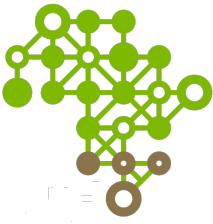




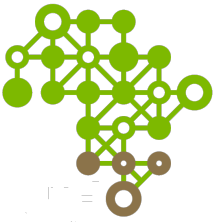
South African e-Infrastructure For physics applications

Sean Murray, iThemba LABS
for
SAGrid Application Support
SAGrid Operations Team
SAGrid Joint Research Unit



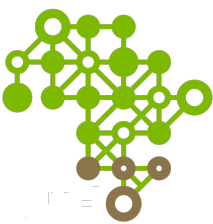
outline

- 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 ?



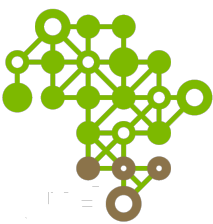
Physics and computing

- 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

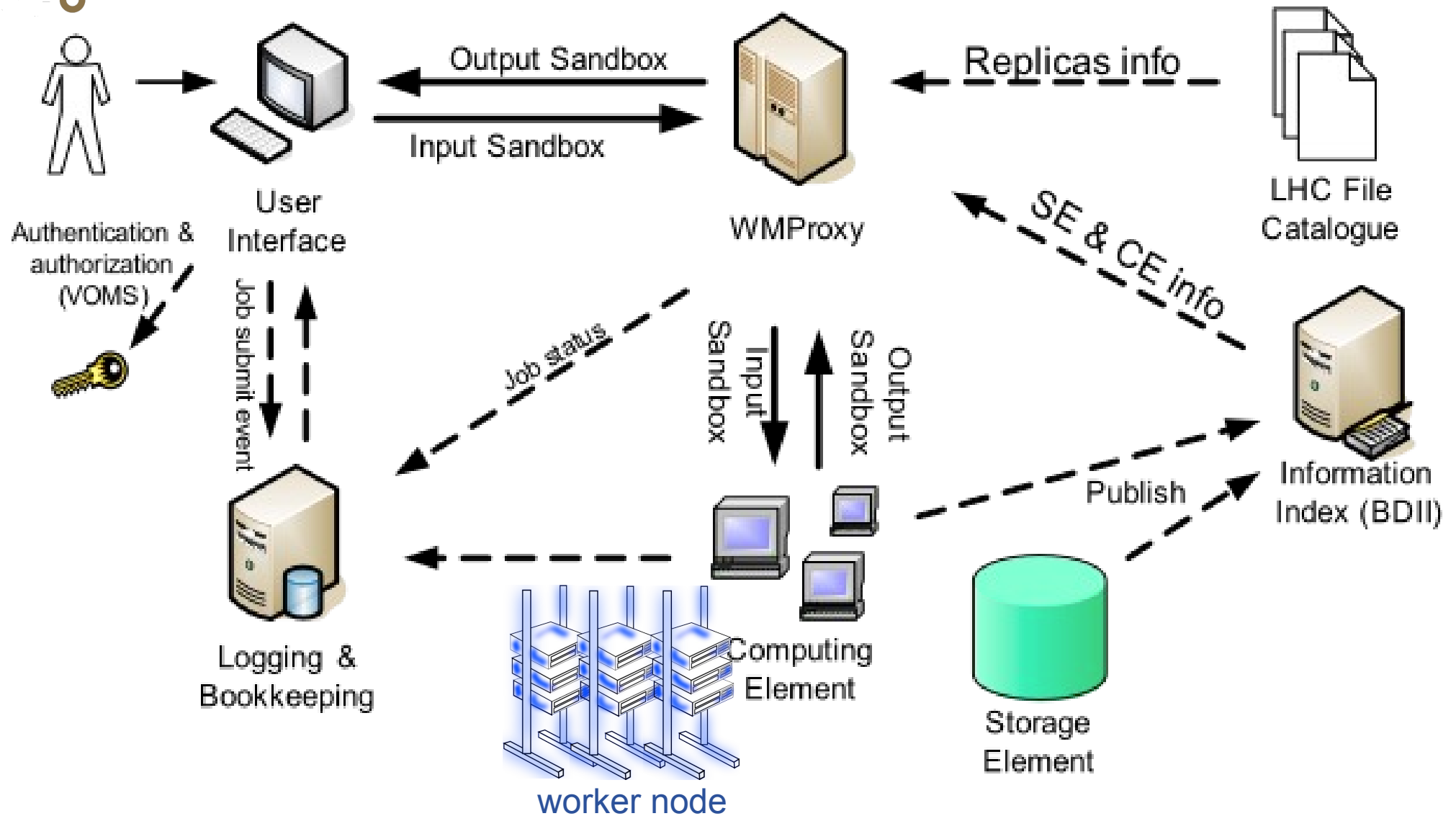
- The advent of global open standards, high-speed networks and intergrid middleware has brought to focus the “5 big ideas” of grid computing infrastructures for research :
 - **Resource sharing:** Global **sharing** is the very essence of grid computing.
 - **Secure access:** **Trust** between resource 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
 - <http://www.gridcafe.org/five-big-ideas.html>
- **The grid is the expression of today's research activities :**
 - Collaborative, efficient, distributed, multi-disciplinary, service-oriented.

