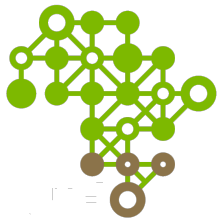


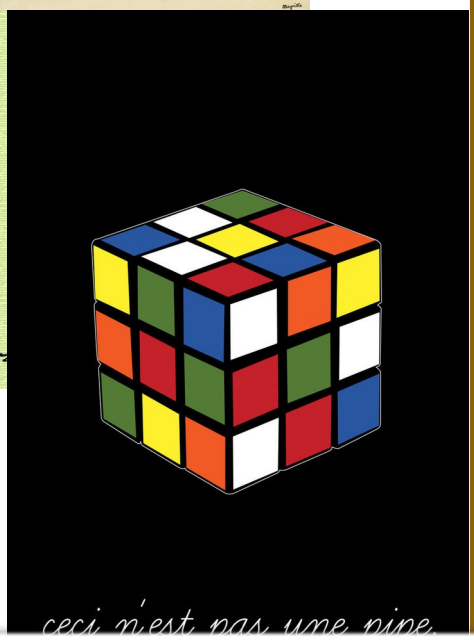
SAGrid 2.0:
History, Lessons, Evolution

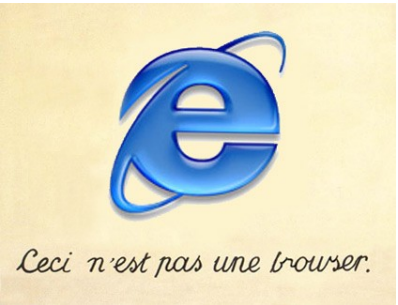
Bruce Becker | bbecker@csir.co.za
Coordinator, SAGrid
Meraka Institute, CSIR

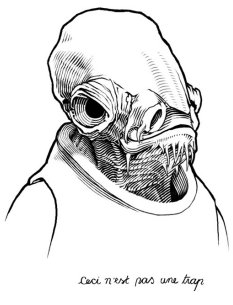
Outline

- This talk... apologies to Magritte, Pope Francis, Octocat, and you.
- The grid -
  - What is it ? What do people think it is ? What do people think it does ? What does it really do ?
- Failures, Bottlenecks
- Technology changes
- Methodology changes
  - Site deployment
  - Application porting

Ceci n'est pas une presentation







Coordinator, SAGrid | bbe

Perceptions

What is the grid

Ok... can it make coffee ?

What is ”SAGrid” ? (2007)

“The” :

- there is one major effort to deploy computing resources, in a coherent and well-managed way.
- This does not exclude smaller or less-significant “research” projects, which may be integrated later or interoperate with the national infrastructure

“South African National” :

- The infrastructure is hosted and maintained within the borders of South Africa and the operations team is South African
- Expertise is locally built, exploiting international contacts in operations and middleware
- A single operations team (a Virtual Organisation) is responsible for the operational state of the entire grid.

“***Grid***”

- This is a federation of computational resources, respecting the definition of a compute grid and a data grid
- The computing resources are and remain the property of the site which paid for them, although they are shared amongst all users
- The kind and level of resource sharing is agreed to on a virtual organisation basis

Goal

to enable anyone
with the right credentials anywhere in South Africa,

to access the
entire national and, if it is the case, international

cyberinfrastructure and software
in a way that is uniform, coherent and easy-to-use

and to provide a
federated, flexible and dynamic

tool for collaboration and research.

Goal 2.0

to enable anyone
with the right credentials anywhere in ~~South Africa~~
Africa and Arabia

to access the
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Cyberinfrastructure (data, compute, software, metadata, support, etc services)
in a way that is uniform, coherent and easy-to-use

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What we wanted to do

What we wanted to do

- IT Departments of Universities centralise computing/data resources on site
  - Owners of equipment form technical collaboration as the basis of the grid – Joint Research Unit Agreement (JRU)
  - Activities coordinated by neutral 3rd party (Meraka)
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- Deploy standards-based interface to each resources using widely-used middleware
  - Train IT staff to operate it
  - Form national operations team
- Create catch-all VO and sign up users
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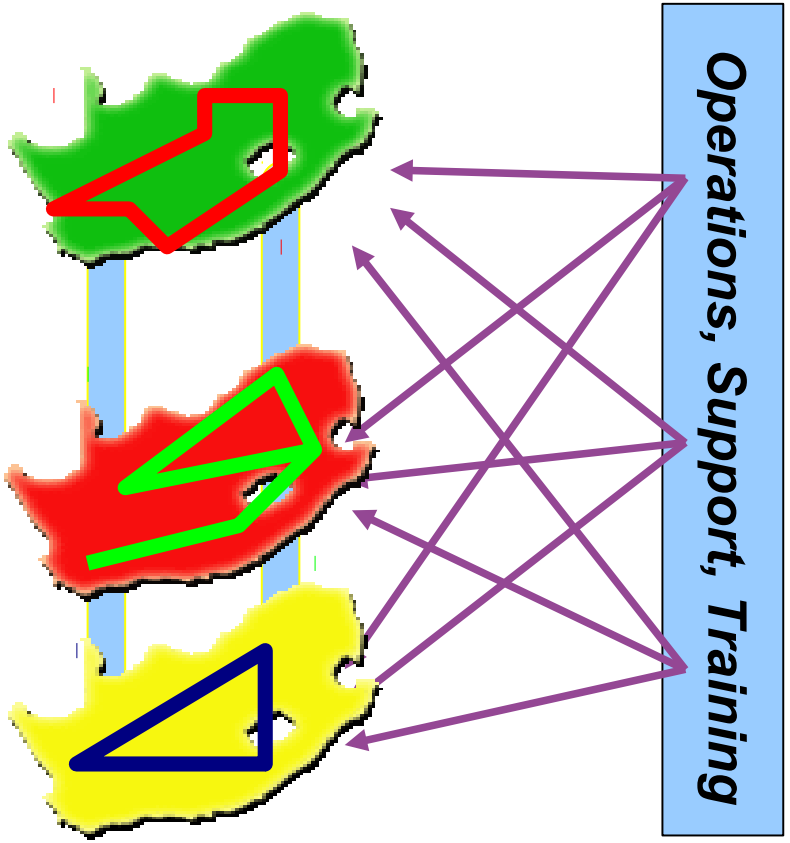
- …
- Science !

What we wanted to do

National Research Network connects

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



Operations, Support, Training

Users access instruments, software and computing resources independent of their location in a self-organised way, transparently across infrastructures

e-infrastructure

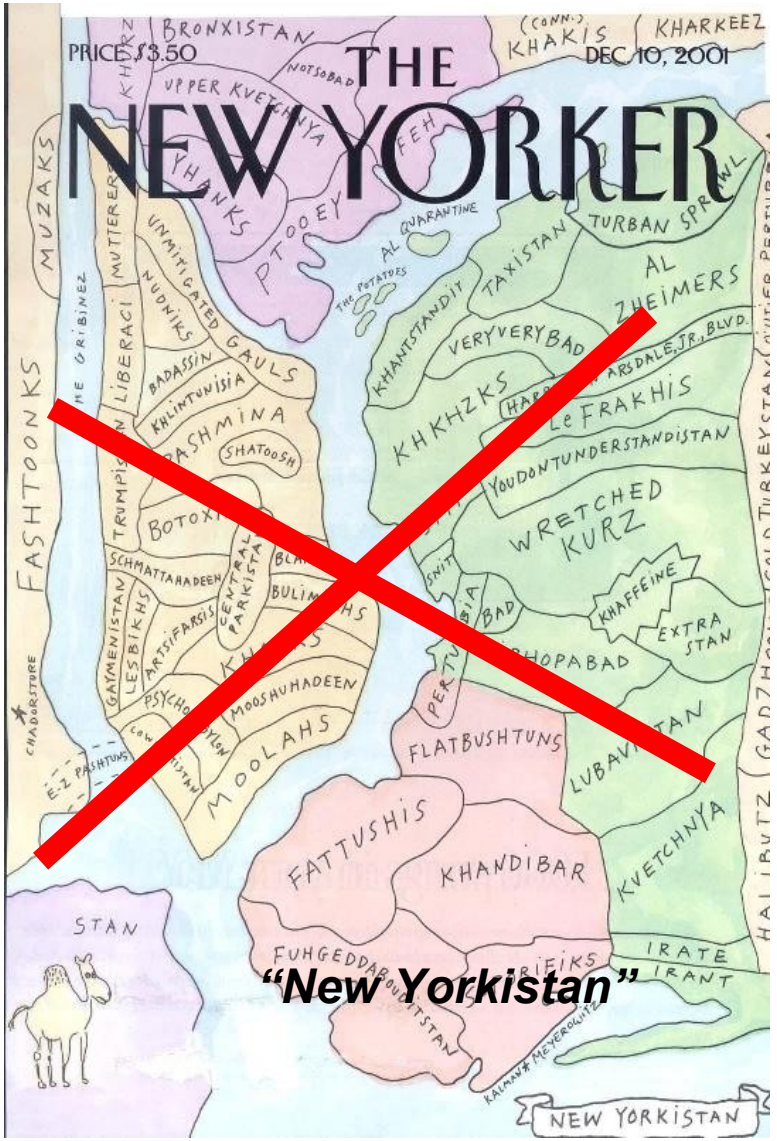
ONE DOES NOT SIMPLY
KILL THE BATMAN
Troll.me

SAGrid activities

- What does SAGrid do ? **”HPC and data storage + other esoteric ”grid” stuff” right ?**
- Nope – we tried to make a full platform for collaboration
  - Virtual Organisation service – https://voms.sagrid.ac.za
  - Tracking system – https://ops.sagrid.ac.za
    - Projects, tasks
    - Help and feedback
  - Agenda service – https://indico.sagrid.ac.za
  - Digital repository – https://docs.sagrid.ac.za
  - Etc..
- Were installed to help coordinate the operations of the infrastructure, but could be used by all user communities

How it was (not) supposed to be managed

16th Century "Italy"



"New Yorkistan"

How it was (not) supposed to be managed

But neither some mysterious, central dictatorship

How it was supposed to be managed

- JRU was supposed to be a decision-making body, allowing ***collective*** action
  - Decisions are made by JRU, implemented bottom-up by members
  - Coordinated by Meraka
- In the case of participation to collaborative research or development projects, CSIR Meraka could represent the collaboration
- Institutes maintain full ownership and control of their equipment, but agree to share it

How it's really managed

- JRU takes no proactive action
- Members act individually, rather than collectively.
  - Incoherent hardware acquisition – seen as waste or duplication by NRF
  - Inconsistent (inexistent) communications strategy – seen as institutional only
- Decisions are made by coordinator, implemented ”brute-force” top-down
  - Slow, meets with resistance due to conflicting priorities
- No collective participation to e-Infrastructure support actions

What we really do

- Sites differ significantly in capacity and resources
- Separated resources at any given site require specific attention – does not scale
- Loosely-coupled experts form national operations team – initial barrier to entry for new sites remains high
- Inconsistent monitoring and accounting – no accurate view of usage and performance

How users were supposed to use it

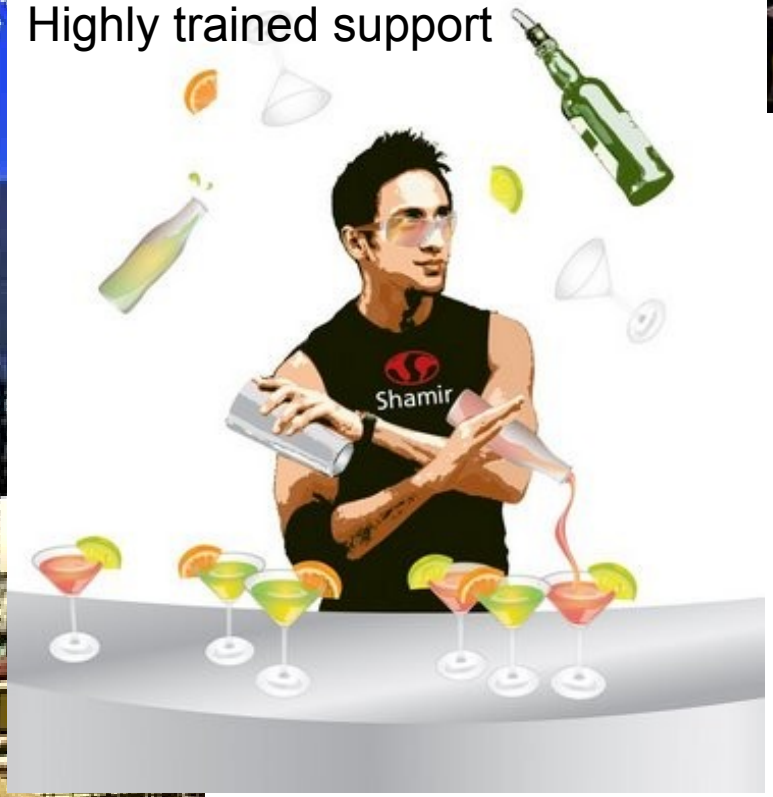
A scenario : this scientist walks into a bar...

