



ESCAPE

European Science Cluster of Astronomy &
Particle physics ESFRI research Infrastructures

FairRoot, FairMQ and DDS

Facility for Antiproton and Ion Research GmbH

GSI Helmholtzzentrum für Schwerionenforschung GmbH

E-OSSR Onboarding Presentation

January 22, 2021



ESFRI/RI

FAIR

Partner

GSI

GSI Helmholtzzentrum für Schwerionenforschung GmbH

Introduction

Facility for Antiproton and Ion Research

Helmholtz Center for Heavy Ion Research

- Super heavy elements
- Astro- and nuclear physics
- Biophysics
- Hadron physics
- Heavy ion collisions
- Plasma physics

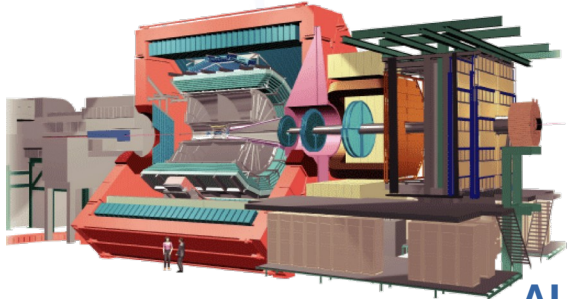


Demands of GSI / FAIR experiments

- Complex detectors need to be designed and optimized – detailed simulations
- Framework for online and offline data analysis
- Understand experimental results with help of simulations
- Parallel data processing
- Dynamic controlling of large scale data analysis on a super computer



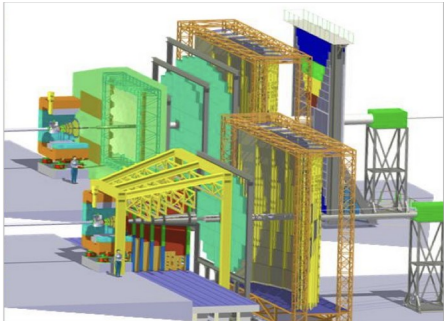
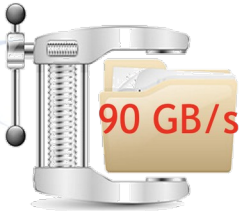
Introduction



3.4 TB/s

ALICE

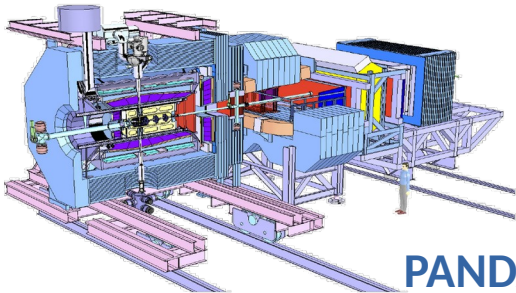
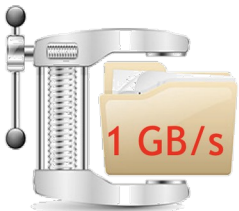
- + 463 FPGAs
- + 100'000 CPU cores
- + 3000 GPUs



1 TB/s

CBM

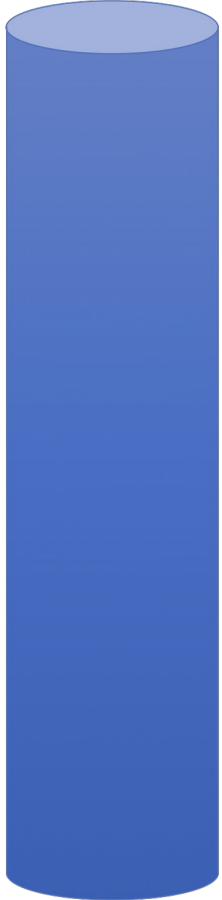
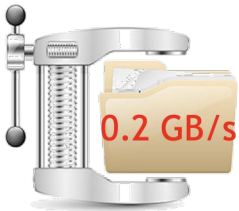
- + ??? FPGAs
- + 60'000 CPU cores
- + ??? GPUs



0.2 TB/s

PANDA

- + ??? FPGAs
- + 66'000 CPU cores
- + ??? GPUs



- FairRoot: simulation, reconstruction and data analysis
- FairMQ: framework for high throughput distributed data analysis
- Dynamic Deployment System (DDS): management and controlling of distributed workflows

10.5281/zenodo.3896282

10.5281/zenodo.1689985

10.5281/zenodo.3854975

<https://fairroot.gsi.de>

<https://github.com/FairRootGroup/FairMQ>

<http://dds.gsi.de>



- Provides building blocks
 - for experiment-specific algorithms
 - distributed data analysis on small to very large data scale
 - in heterogeneous hardware
 - multiple languages environment
- DDS is used on computing cluster to start, initialize and manage large amount of user processes
- Each process is a separated reconstruction/analysis step
 - communicate over network or shared memory via message passing