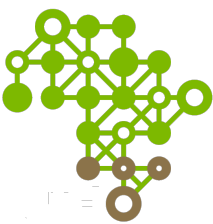


What does a physicist need ?

- 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

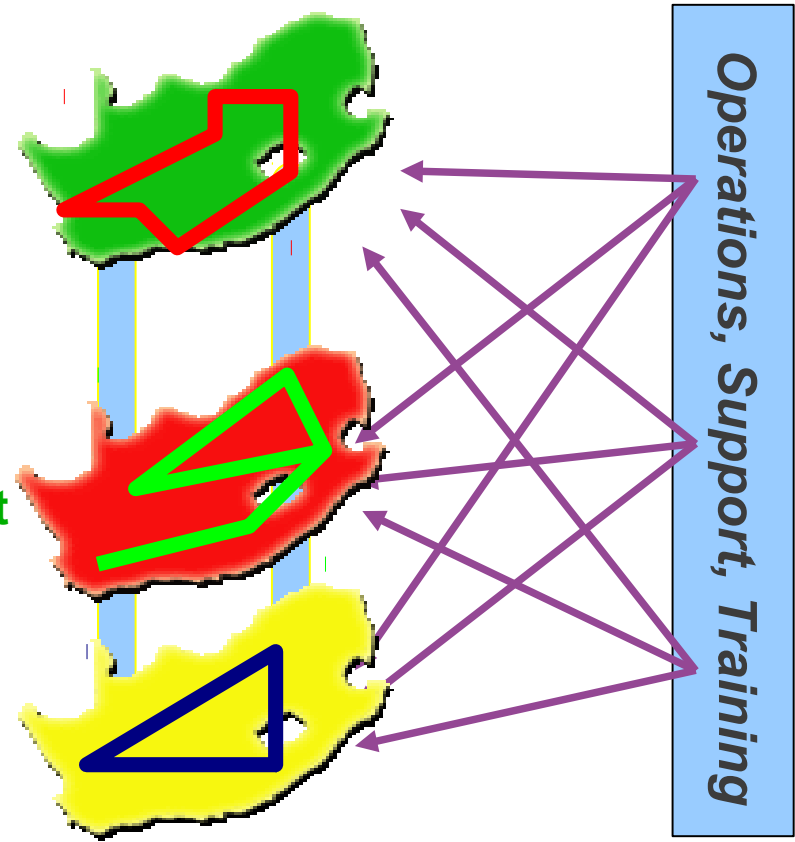




Production grid infrastructures

**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

e-infrastructure

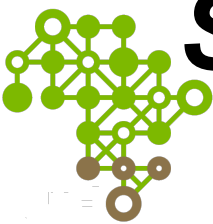


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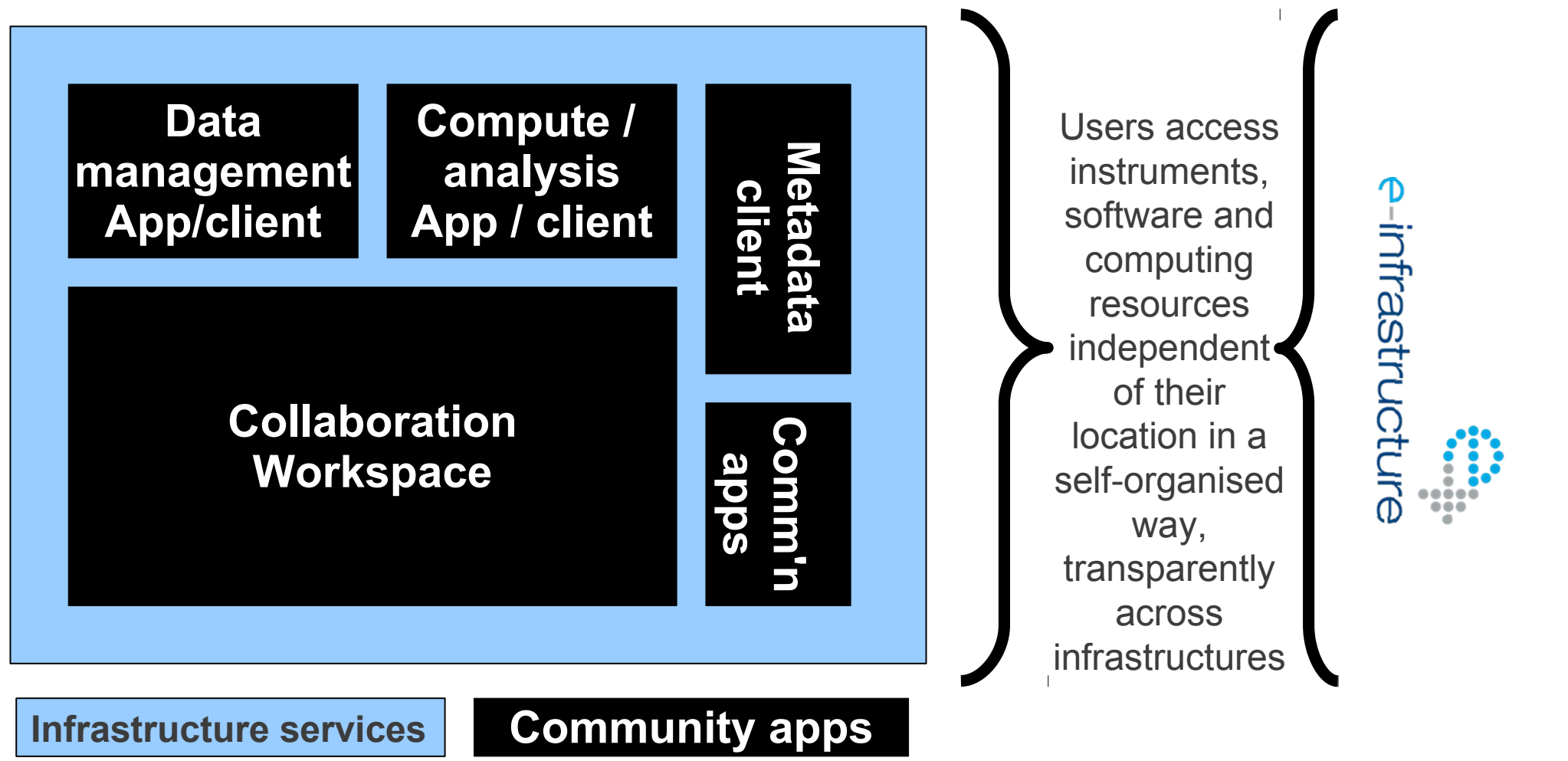
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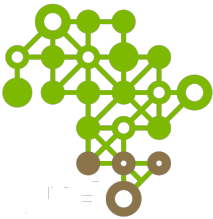


