Challenges for HPC in HEP
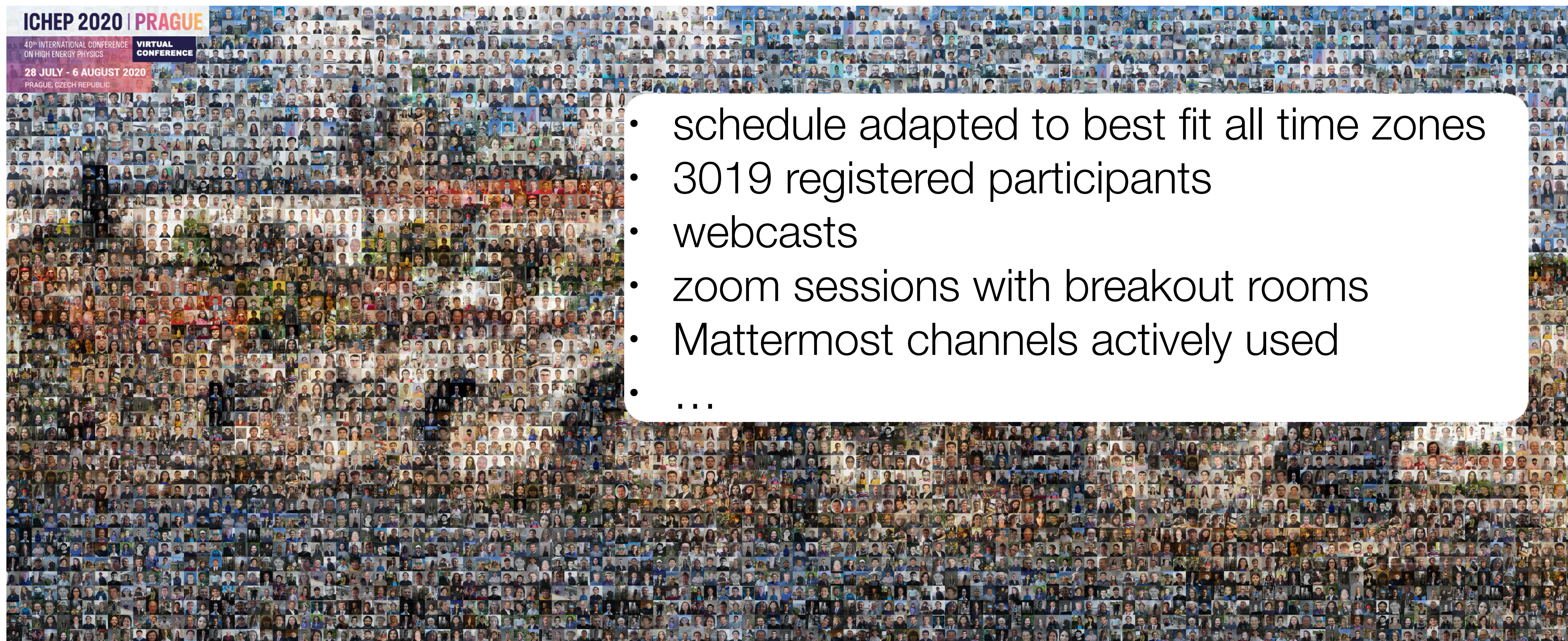
E.Elsen

PRACE-CERN-GÉANT-SKAO Kick-off workshop on High