What users want

Some users want highly varied, modular application selection

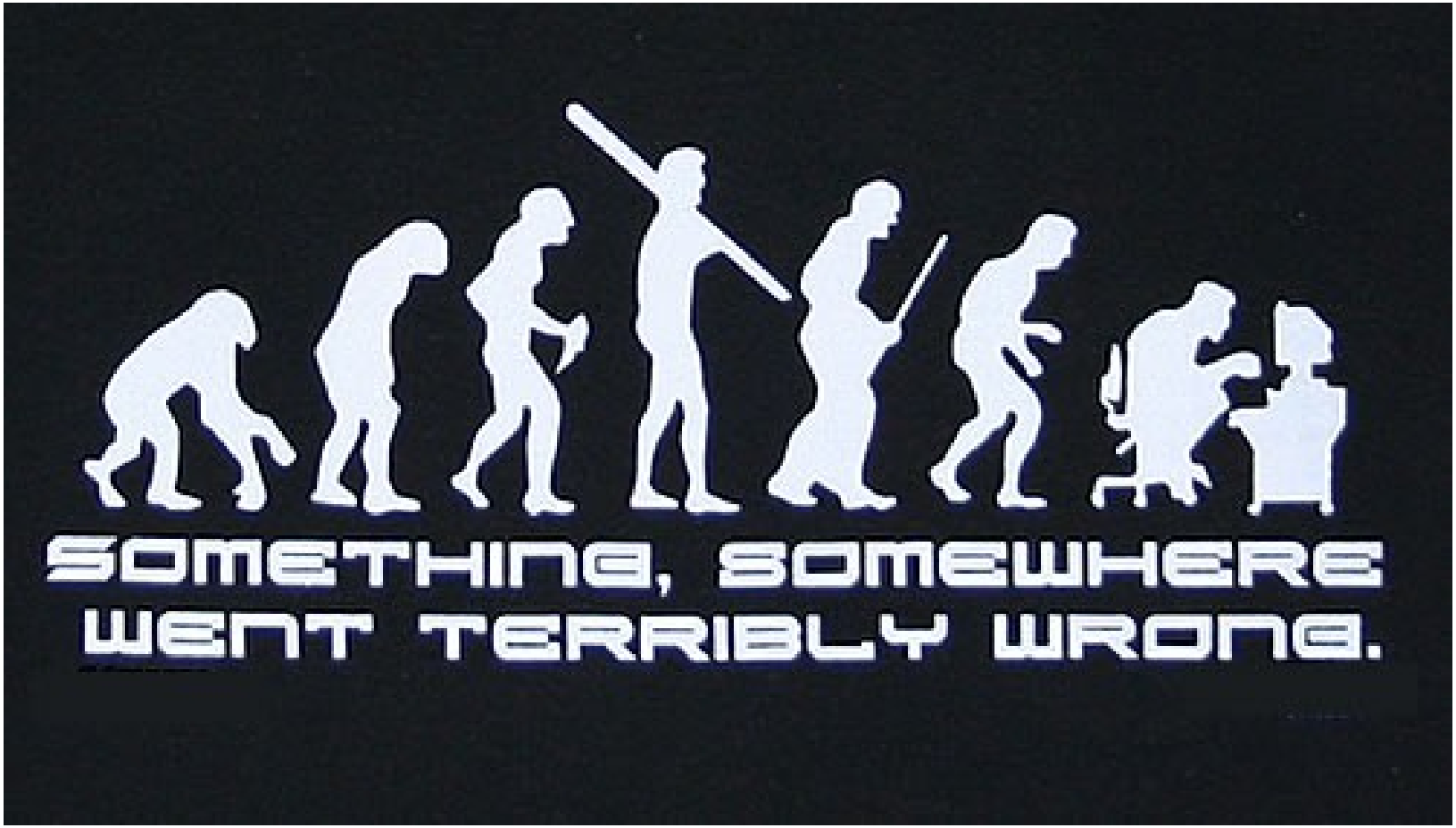
Amazing infrastructure

Highly trained support

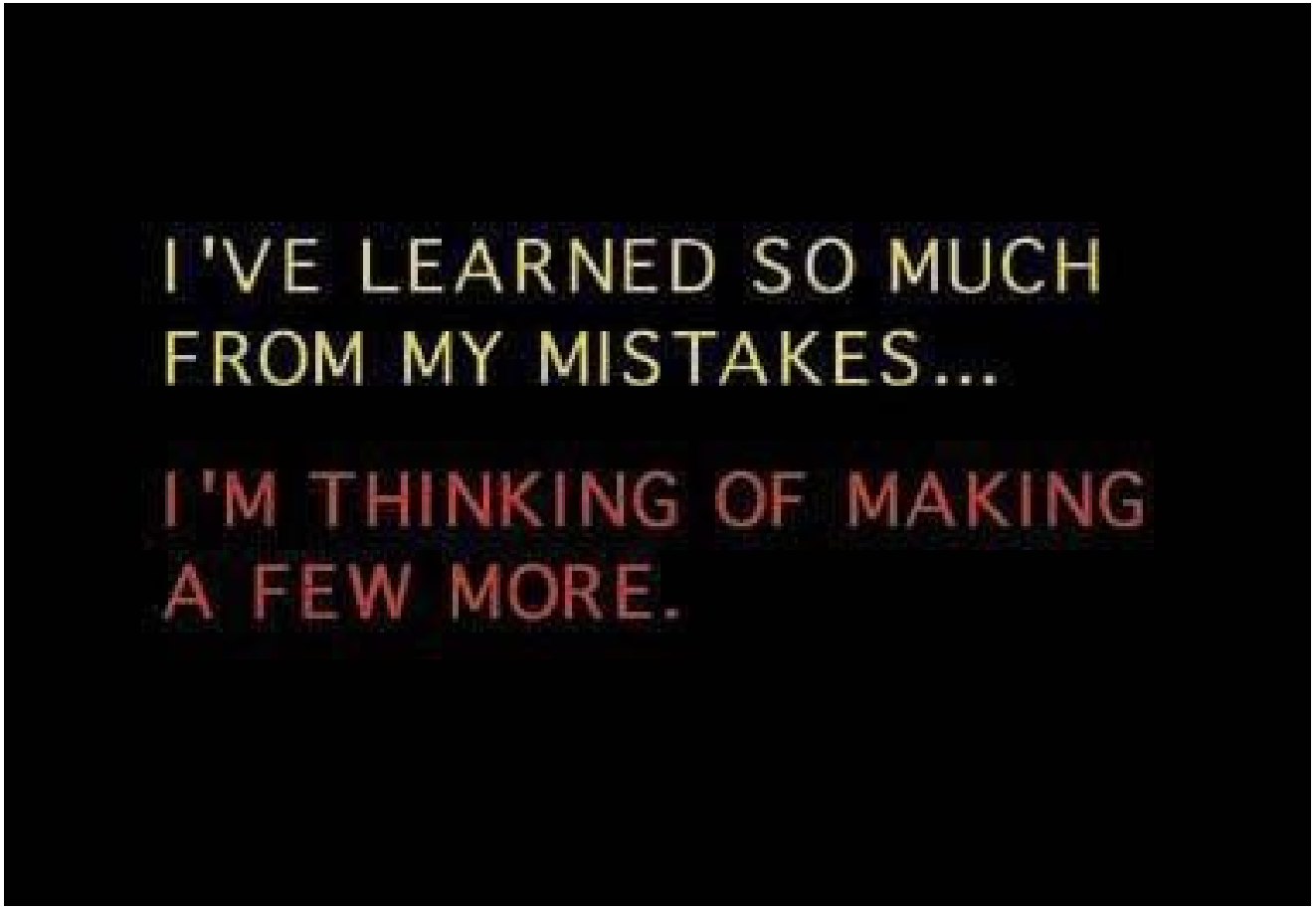


Vertically integrated
Highly specialised applications

What users get sometimes


SOMETHING, SOMEWHERE
WENT TERRIBLY WRONG.

What went wrong ?



Problems help you learn

Failures : HPC vs grid

- There is a widely-held belief that HPC and grid computing are mortal enemies
  - HPC = big machine for supercomputing / MPI
  - GRID = lots of little machines for ”HEP”
- This is highly counterproductive in SA
  - We don't have any ”supercomputers” - all cluster-based hybrid architectures
  - Advances in middleware, schedulers and workload management systems have made this distinction irrelevant
  - Virtual environments make this distinction even more useless
  - Feeling that having to support ”grid” and ”HPC” is double effort – strain on site, have to choose one.

HPC vs grid – for the record

- The grid is a federation of resources and services, one kind of which is HPC
- Middleware is a ”job transport mechanism”
- Why did this not work in SA ?
  - Proper advertising of resources
  - Common environment for applications
  - No effort on standardising priority and scheduling policies
  - Very little sharing of user-gridops interaction to learn best practices

Failures – Site X

- Very good case to join the infrastructure
  - Well-defined set of applications, widely used
  - Compact team using the site
  - Site admin initially trained at EPIKH school
- Looked good for a while...
  - Site deployed, tested, ready
  - Hardware upgrade + middleware upgrade overloaded system admins
  - Site was removed from the infrastructure

Why ?

- GridOps was seen as an ”extra” activity
- ”price” you pay to join the grid – but what are you getting in return ?
- No help was called in for problems
- Didn't work enough on having relevant applications available to users across the grid
- Unbalanced equation : using local resources, but supporting remote users – no thanks.

Failures – SAAO, SANBI, tLABS

- National facilities with large pools of users
- Commonly-used applications
- Local expertise in HPC and user support
- Almost zero takeup...

Why was it so hard to bring new users on board ?

