South African e-Infrastructure
For physics applications

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outline

- Physics and computing
- The grid paradigm and production grids
- SAGrid and SANReN: making the most of infrastructure
- Examples of how the grid is used for physics in SA
- How can any physicist use the grid in SA?
Physics and computing

- Almost all of physics is highly dependent on computing of some form:
  - Computational solutions to theoretical descriptions
  - Monte-Carlo simulations
  - Data analysis, modelling
  - … most common some combination of these
  - … frequently in collaboration with others

- Physics has been on the forefront of many technological revolutions – the grid is one of these
The Grid Paradigm – 5 big ideas

- The advent of global open standards, high-speed networks and intergrid middleware has brought to focus the “5 big ideas” of grid computing infrastructures for research:
  - **Resource sharing**: Global sharing is the very essence of grid computing.
  - **Secure access**: Trust between resource providers and users is essential, especially when they don't know each other.
  - **Resource use**: Efficient, balanced use of all computing resources
  - **The death of distance**: Distance should make no difference
  - **Open standards**: Interoperability between different grids

- The grid is the expression of today's research activities:
  - Collaborative, efficient, distributed, multi-disciplinary, service-oriented.

- [http://www.gridcafe.org/five-big-ideas.html](http://www.gridcafe.org/five-big-ideas.html)
What does a physicist need?

- Physics needs computational **resources**
  - Compute power (CPU's, RAM, GPGPU's...)
  - Data storage (permanent, transient)
- However, sometimes the technology can get in the way of efficient usage
- Provide the user with a transparent, easy-to-use way to
  - access all the resources on which an application can run
  - Access, manage and share data with collaborators
The grid simplifies the user's life
Production grid infrastructures

National Research Network connects

HPC resources and scientific equipment which self-organising user communities use to conduct their research

Users access instruments, software and computing resources independent of their location in a self-organised way, transparently across infrastructures
Services can be combined according to the needs of individual users or entire communities.

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SAGrid and SANReN: resources
7 (+3) sites
~1300 CPU cores
~20 TB perm. Storage
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~17 permanent staff
Functional Sites | Core Services | Deployment In progress | Proposed extensions | External Infrastructure
---|---|---|---|---
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Existing SANReN backbone
Construction in progress
Proposed extensions
TENET/SEACOM 10Gbps

EUMed, EGI, EELA, CERN
Usage of the grid

- The computing infrastructure is available to all – in and outside of South Africa
- Fully interoperable with global computing infrastructures
- Users are self-organised into "virtual organisations"
- SAGrid supports many independent VO's:
  - Biomed (life sciences), GILDA (training), E-NMR (protein structure, physical chemistry), etc...
- And of course physics...
Physics on SAGrid

Image courtesy of GEANT4 collaboration

http://www.opengatecollaboration.org
Physics on the grid : LHC

- **ALICE** : since 2004
  - UCT/iThemba collaboration
  - Service challenges 2006 – 2008
  - Dedicated site – resource commitment upgraded following start of collisions
  - Data analysis to start later in 2011

- **ATLAS** : since 2011
  - UJ / Wits collaboration – physics analysis / MC
  - Subset of ATLAS physics data staged to UJ
Nuclear Physics : GEANT4

- A toolkit for the passage of particles through matter : http://geant4.cern.ch/
- GEANT4 VO is enabled on all sites – bi-annual regression tests conducted to ensure quality of the software release
- GEANT4 application is installed on all sites :
  - All users can access GEANT4 pre-installed
  - Compile custom GEANT4 applications
- 2010 : Diamond detector modelling on the grid (MUSR – University of Johannesburg)
Medical Physics

- **GATE**: [http://www.opengatecollaboration.org](http://www.opengatecollaboration.org)
  - GEANT4-based package for numerical simulations in medical imaging and radiotherapy
  - Simple interface to many simulations of interest to the medical physics community:
    - Positron Emission Tomography (PET), Single Photon Emission Tomography Computed Tomography (SPECT), Computed Tomography (CT), Radiotherapy
  - Used very widely (iThemab LABS, UFS), recently ported to SAGrid – available for all to use.
Physics on the grid: QCD MC simulation with Pythia

- Service challenges to determine the performance of the grid – Simulation of heavy quark production
- Production, decay of pp collisions at 5.5 TeV, heavy quark production, only dimuon decay channel
- $10^{10}$ events in batches of $10^6$: in a single JDL
  - Sites used: 6 SAGrid, 3 EUMed, 1 EELA
  - Completely standalone application
  - Data stored on 3 different SE's in SA.
What the grid can do in a day

10 years of nominal LHC running: Just over 24 hours of real time on SAGrid
Nothing new – just proving that the infrastructure works as advertised
How could this be useful for you?

- Any scientist can start using the grid in 4 easy steps:

- Porting and development on demand by the SAGrid app porting team, support through AfricaGrid Regional Operations Centre:
  - [https://support.africa-grid.org](https://support.africa-grid.org)

- Any application can be run on the grid, and many have been already ported:
  - [http://appdb.egi.eu/](http://appdb.egi.eu/)
Application porting procedure

- New application identified via questionnaire:
Conclusion

- Physicists need significant compute resources, as well as relevant services.
- SAGrid takes advantage of existing resources, SANReN and university expertise, along with experts worldwide to provide a coherent set of services.
- New applications are always being ported, improving user experience and performance.
- You can benefit – please get in touch.
Thank you

To know more:
- SAGrid website: [http://www.sagrid.ac.za](http://www.sagrid.ac.za)
- Regional Operations Centre: [https://roc.africa-grid.org](https://roc.africa-grid.org)

To stay in touch:
- Twitter: follow @TheSAGrid
- [http://www.facebook.com/SAGrid](http://www.facebook.com/SAGrid)

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