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Services can be combined according to the needs of individual users or entire communities





SAGrid and SANReN : resources



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Functional Sites Core Services

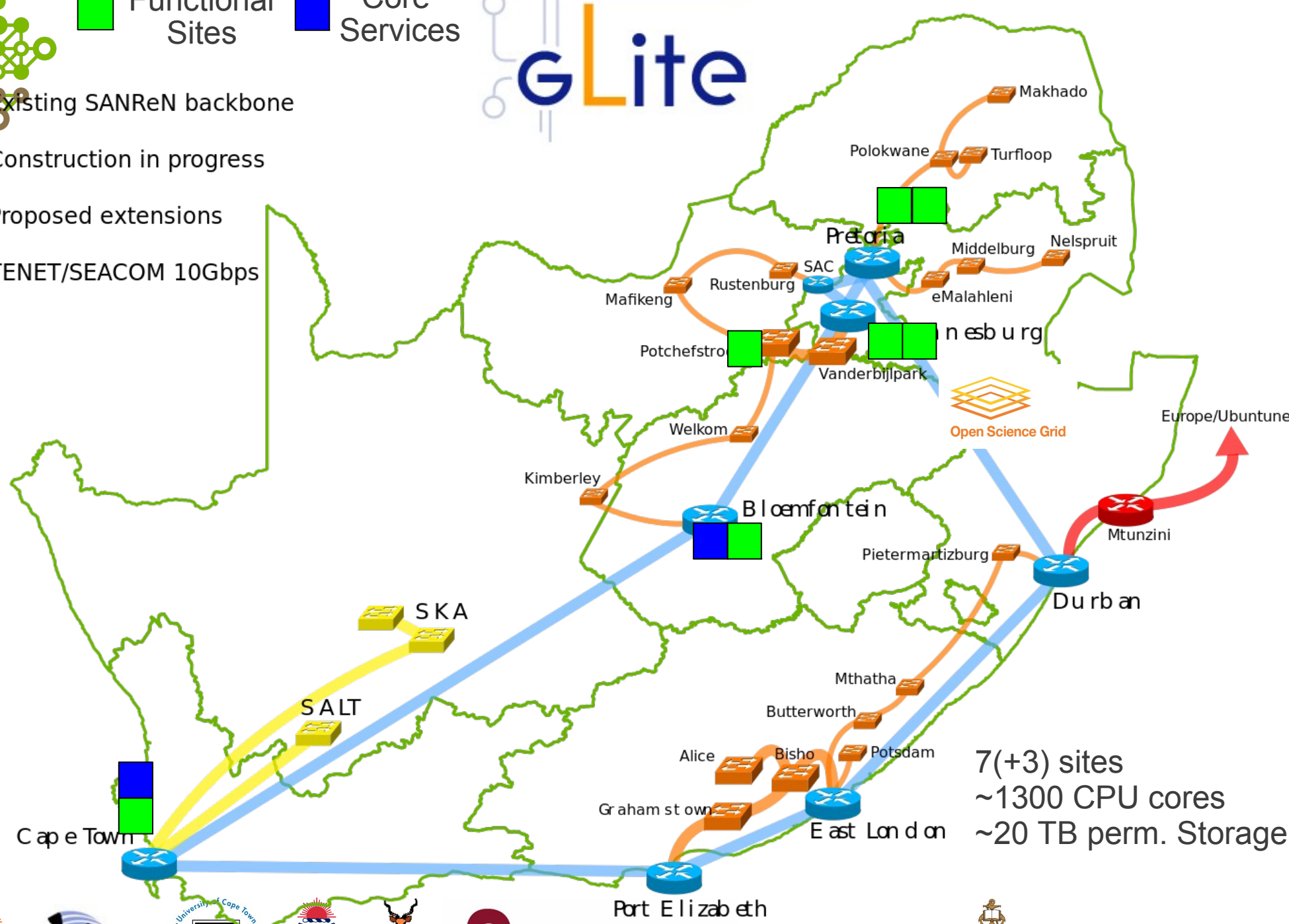
GLite

Existing SANReN backbone

Construction in progress

Proposed extensions

TENET/SEACOM 10Gbps