- Culture shock
  - Fundamental misconception of what the grid can do / what it is
  - Missed opportunities of joining existing Virtual Oranisation – user feels alone
  - No specific message – ”the grid can do everything !” yes, but how do I do this specfic thing
  - Static, irrelevant training material – doesn't speak to the user
  - One-way communication – no feedback channel → no improvement
  - Responsiveness too low
- Barriers to entry
  - x.509 certificates, new technology/methodolgy
  - Training model

New User Bottlenecks

- I want to get started !
  - Wait for your certificate
- I want to get started.
  - Learn a new paradigm and a new language
- I want to get started...
  - Tell us about your code and we'll put it in the list of applications to be ported
- Bye...

New Site Bottlenecks

- Q: What's this grid thing ?
  - A: Set up your cluster, rtfm, deploy middleware, give us your bdii and you're good.
- Q: Yes, but what ***is*** this grid thing ?
  - A: You have 12 tickets open, what's the problem ?
- Q: It's for physicists, right ? But I have astronomers asking for HPC...
  - A: Ok, we're going through a middleware upgrade – when are you going to be upgrading ?

Parlez-vous grid ?

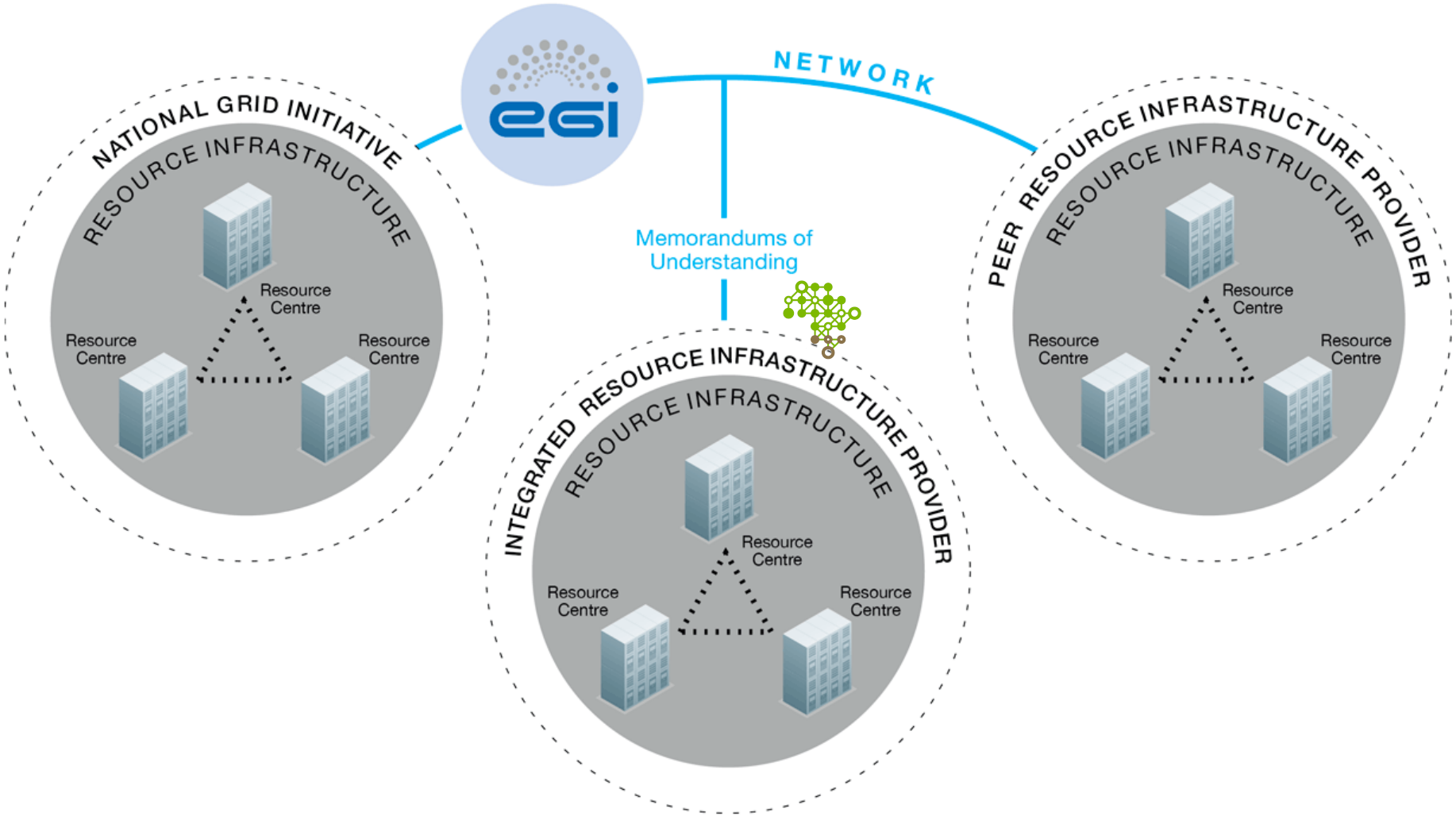
Changes to the playing field

- New middleware stack
- Highly improved technology provider, but some disruption

Changes to the playing field

- More formal technical basis to the collaboration
  - OLA/SLA basis to operational infrastructure and services
- Better understanding of the state and nature of the services provided
- Easier to add, publish services and collaborate: e.g. :
  - Monitoring
  - Security
  - Web services
  - Identity Services

An interoperable infrastructure



NGI_ZA

Edit

What is an NGI?

Contacts	
E-Mail	sagrid-ops@lists.sagrid.ac.za
ROD E-Mail	
Helpdesk E-Mail	
Security E-Mail	sagrid-site-security@lists.sagrid.ac.za

Project memberships
EGI

Scope(s)	
EGI	?

6 Sites

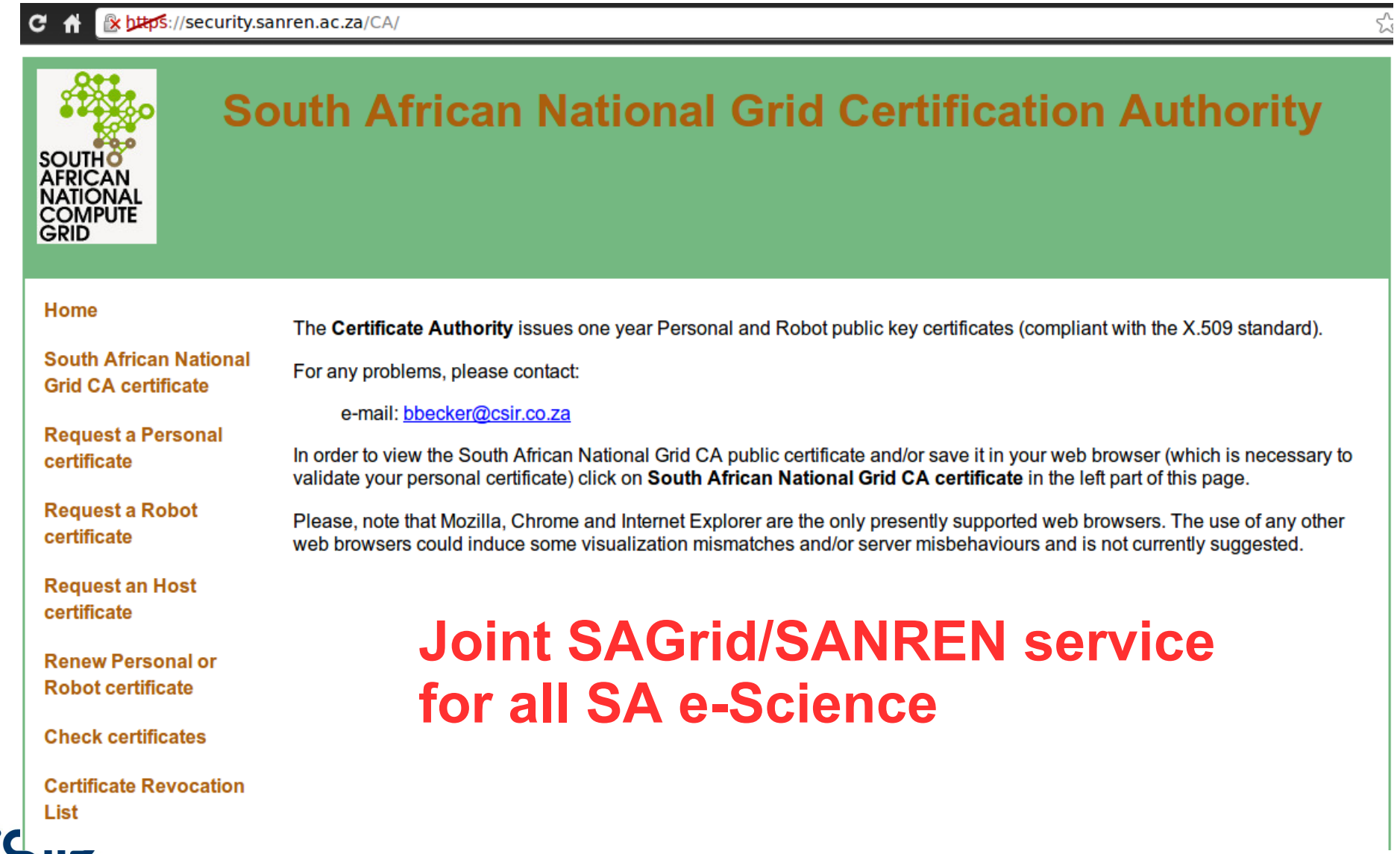
Name	Certification Status	Production Status	Scope(s)
ZA-UJ	Certified	Production	EGI
ZA-CHPC	Certified	Production	Local
ZA-UFS	Certified	Production	Local
ZA-MERAKA	Certified	Production	EGI
ZA-UCT-ICTS	Certified	Production	Local
ZA-WITS-CORE	Certified	Production	EGI

8 Users

Name	Role
Bruce Becker	NGI Operations Manager
Ntuthuko Sambo	Regional Staff (ROD)
Christopher Lee	Regional Staff (ROD)
Roderick Mooi	NGI Security Officer

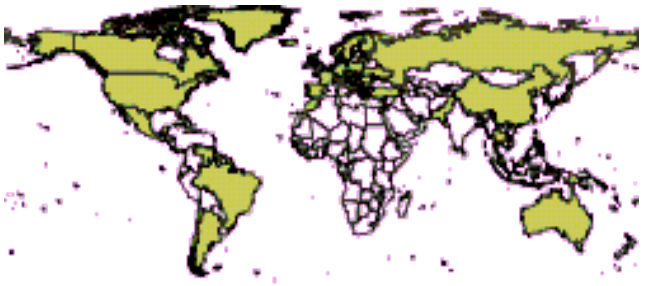
Who is the grid ?