Performance Computing, Sep 29, 2020
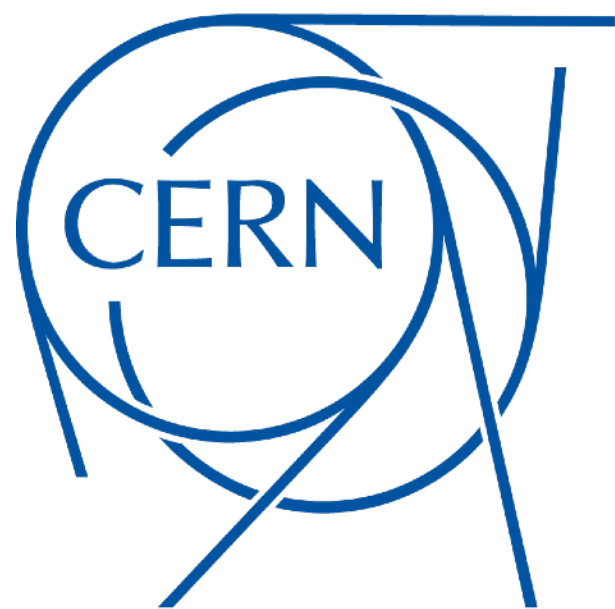
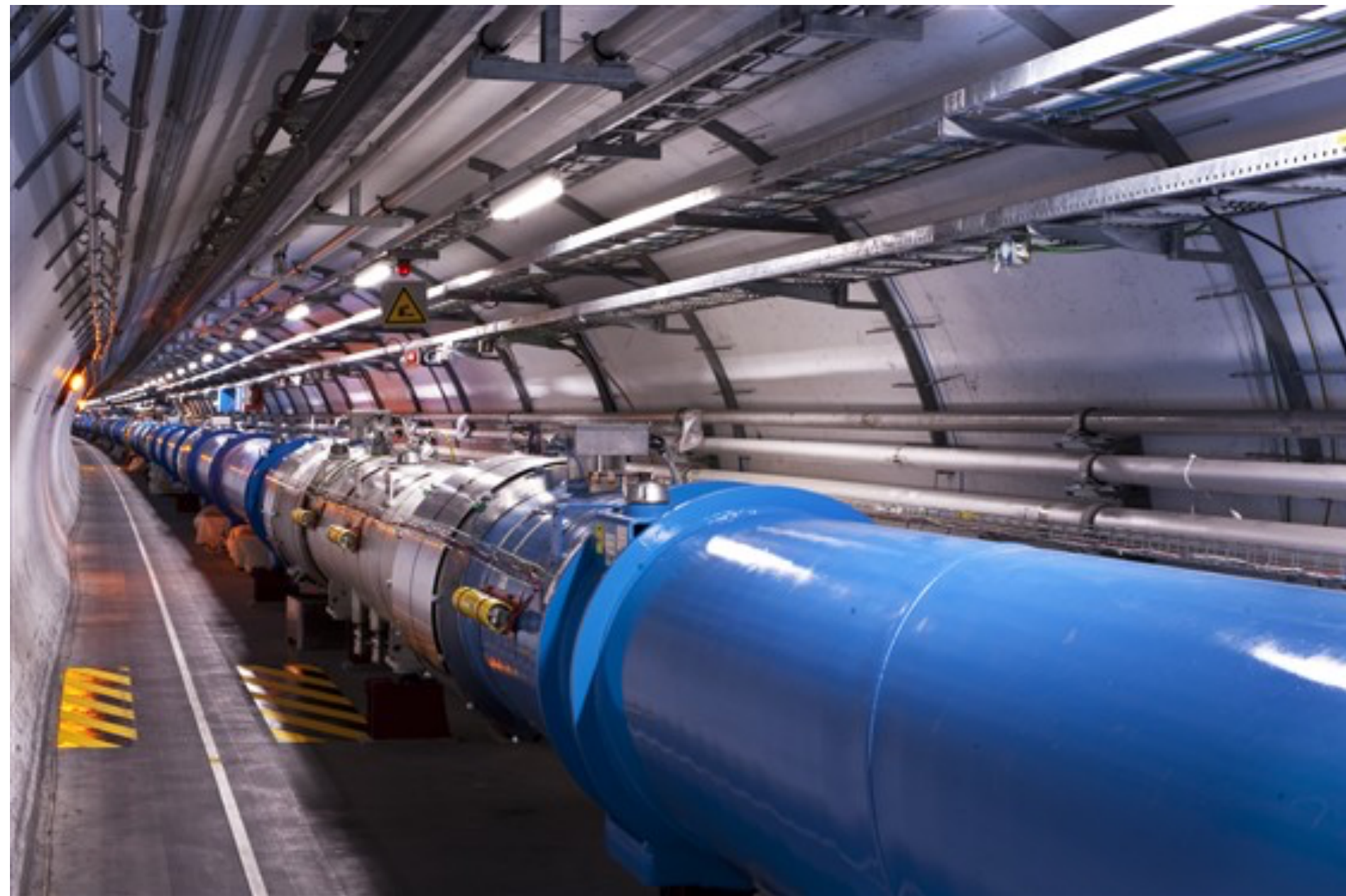Physics