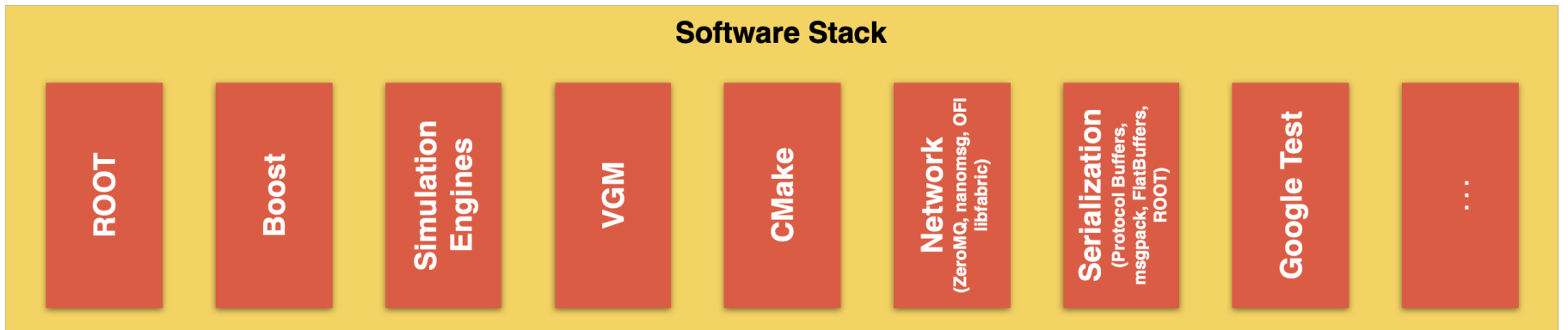
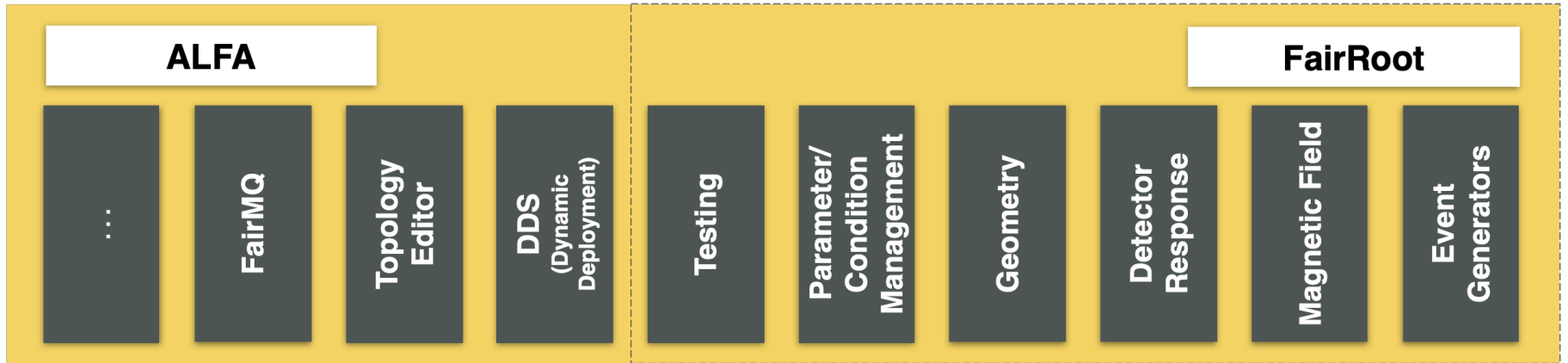


Integration in workflow

- Concrete experiment software is derived from FairRoot and FairMQ
- DDS is used as a service to steer the experiment software
- Provides ready-to-use tools
 - Event filtering
 - Interfaces to HEP event generators
 - Tools for full and fast MC simulations
 - Propagation in non-homogeneous magnetic field



AliceO2 http://alice-o2.web.cern.ch/	CbmRoot https://fair-center.eu/for-users/experiments/cbm.html	PandaRoot https://panda.gsi.de/	R3BRoot https://www.gsi.de/r3b
FairShip http://ship.web.cern.ch/ship/	SofiaRoot	AsyEosRoot	MPDRoot http://mpd.jinr.ru
ExpertRoot http://er.jinr.ru/	EnsarRoot http://lgfae.usc.es/satnurse/ensarroot.html	ATTPCRootv2 https://github.com/ATTPC/ATTPCROOTv2	BNMRoot http://mpd.jinr.ru



Software Development

- License: LGPL 3.0
- Projects are on Github
- Use GitHub tools: tickets / issues / projects / milestones
- Review using Pull Requests
- Release Management: project specific



Software Development

- Git Workflow
- Test-suites for the major use cases
- CI as integral part of development. Jenkins and others to control the CI flow
- Part of our CI runs on cluster

Talk by C. Tacke in the Workshop on
Open-Source Software Lifecycles



Software Requirements

- Operating system and Compilation environment
 - Linux or macOS
 - gcc or clang, cmake
- Hardware requirements
 - FairRoot is a single node application. Scalable on event basis
 - Geant4 multithreaded transport - use all cores on a single machine
 - RAM requirement is experiment specific
 - FairMQ and DDS are aimed for a large cluster (online / offline)
 - High network throughput



Software Requirements

- Containerization requirements
 - Large dependencies (ROOT, Geant4) -> size of a container ~ 5 GB
- Workflow / Interface requirements to other software
 - FairRoot supports:
 - macro workflow (C++ interpreter)
 - compiled code
 - Python
 - FairMQ applications are built out of independent processes
 - different programming languages: C/C++, Python, Go ...
 - data exchange can be **internode** (Ethernet/InfiniBand) or **intranode** (shared memory and named pipes)



OSSR Integration

- What is available?
 - Source code, examples, documentation, containers, shared installation (Cern-VM FS)
- What will be onboarded?
 - Source code, container with installed software + dependencies



OSSR Integration - User story

- Generate skeleton of an experiment specific framework using our automated template
- Run examples of Monte Carlo simulation + reconstruction + visualization
- Run examples of parallel data processing
- FairRoot is a software framework – analysis of concrete experimental data will not be provided



Time for a short demo

Preliminary version of the container

<https://hub.docker.com/repository/docker/gsisde/escape>