New Services – SA CA

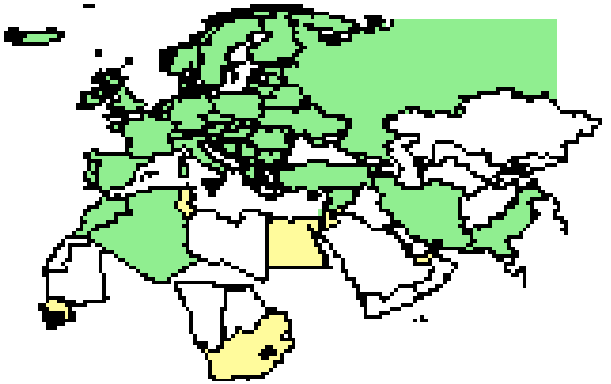


New Services – SA CA Accreditation

IGTF
International Grid Trust Federation
AP | EU | TAG



eugridpma



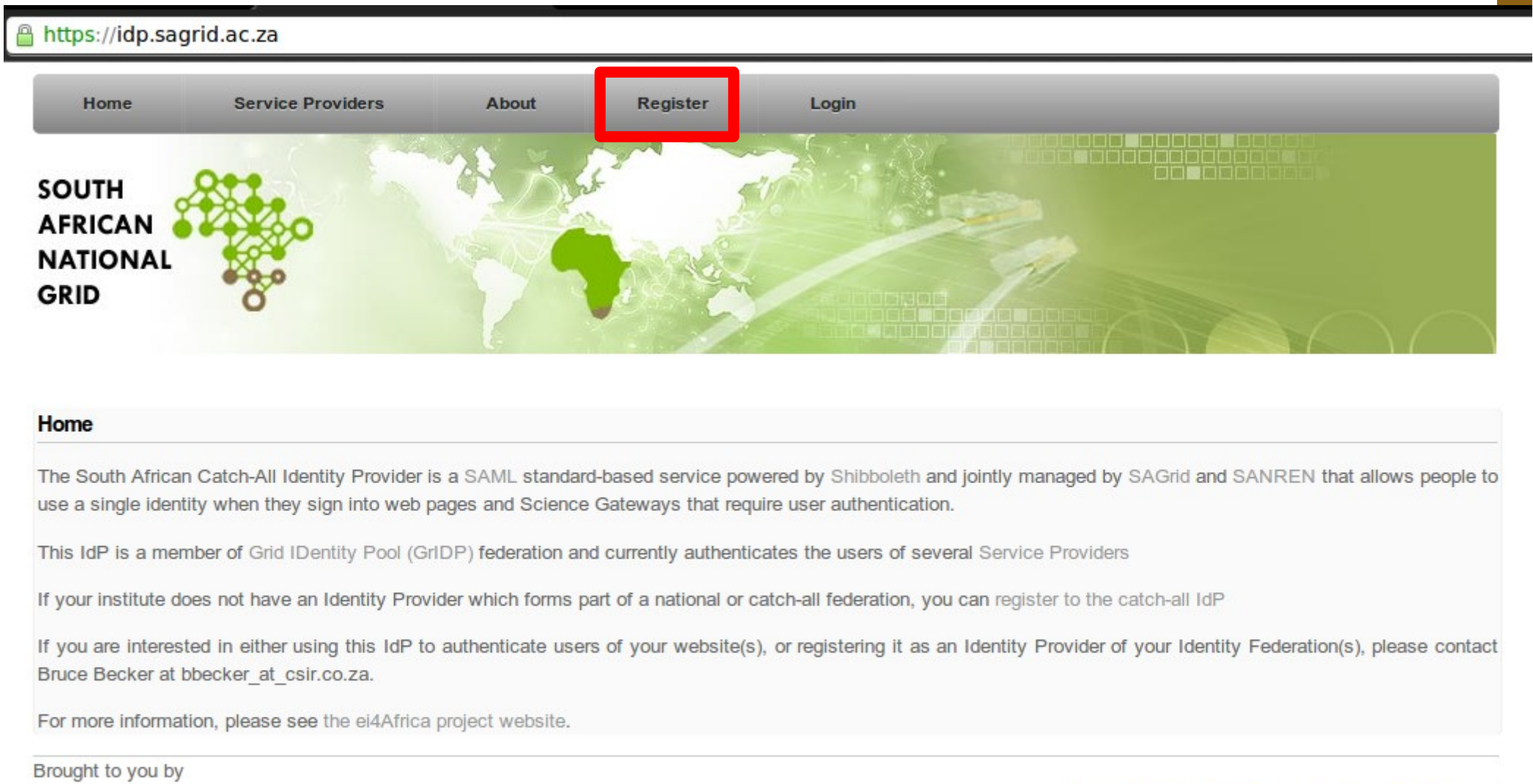
Meetings

(meetings from our sister PMAs are available at: the TAGPMA conference site and the APGridPMA F2F meeting site)

Date	Location	Details
January 2014	Abingdon, Oxfordshire, UK hosted by RAL STFC	Monday 13 - Wed 15 January 2014, with SCI meeting on 15th and 16th
September 2013	Bucharest, Romania hosted by ROSA	Monday 9 - Wed 11 September 2013
May 2013	Kyiv, Ukraine hosted by UGrid	Monday 13 - Wed 15 May 2013

CSIR meraka

Easier Access to services



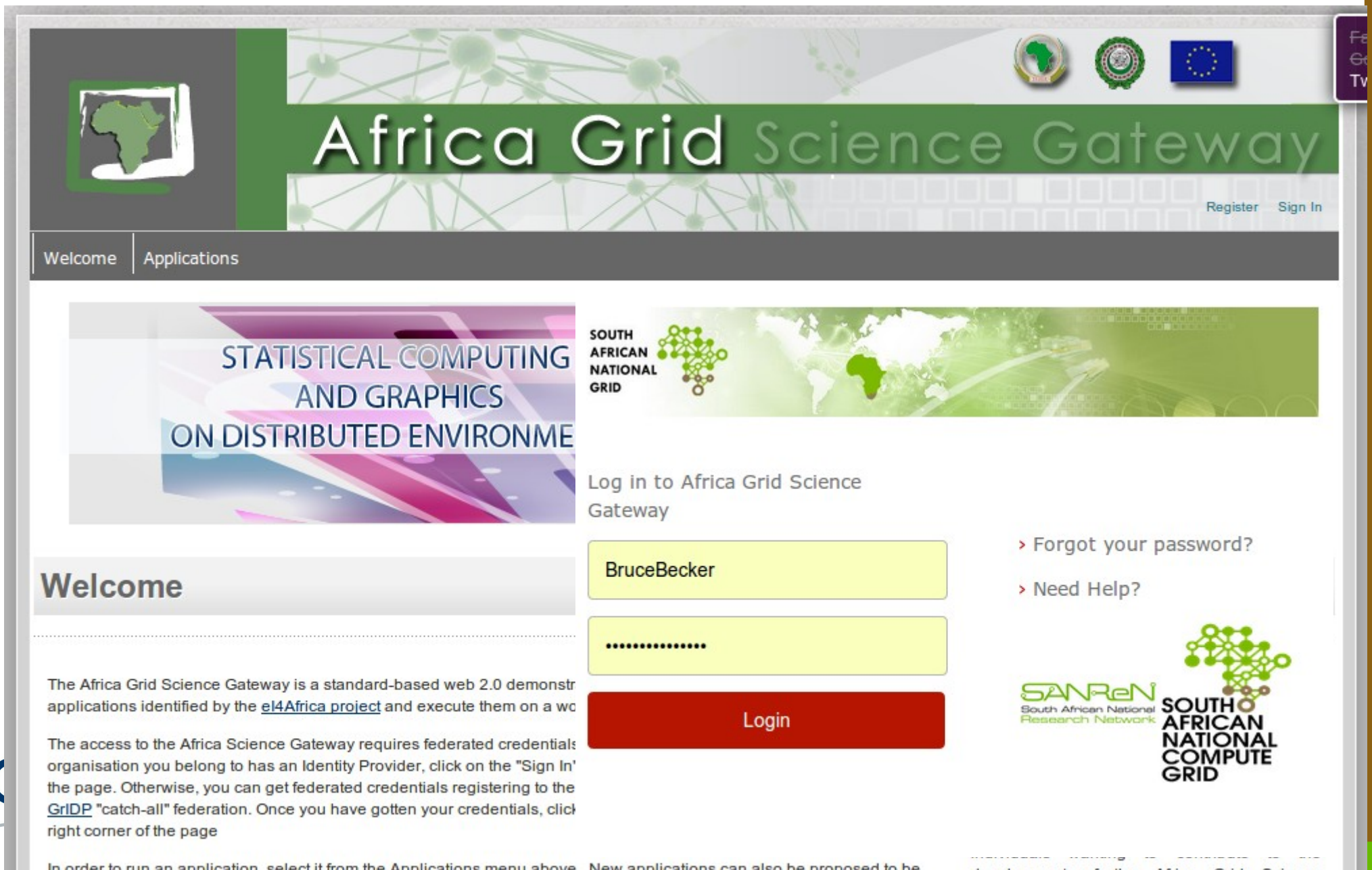
Talk to Siju Mammen

smammen@csir.co.za

Science Gateways

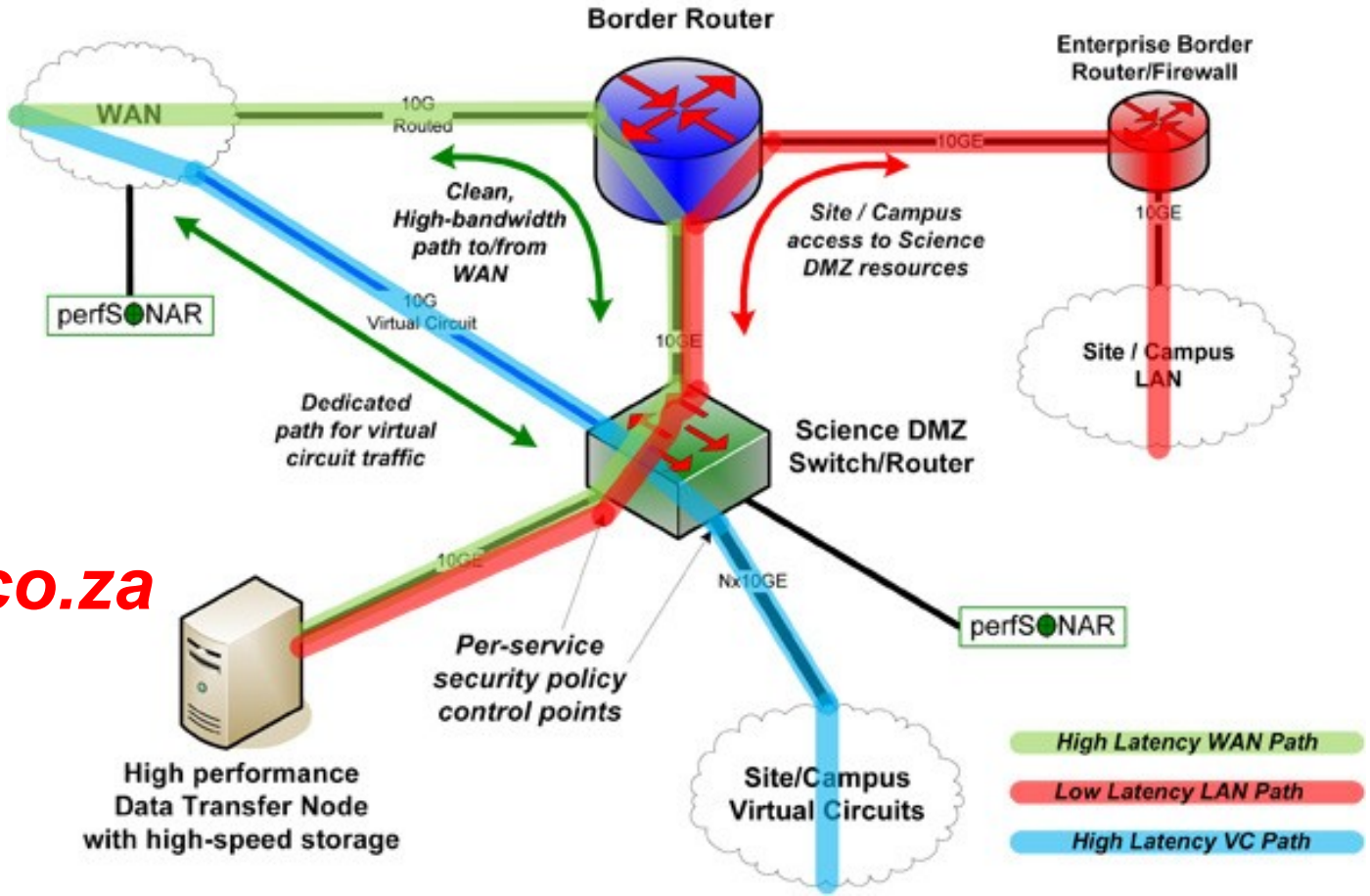
Talk to Albert van Eck (vanecka@ufs.ac.za)
Join CTSG sg-license@ct.infn.it
http://www.catania-science-gateways.it/