7(+3) sites
~1300 CPU cores
~20 TB perm. Storage



 Functional Sites
  Core Services

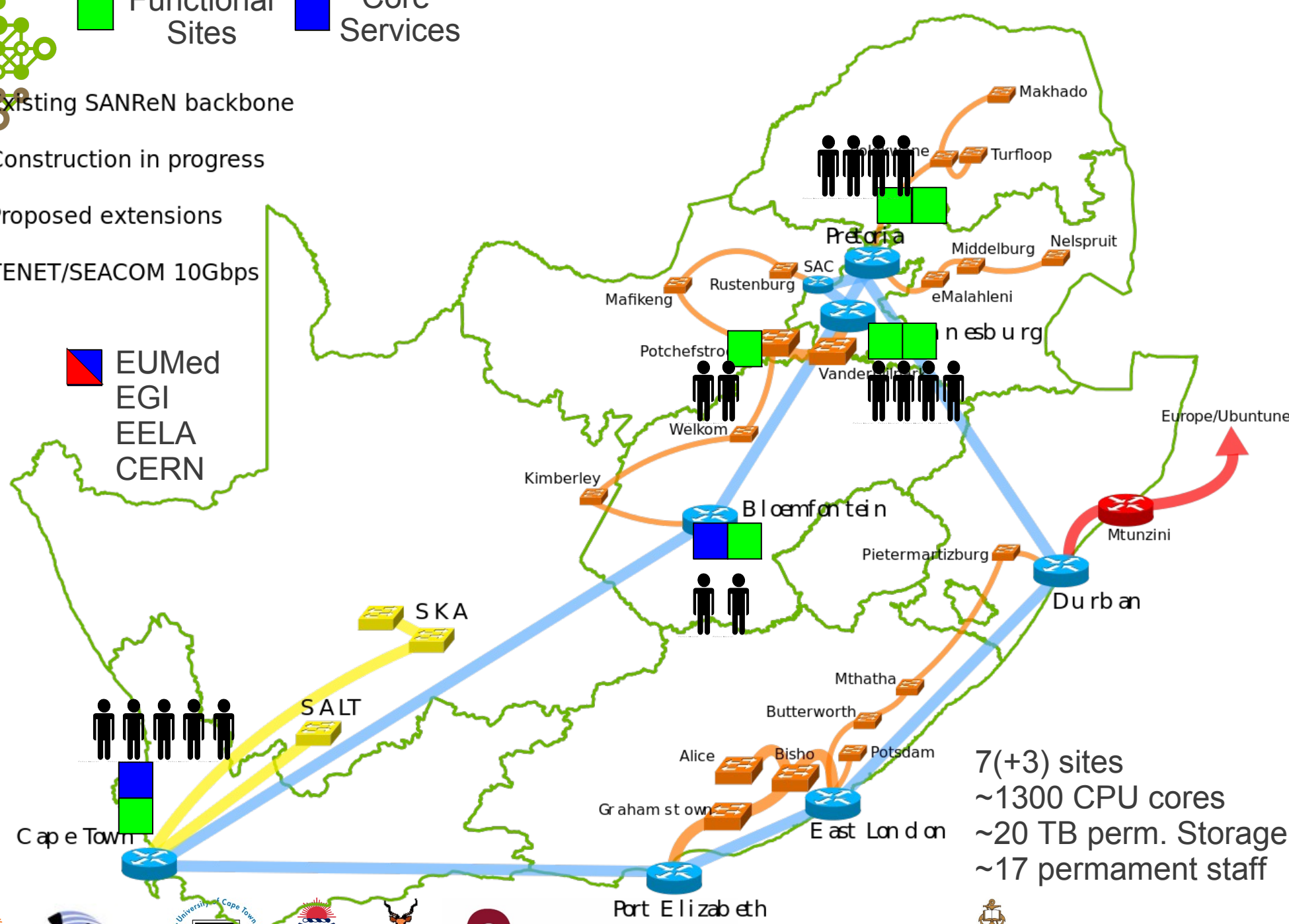
 Existing SANReN backbone

 Construction in progress

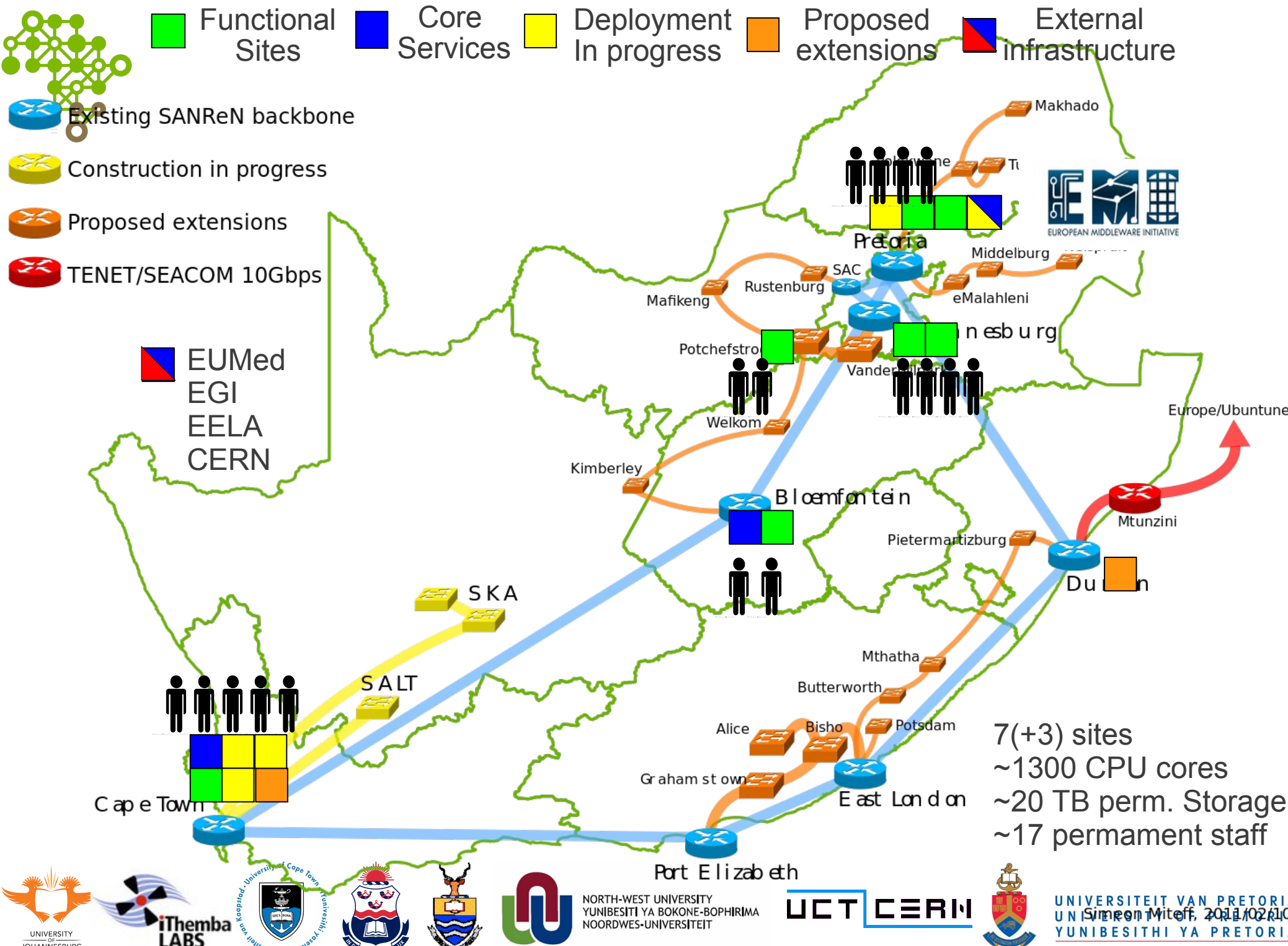
 Proposed extensions

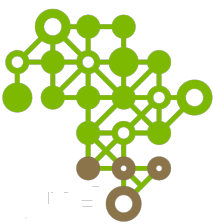
 TENET/SEACOM 10Gbps

 EUMed
 EGI
 EELA
 CERN



7(+3) sites
 ~1300 CPU cores
 ~20 TB perm. Storage
 ~17 permanent staff





Usage of the grid

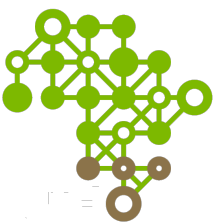
- The computing infrastructure is available to all – in and outside of South Africa
- Fully interoperable with global computing infrastructures
- Users are self-organised into "virtual organisations"
- SAGrid supports many independent VO's:
 - Biomed (life sciences), GILDA (training), E-NMR (protein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



