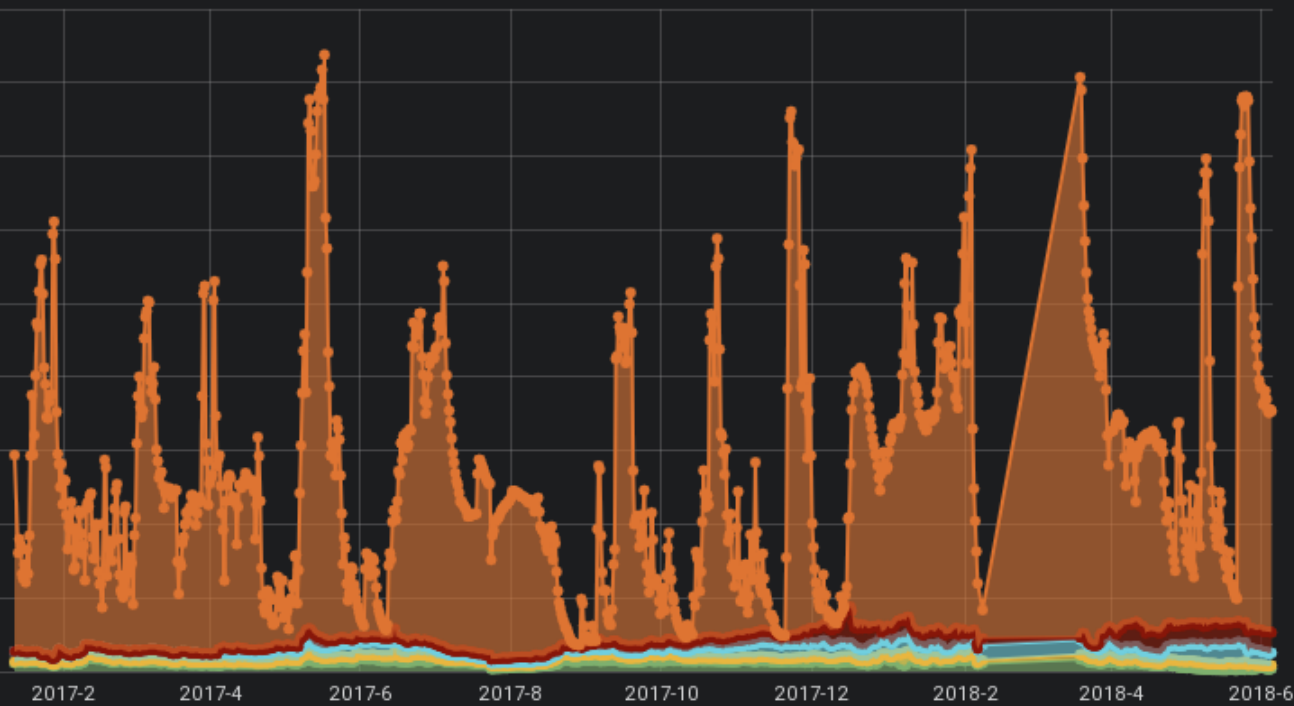   - ATLAS via ARC-CE and shared file buffer