Science Gateways



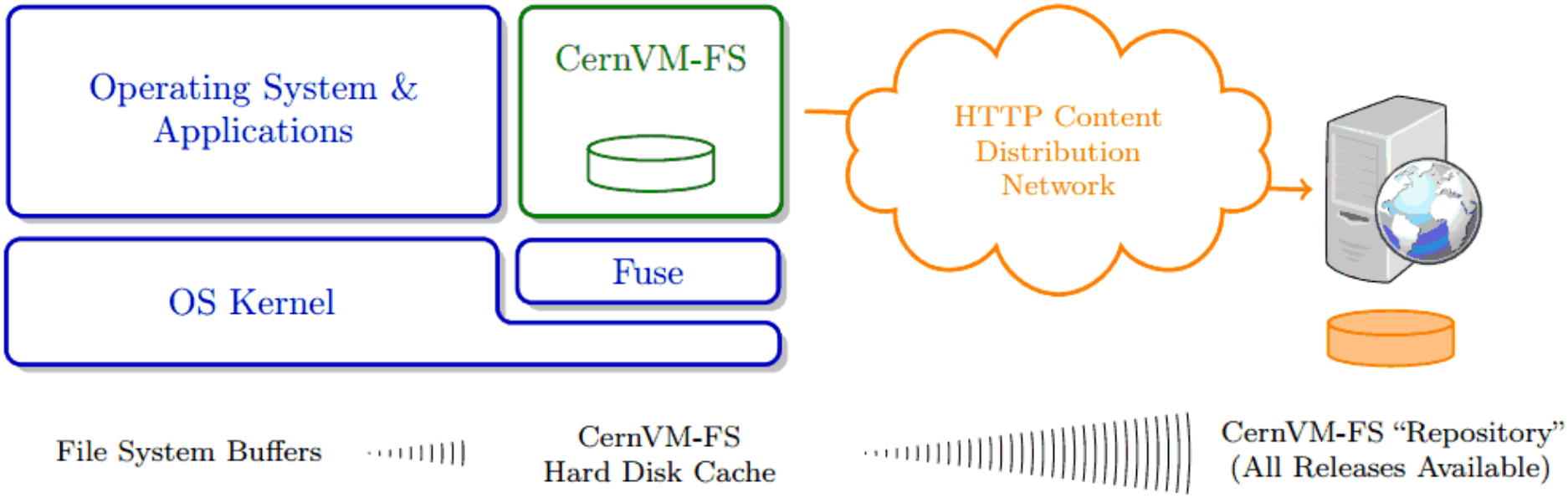
Data: Movement

- Why aren't we moving data at the speed of light?



Talk to
Simeon Miteff
smiteff@csir.co.za

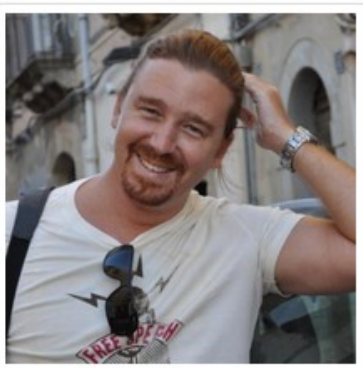
Application distribution : CERNVMFS



Make it easier to contribute

- I have something I want on the grid …
- I have some code that the ops team can use...
- etc

Recognise individuals… wider trust base



Bruce Becker
brucellino

Meraka Institute, CSIR
Pretoria, South Africa
bbecker@csir.co.za
http://www.sagrid.ac.za
Joined on Aug 08, 2012

1	7	8
follower	starred	following

Contributions | Repositories | Public Activity | Edit Your Profile

Popular repositories

- **SAGridIdP** — Code for the Catch-All IdP of South Africa — 1 ★
- **SAGridDemo** — A repository of demo applications to sho… — 1 ★
- **SAGridApps** — SAGrid Applications — 0 ★
- **Quarks-Matter** — Quarks Matter - the story of how and why. — 0 ★
- **test** — playground — 0 ★

Repositories contributed to

- SAGridOps/**SoftwareInstallation** — The installation scripts for SAGrid Applic… — 1 ★
- SAGridOps/**ServiceDocumenta**… — A repository to contain the documentati… — 0 ★
- SAGridOps/**Documents** — A place for public documents — 0 ★

Your Contributions

Decentralise the team

SAGrid Operations team
SAGridOps

South Africa
sagrid-ops@lists.sagrid.ac.za
http://www.sagrid.ac.za
Joined on Jul 05, 2013

6	0	1
public repos	private repos	member

Repositories | Members | Edit SAGridOps's Profile

Find a repository… Search

All Public Private Sources Forks Mirrors

grid-services-deployment
forked from auth-scc/grid-services-deployment
Example ansible playbooks that are used to deploy Grid services
Last updated 12 days ago
Shell ★ 0 1

Documents
A place for public documents
Last updated 16 days ago
★ 0 0

DevOps
Top-level directory of devops scripts for SAGrid
Last updated 20 days ago
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The installation scripts for SAGrid Application deployment.
Last updated 2 months ago
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ServiceDocumentation
A repository to contain the documentation and planning for various services. Includes technical documentation, prototypes, etc.
★ 0 0

Collaborate with code

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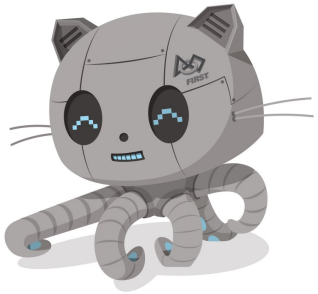

Let the robots do the work

- Define what we want to deploy – let the experts take care of how to deploy
- ***DevOps*** paradigm – same review/tag/release mechanisms on operations code as we have for scientific applications
  - Teach a marketable skill
  - Allow specialisation
  - Enable remote management of complex services
  - Ensure that published methodology is adopted methodology

ANSIBLEWORKS
Radically simple IT orchestration

puppet labs

CSIR meraka

Quality Control and feedback

- Ensure that requested applications are included in the repo
- Provide testing and QA infrastructure
- Self-serve to users

Talk to Fanie Riekert
fanie.riekert@gmail.com

Well done, you made it to the end of the talk

- ”SAGrid” is now a misnomer – have you got a suggestion ?
  - NGI_ZA + lots of other services in a federation
  - A lot of assumptions about ***what*** and ***how*** need to be updated
- Underlying infrastructure and core services need to be reliable – measured and improved
- Peer MoU with EGI.eu
  - greatly increased reliability/availability and scope of services
  - Direct collaboration with other NGI/NRENS
- Eat your own dog food – if it tastes bad, don't be afraid to change it
- Remove barriers to access, usage and development
- Predicting, reporting, managing, implementing infrastructure services

Thank you !

- It's a community... there's no ”us” and ”you”
  - SAGrid on Facebook and Twitter
    - https://www.facebook.com/SAGrid
    - https://www.twitter.com/TheSAGrid
- There's place for everyone and there doesn't necessarily have to be only 1 leader

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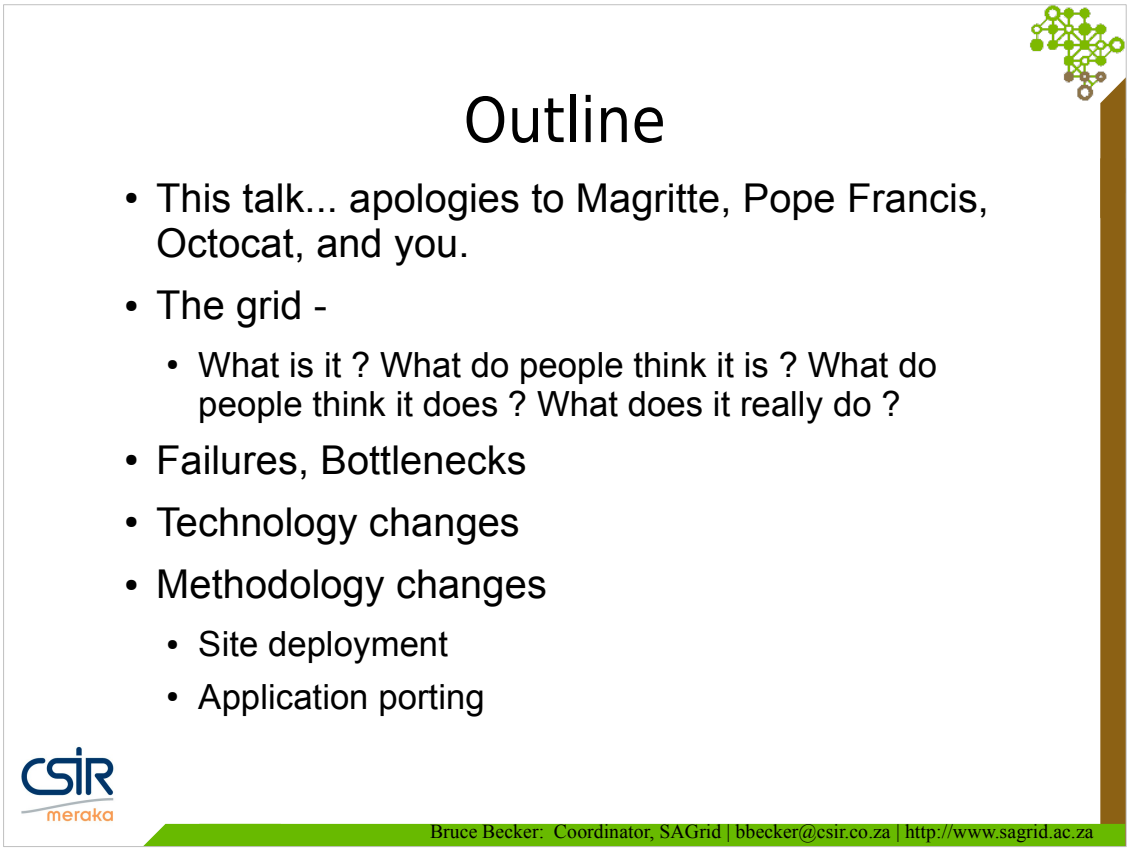

This is the outline of my presentation. I will describe some of the philosophy, interventions and lessons we have learned in South Arica regarding the development of an integrated e-Infrastructure; then I will briefly give a snapshot of the status of such activities in Africa.
Thereafter, I will go into some consideration on how to sustainably support and grow these, leading into the core of my presentation – the Africa and Arabia Regional Operations Centre. Finally, a summary and outlook will be given.