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Physics on SAGrid

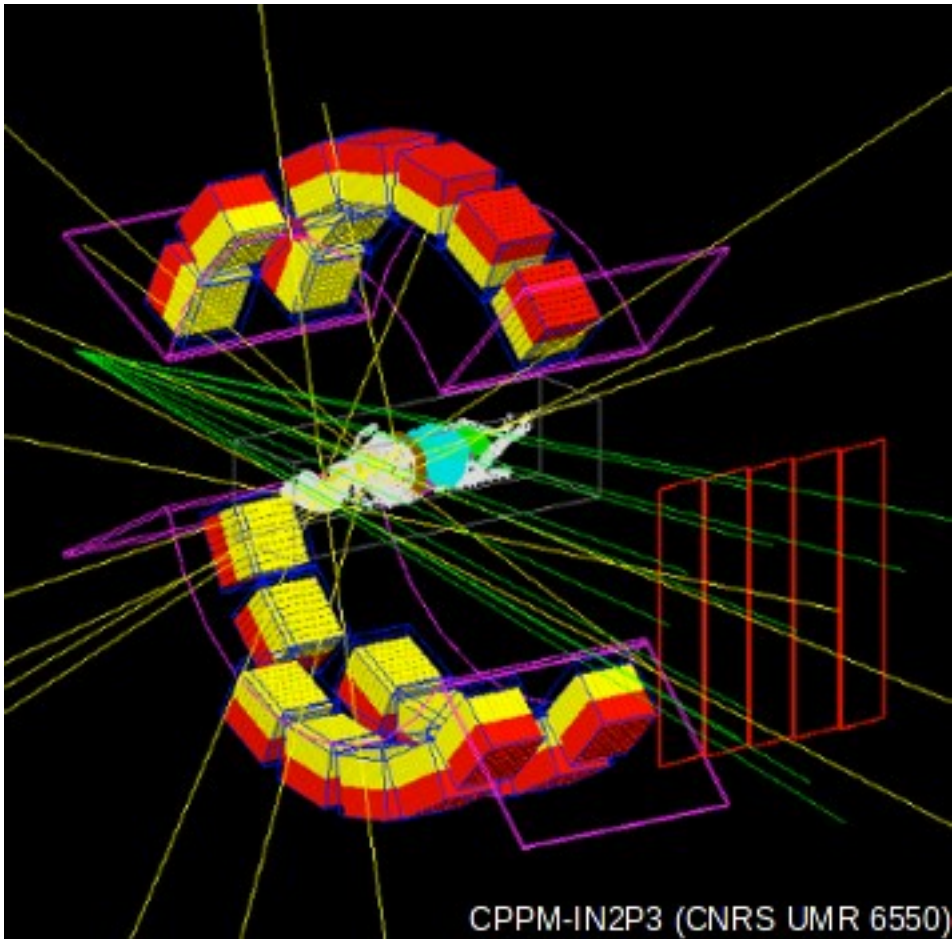
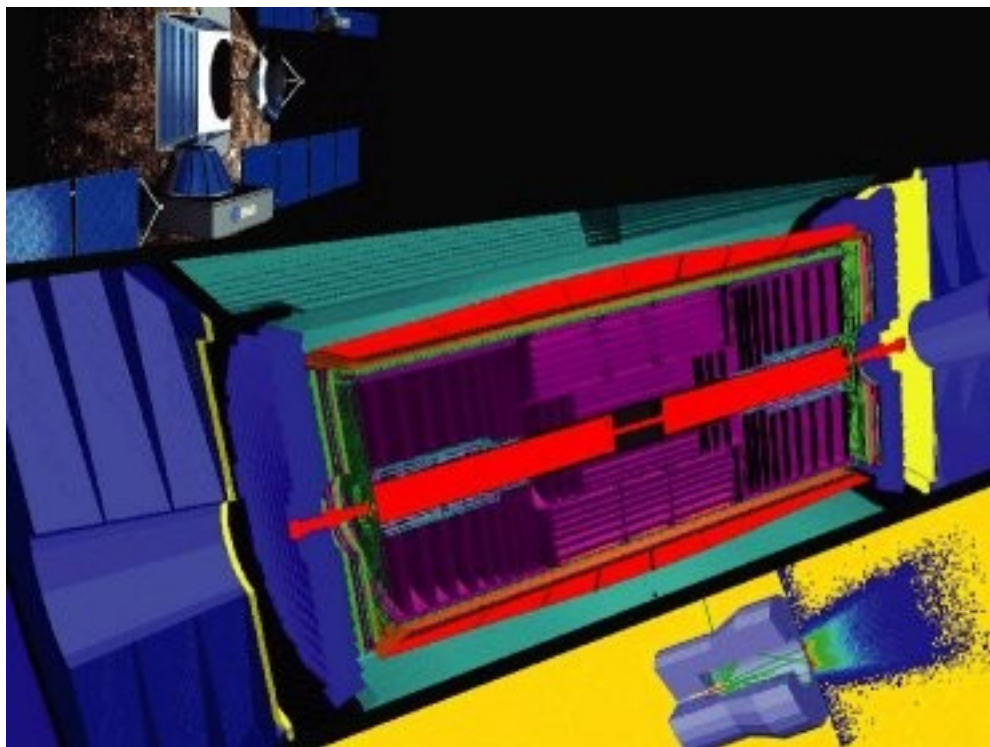


Image courtesy of GEANT4 collaboration
<http://geant4.web.cern.ch/geant4/gallery/>

<http://www.opengatecollaboration.org>

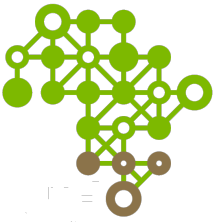


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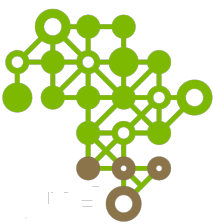