The Vacuum Model

CernVM

Agent

Experiment Framework
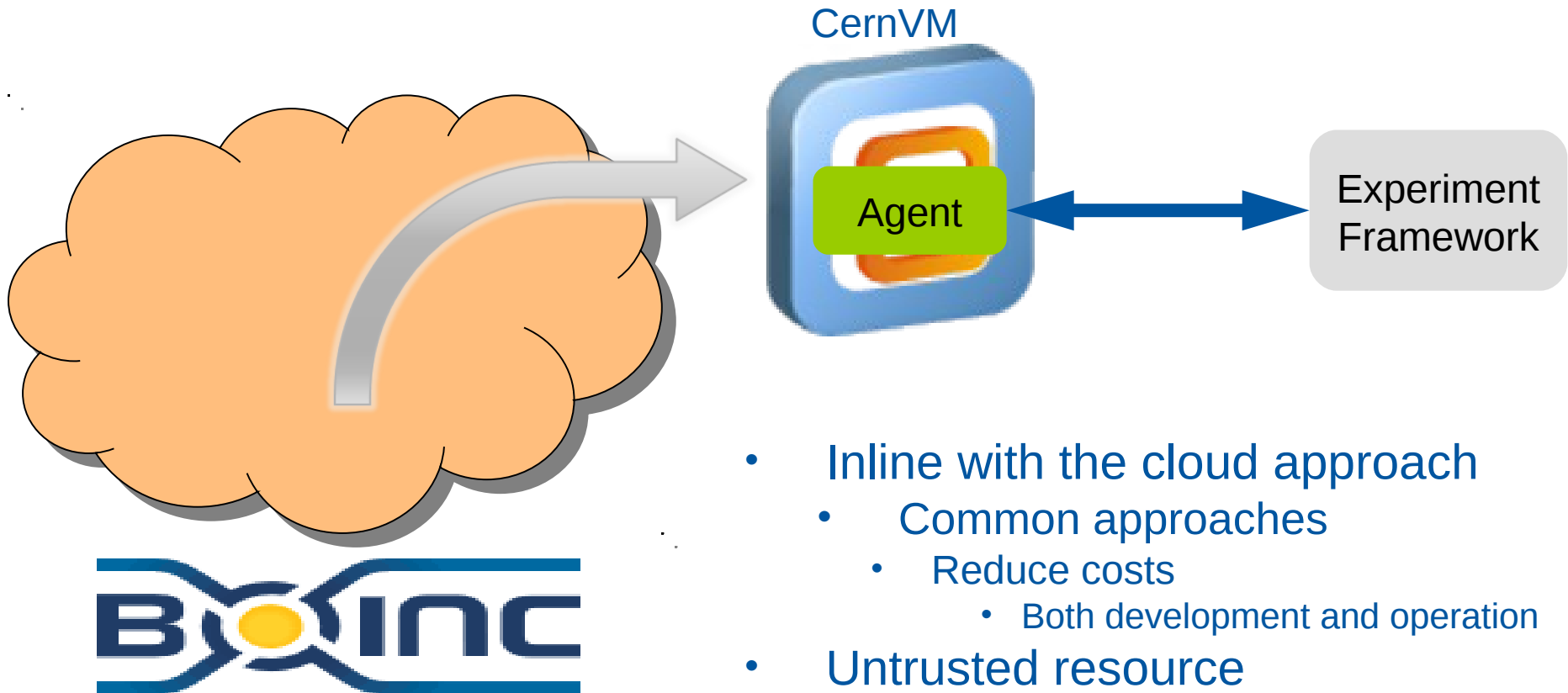
- Inline with the cloud approach
  - Common approaches
    - Reduce costs
      - Both development and operation
- Untrusted resource
  - Authentication – VCCS (Volunteer CA)
  - Validation – DataBridge or BOINC

LHC@home Service Statistics

Running Tasks

	min	max	avg	current
CMS	920.0	10.1 K	5.8 K	1.9 K
LHCb	621.0	9.0 K	2.7 K	2.1 K
Theory	1.7 K	14.7 K	7.0 K	8.6 K
ATLAS	996.0	24.3 K	7.1 K	13.8 K
sixtrack	375.0	397.4 K	114.8 K	150.4 K

Volunteer computing challenges

- Volunteer base not increasing
  - Competition from Bitcoin mining a real issue
  - More use of mobile devices

- BOINC community stable
  - Important to evolve the software stack and keep engaging with the community

- Institute desktops and idle server machines have an unexploited potential
  - Ref. ATLAS talk in this track

BOINC community contributions

- The BOINC software moved from Berkeley to Github in 2016 and now follows a community Open Source governance mode

- The LHC@home team at CERN has contributed to the new governance model and the BOINC workshop in Paris last year where an improved community model was bootstrapped

- New WebRTC BOINC client GUI (proof of concept) as alternative to native GUI

- Maintenance of RedHat/Fedora BOINC client, now at 7.10.22

- Other contributed BOINC code updates have been bug fixes and improvements to the BOINC server components (e.g. for scheduling, HTCondor gateway and GDPR compliance)

- The future of BOINC depends on contributions from the community of BOINC projects!

References

- http://cern.ch/lhcathome
- http://boinc.berkeley.edu

Questions?

www.cern.ch