Ceci n'est pas une presentation

Coordinator, SAGrid | bbe

Perceptions

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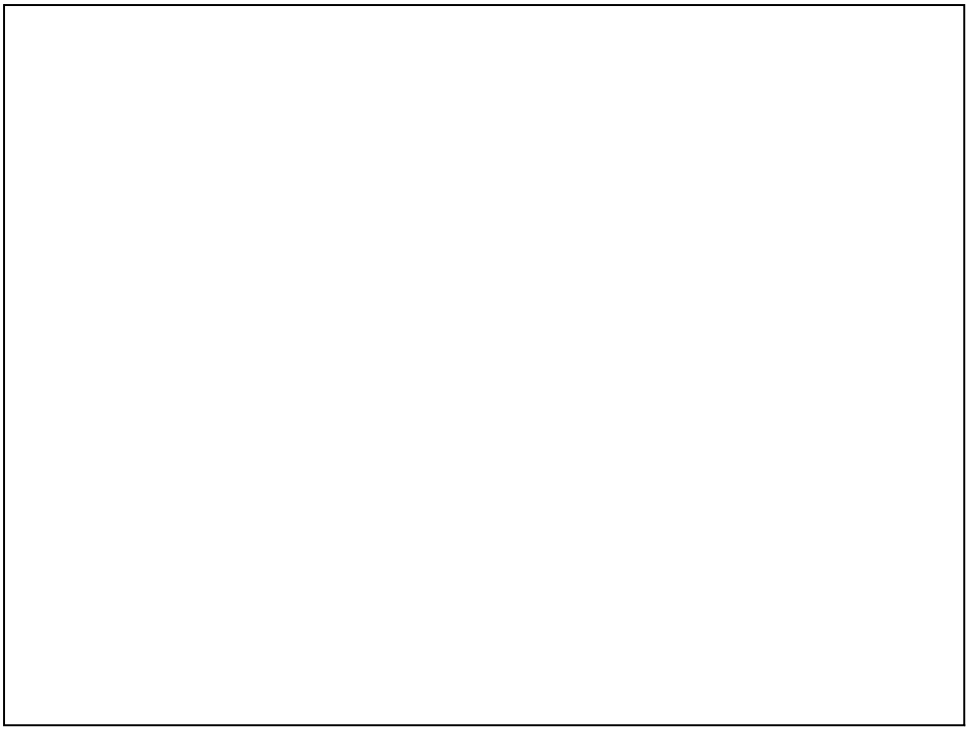

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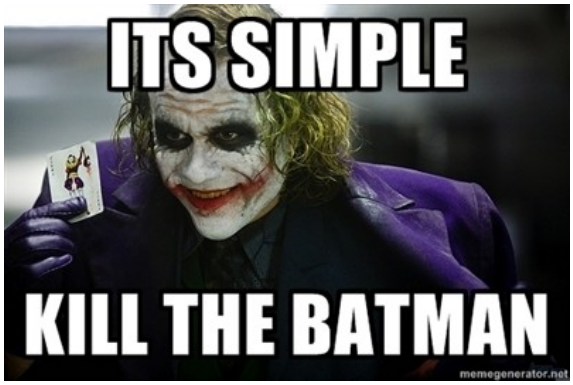

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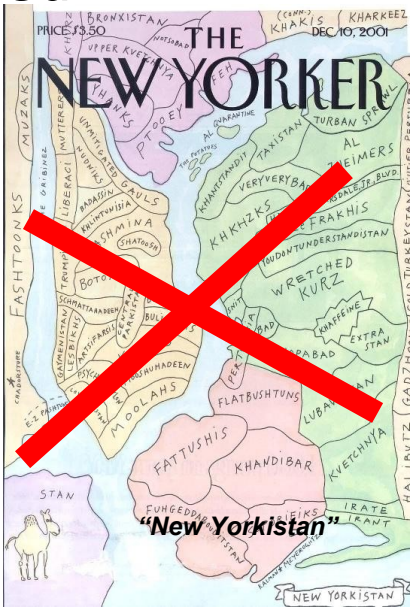
- What does SAGrid do ? **”HPC and data storage + other esoteric ”grid” stuff” right ?**
- Nope – we tried to make a full platform for collaboration
  - Virtual Organisation service – https://voms.sagrid.ac.za
  - Tracking system – https://ops.sagrid.ac.za
    - Projects, tasks
    - Help and feedback
  - Agenda service – https://indico.sagrid.ac.za
  - Digital repository – https://docs.sagrid.ac.za
  - Etc..
- Were installed to help coordinate the operations of the infrastructure, but could be used by all user communities

How it was (not) supposed to be managed

16th Century "Italy"



"New Yorkistan"

How it was (not) supposed to be managed

But neither some mysterious, central dictatorship

How it was supposed to be managed

- JRU was supposed to be a decision-making body, allowing ***collective*** action
  - Decisions are made by JRU, implemented bottom-up by members
  - Coordinated by Meraka
- In the case of participation to collaborative research or development projects, CSIR Meraka could represent the collaboration
- Institutes maintain full ownership and control of their equipment, but agree to share it

How it's really managed

- JRU takes no proactive action
- Members act individually, rather than collectively.
  - Incoherent hardware acquisition – seen as waste or duplication by NRF
  - Inconsistent (inexistent) communications strategy – seen as institutional only
- Decisions are made by coordinator, implemented ”brute-force” top-down
  - Slow, meets with resistance due to conflicting priorities
- No collective participation to e-Infrastructure support actions

What we really do

- Sites differ significantly in capacity and resources
- Separated resources at any given site require specific attention – does not scale
- Loosely-coupled experts form national operations team – initial barrier to entry for new sites remains high
- Inconsistent monitoring and accounting – no accurate view of usage and performance

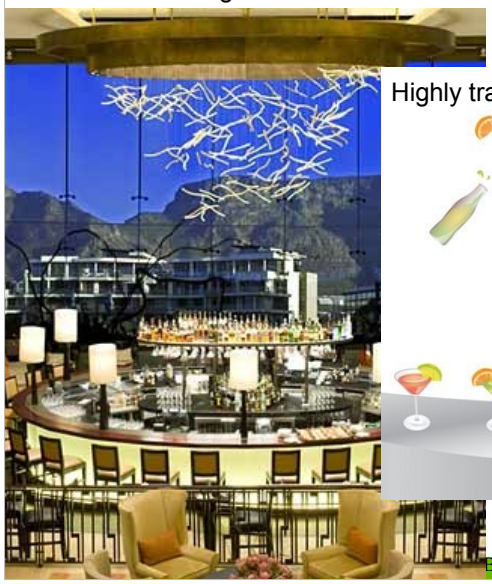
How users were supposed to use it

A scenario : this scientist walks into a bar...

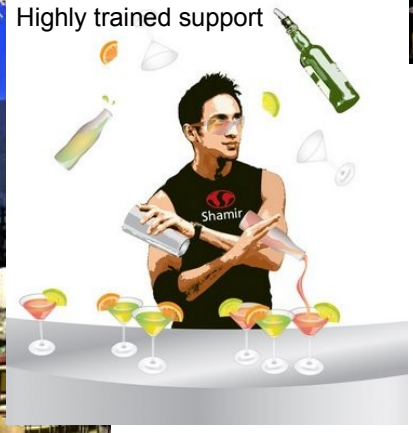
What users want

Some users want highly varied, modular application selection

Amazing infrastructure



Highly trained support



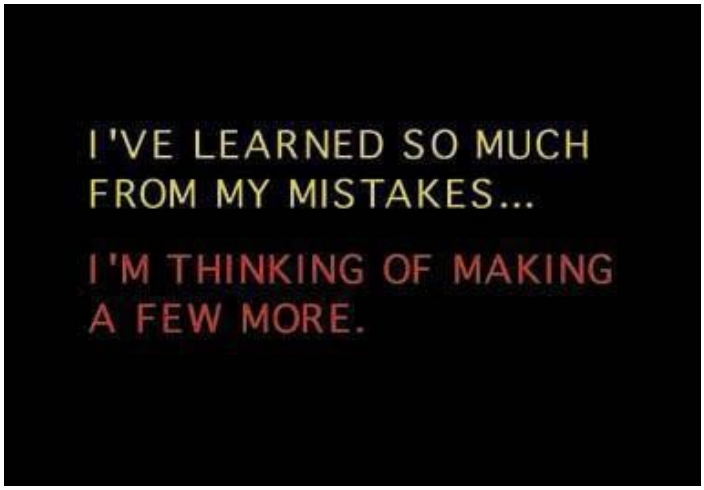
Vertically integrated
Highly specialised applications

What users get sometimes

Bruce Becker: Coordinator, SAGrid | bbecker@csir.co.za | http://www.sagrid.ac.za

SOMETHING, SOMEWHERE
WENT TERRIBLY WRONG.

What went wrong ?



Problems help you learn

Failures : HPC vs grid

- There is a widely-held belief that HPC and grid computing are mortal enemies
  - HPC = big machine for supercomputing / MPI
  - GRID = lots of little machines for ”HEP”
- This is highly counterproductive in SA
  - We don't have any ”supercomputers” - all cluster-based hybrid architectures
  - Advances in middleware, schedulers and workload management systems have made this distinction irrelevant
  - Virtual environments make this distinction even more useless
  - Feeling that having to support ”grid” and ”HPC” is double effort – strain on site, have to choose one.

HPC vs grid – for the record

- The grid is a federation of resources and services, one kind of which is HPC
- Middleware is a ”job transport mechanism”
- Why did this not work in SA ?
  - Proper advertising of resources
  - Common environment for applications
  - No effort on standardising priority and scheduling policies
  - Very little sharing of user-gridops interaction to learn best practices

Failures – Site X

- Very good case to join the infrastructure
  - Well-defined set of applications, widely used
  - Compact team using the site
  - Site admin initially trained at EPIKH school
- Looked good for a while...
  - Site deployed, tested, ready
  - Hardware upgrade + middleware upgrade overloaded system admins
  - Site was removed from the infrastructure

Why ?

- GridOps was seen as an ”extra” activity
- ”price” you pay to join the grid – but what are you getting in return ?
- No help was called in for problems
- Didn't work enough on having relevant applications available to users across the grid
- Unbalanced equation : using local resources, but supporting remote users – no thanks.

Failures – SAAO, SANBI, tLABS

- National facilities with large pools of users
- Commonly-used applications
- Local expertise in HPC and user support
- Almost zero takeup...

Why was it so hard to bring new users on board ?

- Culture shock
  - Fundamental misconception of what the grid can do / what it is
  - Missed opportunities of joining existing Virtual Oranisation – user feels alone
  - No specific message – ”the grid can do everything !” yes, but how do I do this specfic thing
  - Static, irrelevant training material – doesn't speak to the user
  - One-way communication – no feedback channel → no improvement
  - Responsiveness too low
- Barriers to entry
  - x.509 certificates, new technology/methodolgy
  - Training model

New User Bottlenecks

- I want to get started !
  - Wait for your certificate
- I want to get started.
  - Learn a new paradigm and a new language
- I want to get started...
  - Tell us about your code and we'll put it in the list of applications to be ported
- Bye...

New Site Bottlenecks

- Q: What's this grid thing ?
  - A: Set up your cluster, rtfm, deploy middleware, give us your bdii and you're good.
- Q: Yes, but what ***is*** this grid thing ?
  - A: You have 12 tickets open, what's the problem ?
- Q: It's for physicists, right ? But I have astronomers asking for HPC...
  - A: Ok, we're going through a middleware upgrade – when are you going to be upgrading ?

CSIR meraka

Parlez-vous grid ?