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Physics on the grid : LHC

- **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

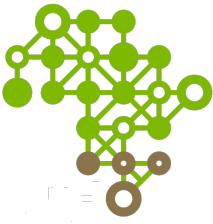
- A toolkit for the passage of particles through matter : <http://geant4.cern.ch/>
- GEANT4 VO is enabled on all sites – bi-annual regression tests conducted to ensure quality of the software release
- GEANT4 application is installed on all sites :
 - All users can access GEANT4 pre-installed
 - Compile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



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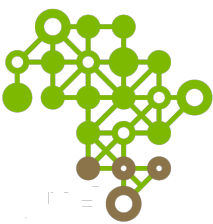


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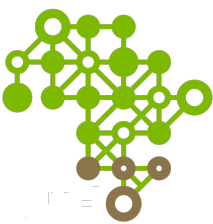
Medical Physics

- GATE : <http://www.opengatecollaboration.org>
 - GEANT4-based package for numerical simulations in medical imaging and radiotherapy
 - Simple interface to many simulations of interest to 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.

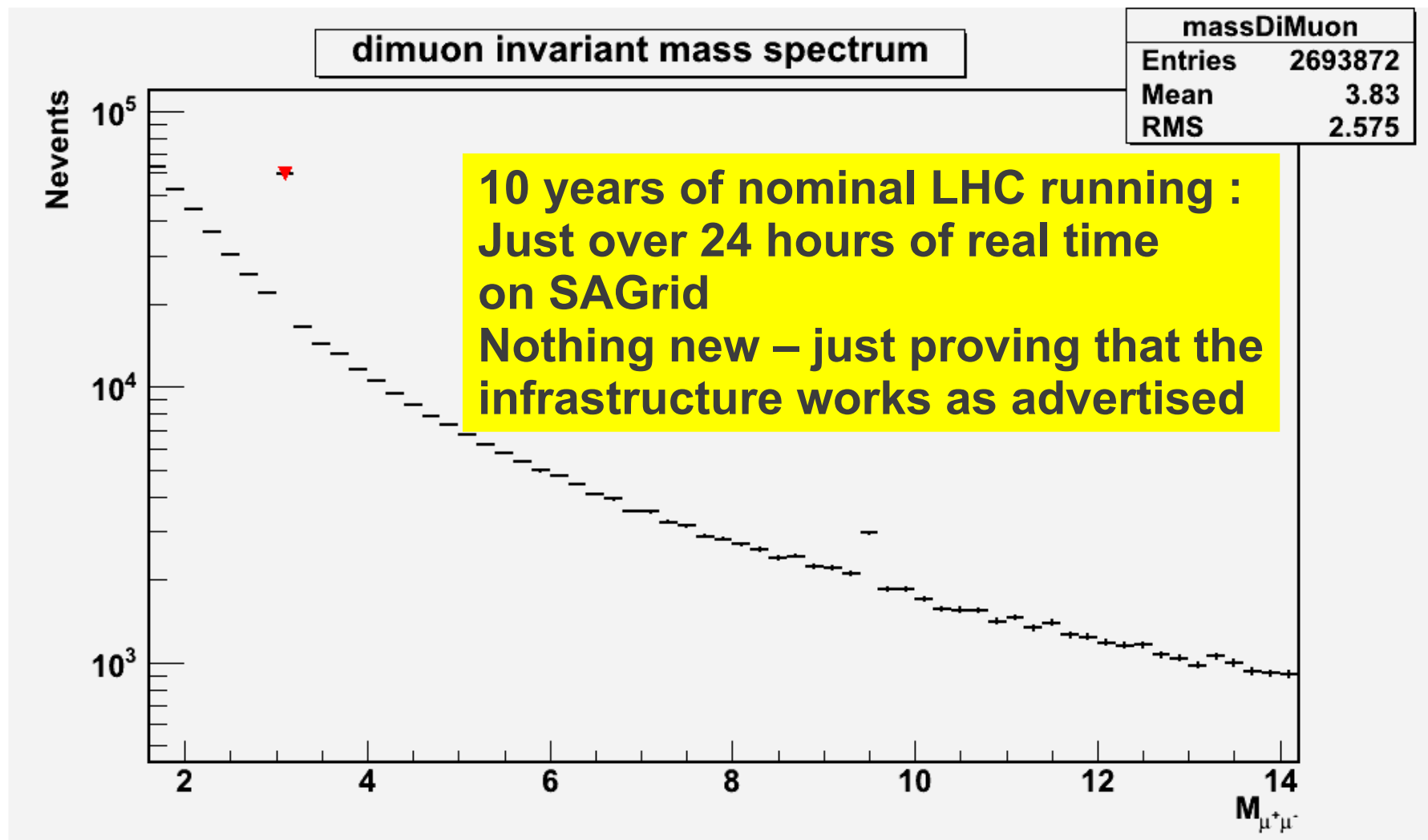


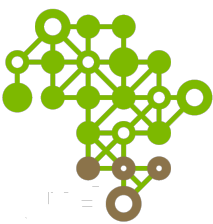
Physics on the grid : QCD MC simulation with Pythia

- 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





How could this be useful for you ?