infrastructures continue to be on the vanguard of computing
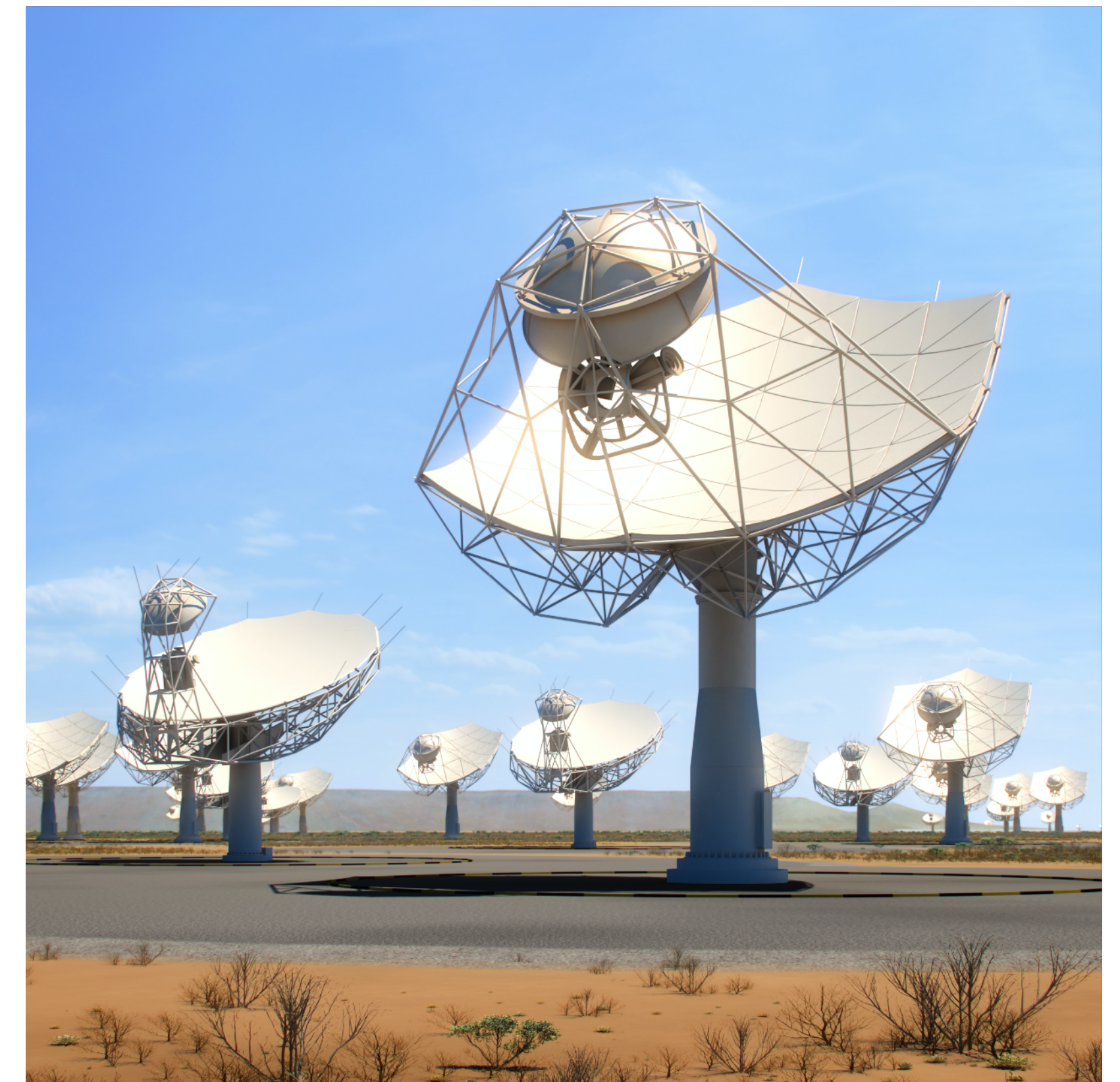
ICHEP 2020 in Prague – virtually