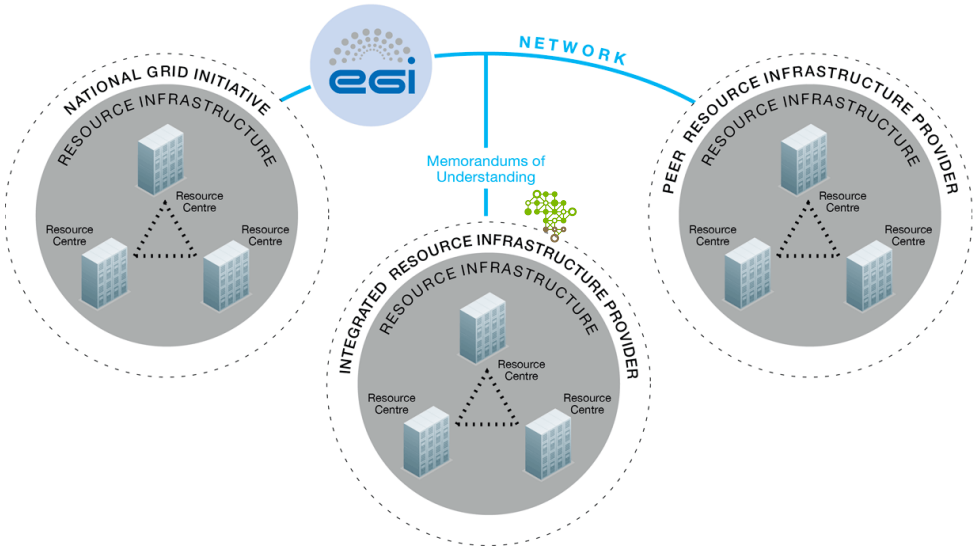
Changes to the playing field

- New middleware stack
- Highly improved technology provider, but some disruption

Changes to the playing field

- More formal technical basis to the collaboration
  - OLA/SLA basis to operational infrastructure and services
- Better understanding of the state and nature of the services provided
- Easier to add, publish services and collaborate: e.g. :
  - Monitoring
  - Security
  - Web services
  - Identity Services

An interoperable infrastructure



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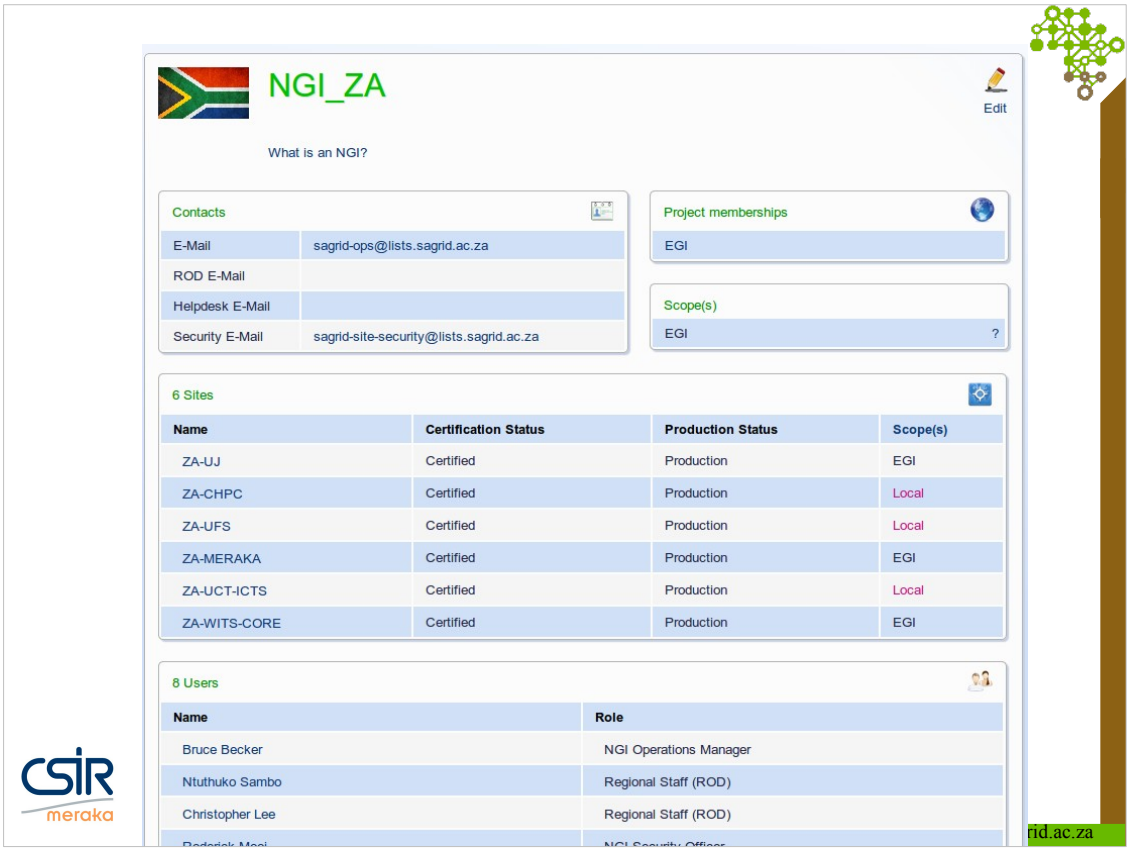


NGI_ZA

Edit

What is an NGI?

Contacts

E-Mail	sagrid-ops@lists.sagrid.ac.za
ROD E-Mail	
Helpdesk E-Mail	
Security E-Mail	sagrid-site-security@lists.sagrid.ac.za

Project memberships

EGI

Scope(s)

EGI ?

6 Sites

Name	Certification Status	Production Status	Scope(s)
ZA-UJ	Certified	Production	EGI
ZA-CHPC	Certified	Production	Local
ZA-UFS	Certified	Production	Local
ZA-MERAKA	Certified	Production	EGI
ZA-UCT-ICTS	Certified	Production	Local
ZA-WITS-CORE	Certified	Production	EGI

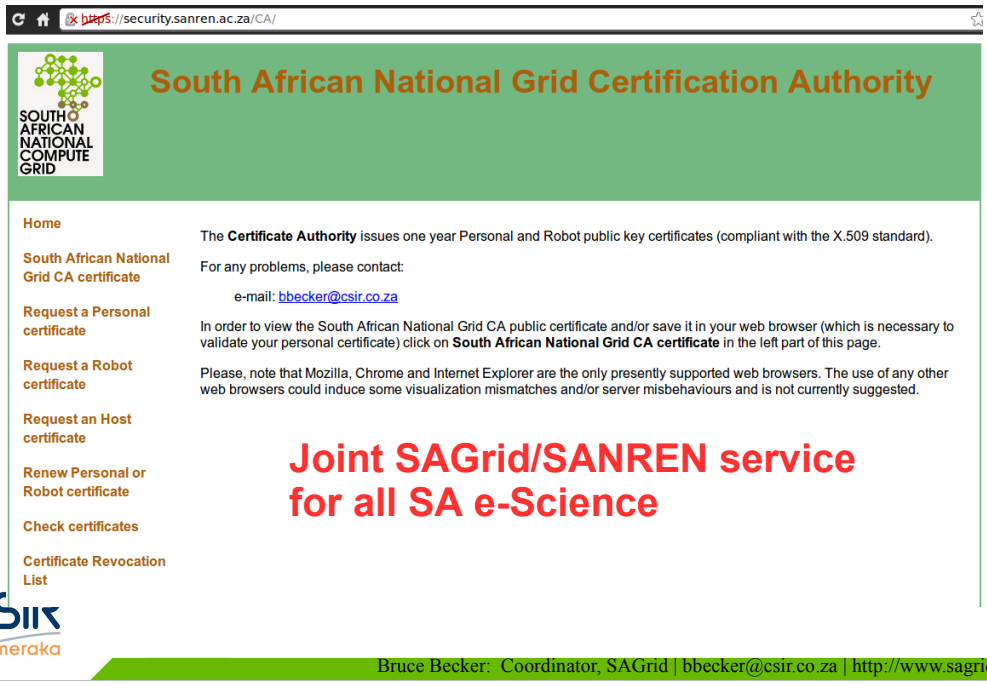
8 Users

Name	Role
Bruce Becker	NGI Operations Manager
Ntuthuko Sambo	Regional Staff (ROD)
Christopher Lee	Regional Staff (ROD)
Roderick Mooi	NGI Security Officer

rid.ac.za

Who is the grid ?

New Services – SA CA



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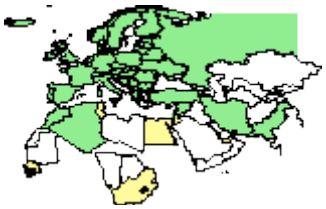
New Services – SA CA Accreditation

IGTF International Grid Trust Federation
AP | EU | TAG

eugridpma



Meetings

(meetings from our sister PMAs are available at: the TAGPMA conference site and the APGridPMA F2F meeting site)

Date	Location	Details
January 2014	Abingdon, Oxfordshire, UK hosted by RAL STFC	Monday 13 - Wed 15 January 2014, with SCI meeting on 15th and 16th
September 2013	Bucharest, Romania hosted by ROSA	Monday 9 - Wed 11 September 2013
May 2013	Kyiv, Ukraine hosted by UGrid	Monday 13 - Wed 15 May 2013

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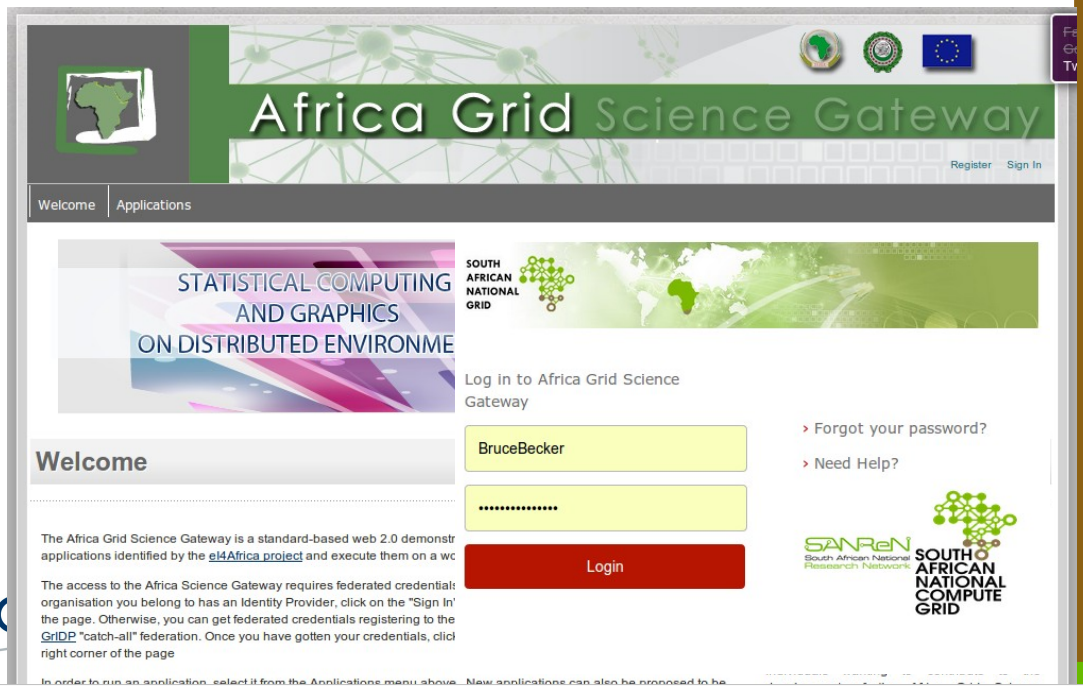
Easier Access to services