- Any scientist can start using the grid in 4 easy steps:
 - http://roc.africa-grid.org/index.php?option=com_content&view=article&id=1172&Itemid=491
- Porting and development on demand by the SAGrid app porting team, support through AfricaGrid Regional Operations Centre :
 - <https://support.africa-grid.org>
- Any application can be run on the grid, and many have been already ported :
 - <http://appdb.egi.eu/>

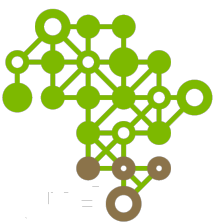


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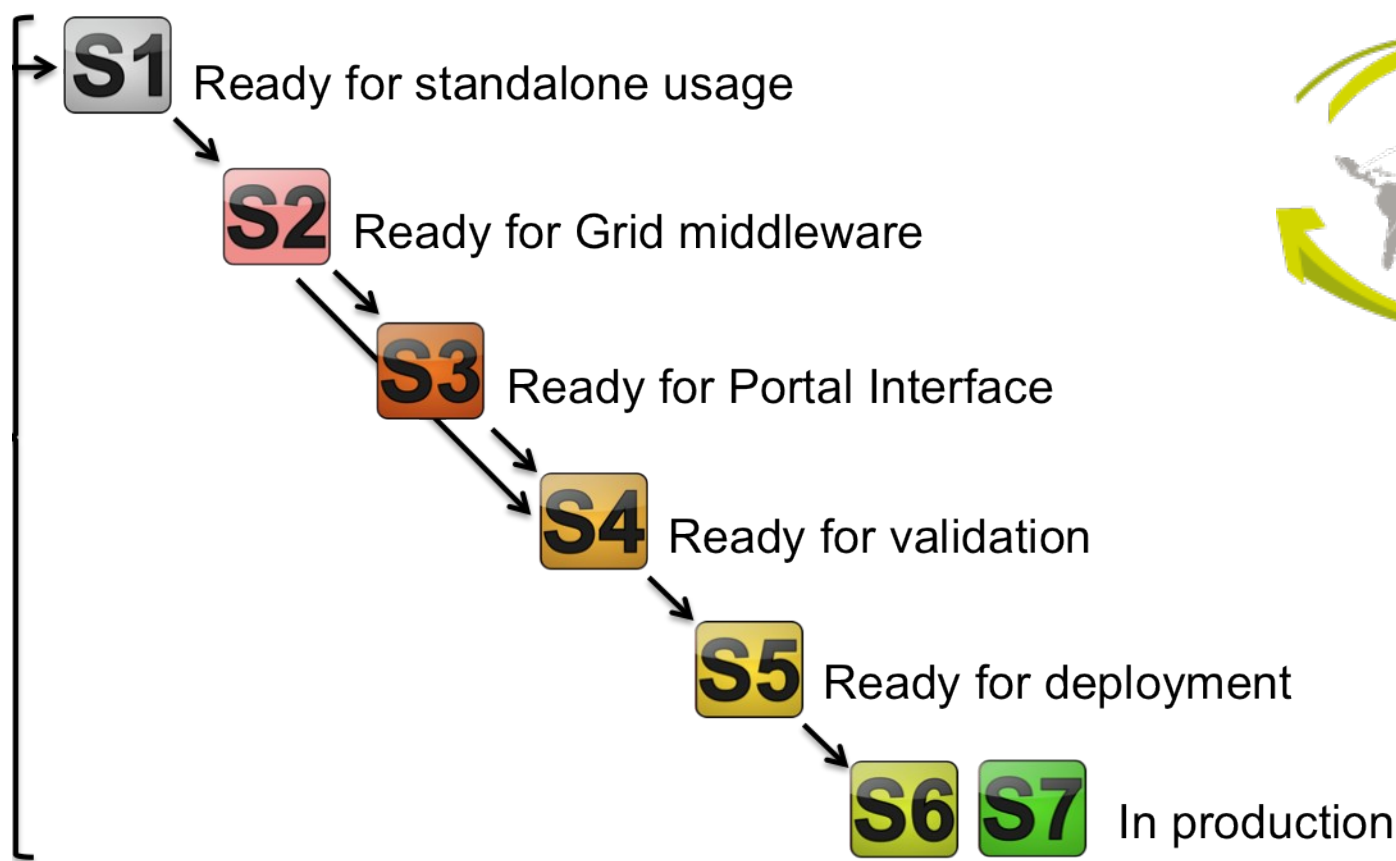


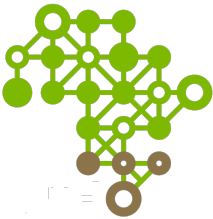
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Application porting procedure

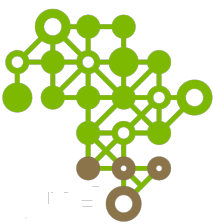
- New application identified via questionnaire :
- <http://www.sagrid.ac.za/index.php/science/appsubmit>





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

Sean Murray for
SAGrid Application Support
SAGrid Operations Team
SAGrid Joint Research Unit
murray@tlabs.ac.za

- To know more :
 - SAGrid website :
<http://www.sagrid.ac.za>
 - Regional Operations Centre
<https://roc.africa-grid.org>
- To stay in touch :
 - Twitter : follow @TheSAGrid
 - <http://www.facebook.com/SAGrid>



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