- schedule adapted to best fit all time zones
- 3019 registered participants
- webcasts
- zoom sessions with breakout rooms
- Mattermost channels actively used
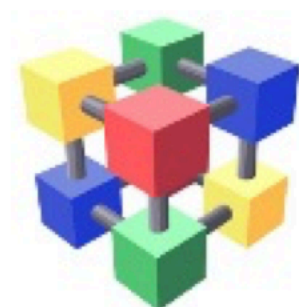- …

LHC / HL-LHC and the SKA as examples

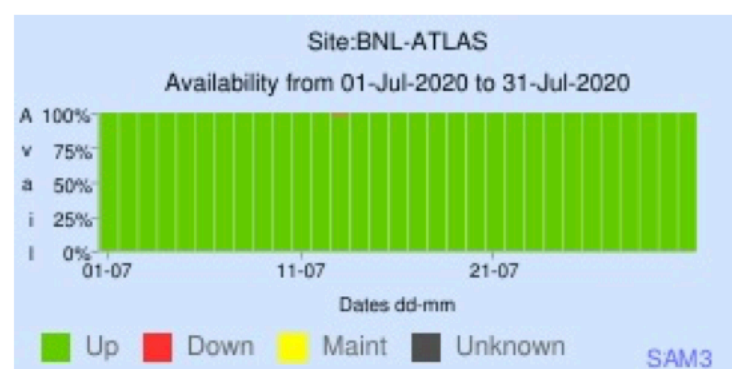LHC

SKA

WLCG as an example of the working infrastructure

Availability of WLCG Tier-0 + Tier-1 Sites

ATLAS

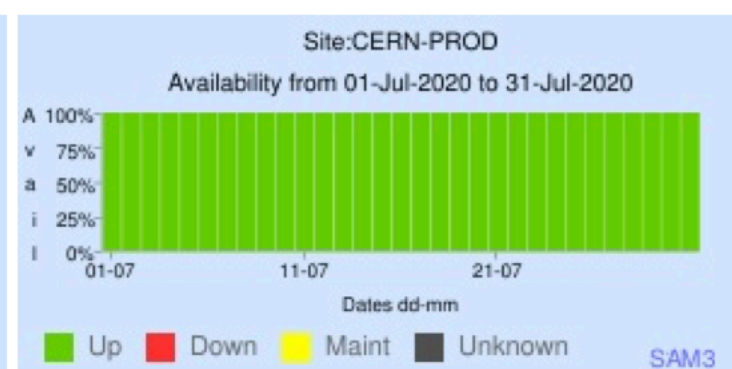Target Availability for each site is 97.0%. Target for 8 best sites is 98.0%

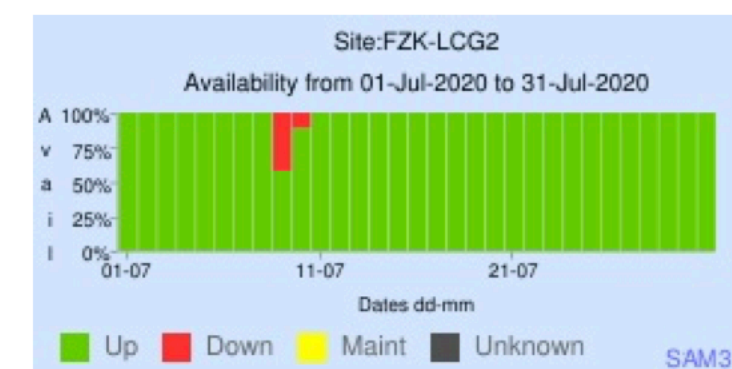Availability Algorithm: (CREAM-CE + ARC-CE + HTCONDOR-CE + GLOBUS) * (all SRMv2 + all SRM + all GRIDFTP)
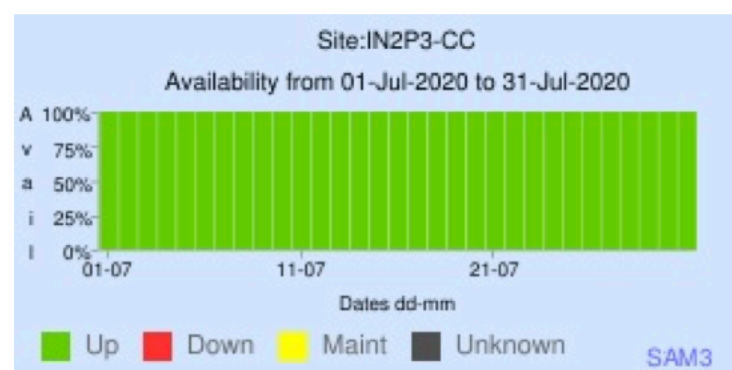

BNL-ATLAS   Avail: 100% Unkn: 0% BNLLAKE   Avail: 100% Unkn: 0% CERN-PROD   Avail: 100% Unkn: 0% FZK-LCG2   Avail: 98%   Unkn: 0%
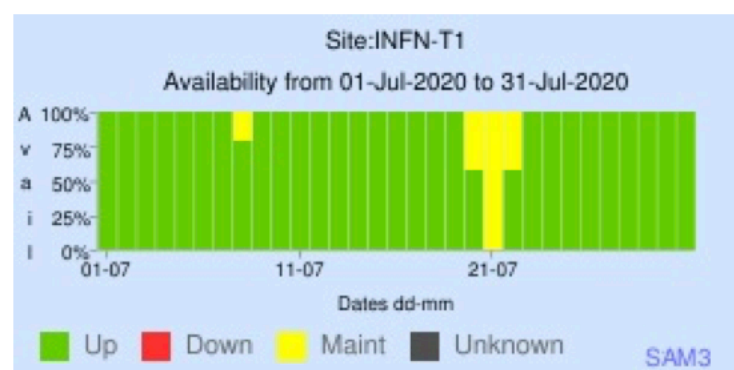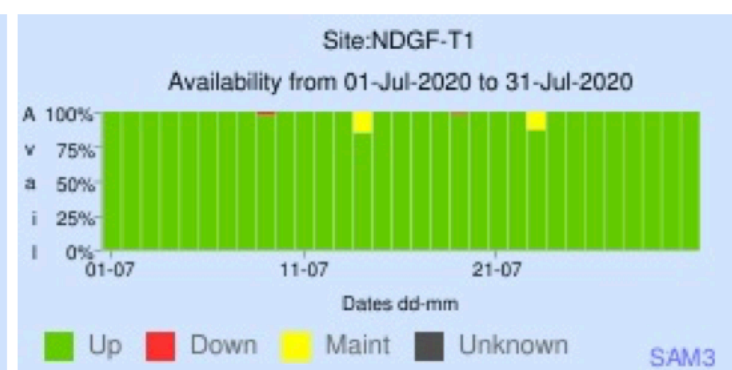
IN2P3-CC   Avail: 100% Unkn: 0% INFN-T1   Avail: 93%   Unkn: 0% NDGF-T1   Avail: 99%   Unkn: 0% NIKHEF   Avail: 100% Unkn: 0%
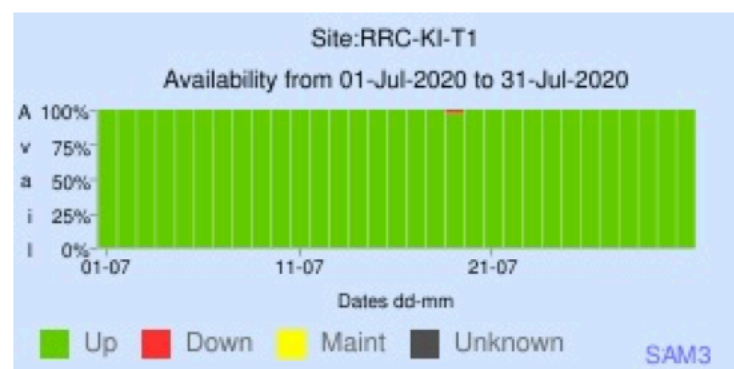
RAL-LCG2   Avail: 100% Unkn: 0% RRC-KI-T1 Avail: 100% Unkn: 0% SARA-MATRIX Avail: 86%   Unkn: 0% TRIUMF-LCG2 Avail: 99%   Unkn: 0%
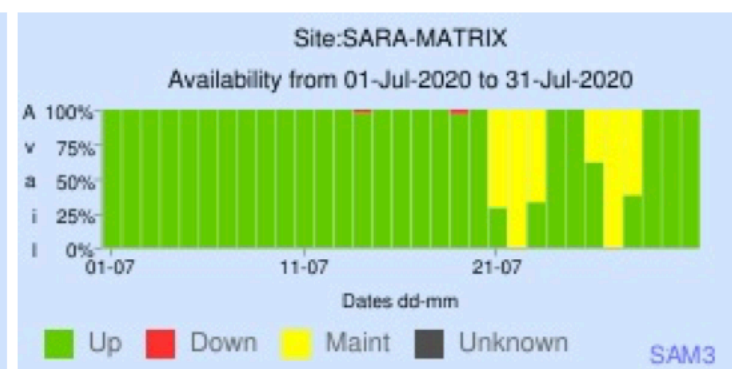
Taiwan-LCG2 Avail: 100% Unkn: 0% pic   Avail: 100% Unkn: 0%

Paradigm change in computing

- After two decades of the unique X86 platform we have entered the phase of heterogenous platforms again

  - Heterogenous systems were the rule in the period 1980 - 2000

- Heterogenous systems are a necessity now when we enter more complex computing architectures

  - CPUs from vendors

  - specialised architectures (SoC)

  - GPUs, FPGAs and dedicated processing units e.g. for ML

    - we should also prepare for the use of quantum algorithms

Example: Online systems of the LHC Experiments

- The online/offline (O2) system of the ALICE experiment will be based on CPU and GPUs performing the TPC reconstruction on the fly using Infiniband

- The LHCb will abandon its hardware trigger and replace the system by a GPU based online filter

- CMS and ATLAS are introducing GPU based triggers and reconstruction

- The offline computing is adapting as a whole
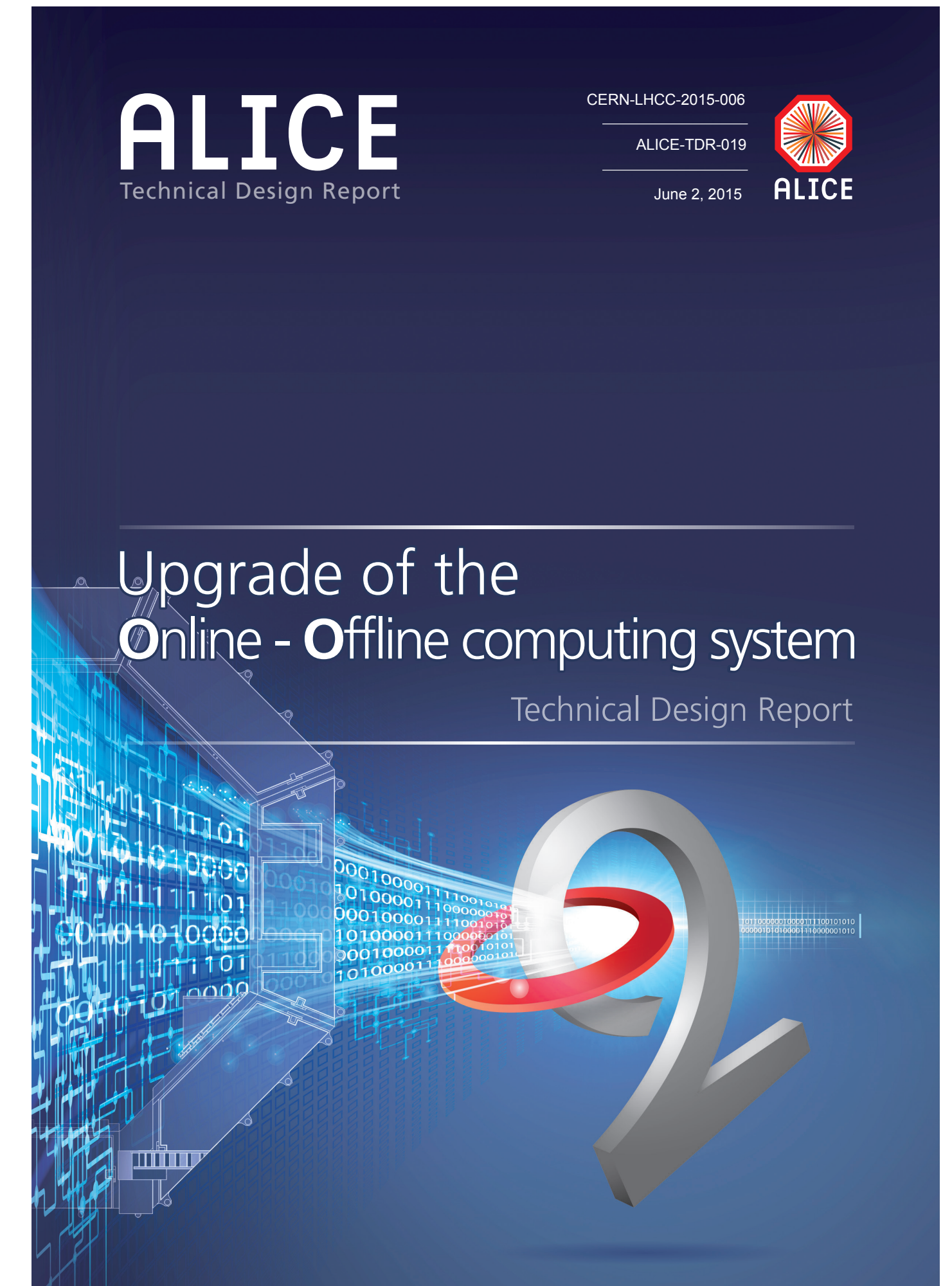
HPCs today are often based on architectures using coprocessors

Evolution of Applications of HPC

- Supercomputers in the past focussed on compute intense applications with limited i/o

  - e.g. weather forecast

  - QCD lattice simulations

  which requires extensive processor/processor communication

- Today fast i/o channels are available and it is a matter of configuration to optimise the supercomputer for specific application suites

As we adapt

- Our consortium is ideally composed

  - HL-LHC and SKA have a burning physics need and in depth knowledge of the algorithms employed

  - PRACE provide considerable experience in the system adaptation of software environments

  - GEANT provides the infrastructure to take the computing to the many nodes that are needed to tackle the demand

Summary

- Our consortium as a whole constitutes a community that has all the relevant experts on board to enable the transition

  - an environment where the breakthrough can be achieved at the system level

- The results of the work will serve as an example setting the bar for other fields of science and beyond