Talk to Siju Mammen
smammen@csir.co.za

Science Gateways

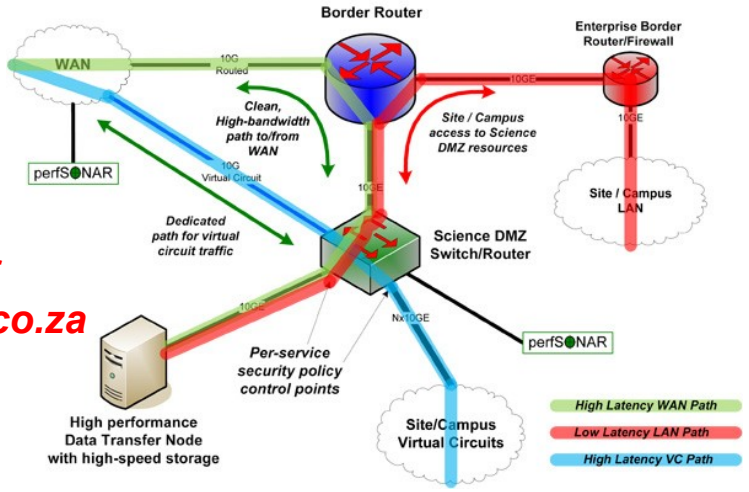
Talk to Albert van Eck (vanecka@ufs.ac.za)
Join CTSG sg-license@ct.infn.it
http://www.catania-science-gateways.it/

Science Gateways



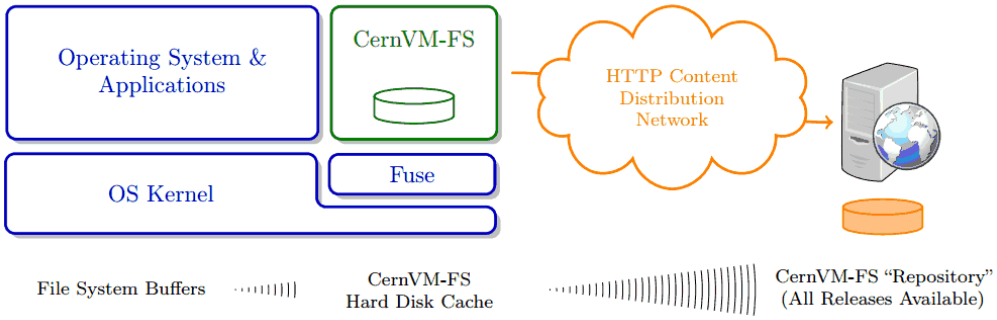
Data: Movement

- Why aren't we moving data at the speed of light?



Talk to
Simeon Miteff
smiteff@csir.co.za

Application distribution : CERNVMFS



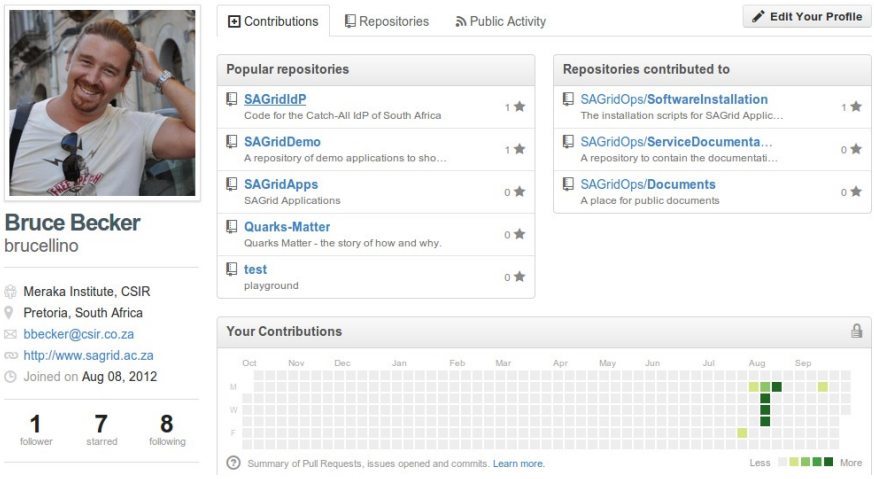
Make it easier to contribute

- I have something I want on the grid …
- I have some code that the ops team can use...
- etc

meraka

Bruce Becker: Coordinator, SAGrid | bbecker@csir.co.za | http://www.sagrid.ac.za

Recognise individuals... wider trust base



Bruce Becker
brucellino

Meraka Institute, CSIR
Pretoria, South Africa
bbecker@csir.co.za
http://www.sagrid.ac.za
Joined on Aug 08, 2012

1 follower | 7 starred | 8 following

Contributions | Repositories | Public Activity | Edit Your Profile

Popular repositories

- SAGridIdP — Code for the Catch-All IdP of South Africa — 1 ★
- SAGridDemo — A repository of demo applications to sho… — 1 ★
- SAGridApps — SAGrid Applications — 0 ★
- Quarks-Matter — Quarks Matter - the story of how and why. — 0 ★
- test — playground — 0 ★

Repositories contributed to

- SAGridOps/SoftwareInstallation — The installation scripts for SAGrid Applic… — 1 ★
- SAGridOps/ServiceDocumenta… — A repository to contain the documentati… — 0 ★
- SAGridOps/Documents — A place for public documents — 0 ★

Your Contributions

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

Summary of Pull Requests, issues opened and commits. Learn more. Less More

Decentralise the team

SAGrid Operations team
SAGridOps

South Africa
sagrid-ops@lists.sagrid.ac.za
http://www.sagrid.ac.za
Joined on Jul 05, 2013

6	0	1
public repos	private repos	member

Repositories | Members | Edit SAGridOps's Profile

Find a repository... Search | All Public Private Sources Forks Mirrors

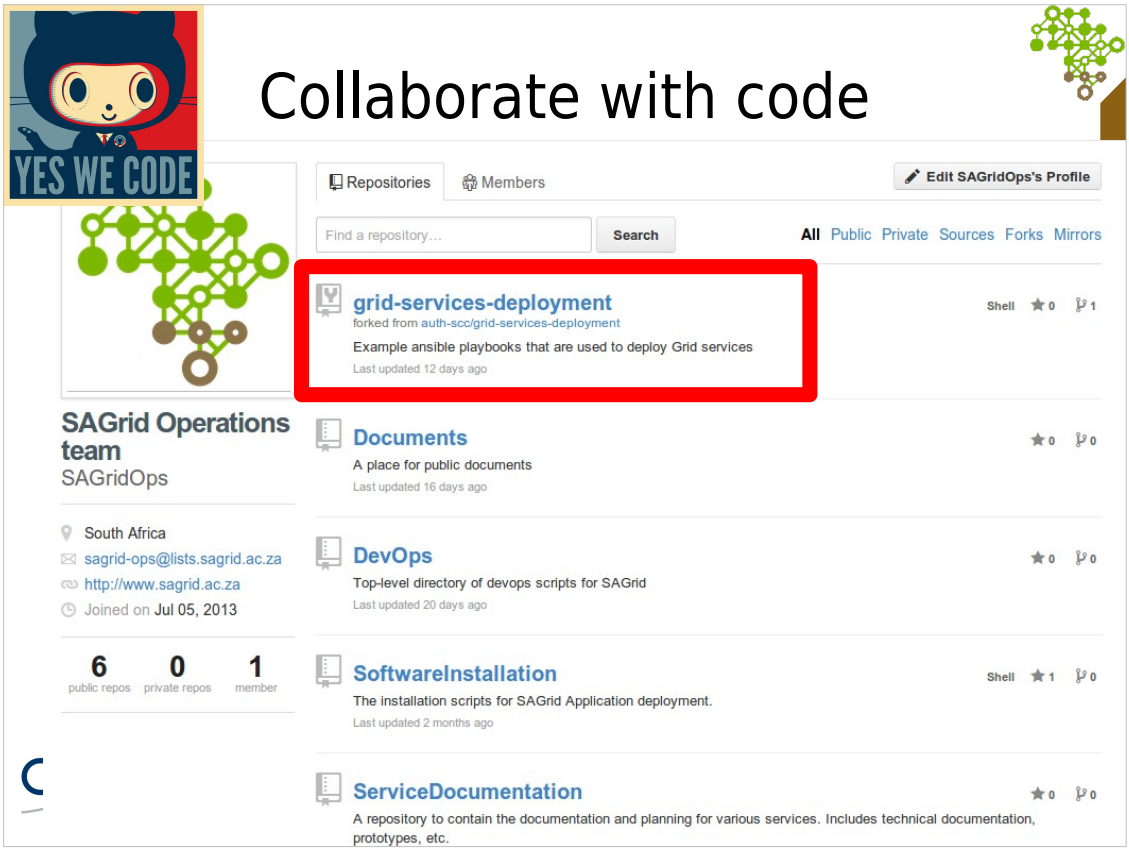
grid-services-deployment — Shell ★0 ⑂1
forked from auth-scc/grid-services-deployment
Example ansible playbooks that are used to deploy Grid services
Last updated 12 days ago

Documents — ★0 ⑂0
A place for public documents
Last updated 16 days ago

DevOps — ★0 ⑂0
Top-level directory of devops scripts for SAGrid
Last updated 20 days ago

SoftwareInstallation — Shell ★1 ⑂0
The installation scripts for SAGrid Application deployment.
Last updated 2 months ago

ServiceDocumentation — ★0 ⑂0
A repository to contain the documentation and planning for various services. Includes technical documentation, prototypes, etc.


YES WE CODE
Collaborate with code
Repositories
Members
Edit SAGridOps's Profile
Find a repository...
Search
All Public Private Sources Forks Mirrors
grid-services-deployment
forked from auth-scc/grid-services-deployment
Example ansible playbooks that are used to deploy Grid services
Last updated 12 days ago
Shell 0 1
SAGrid Operations team
SAGridOps
South Africa
sagrid-ops@lists.sagrid.ac.za
http://www.sagrid.ac.za
Joined on Jul 05, 2013
6 public repos
0 private repos
1 member
Documents
A place for public documents
Last updated 16 days ago
0 0
DevOps
Top-level directory of devops scripts for SAGrid
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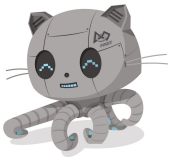

Let the robots do the work

- Define what we want to deploy – let the experts take care of how to deploy
- ***DevOps*** paradigm – same review/tag/release mechanisms on operations code as we have for scientific applications
  - Teach a marketable skill
  - Allow specialisation
  - Enable remote management of complex services
  - Ensure that published methodology is adopted methodology

ANSIBLEWORKS
Radically simple IT orchestration

CSIR meraka

puppet labs

Quality Control and feedback

- Ensure that requested applications are included in the repo
- Provide testing and QA infrastructure
- Self-serve to users

Talk to Fanie Riekert
fanie.riekert@gmail.com

Well done, you made it to the end of the talk

- ”SAGrid” is now a misnomer – have you got a suggestion ?
  - NGI_ZA + lots of other services in a federation
  - A lot of assumptions about ***what*** and ***how*** need to be updated
- Underlying infrastructure and core services need to be reliable – measured and improved
- Peer MoU with EGI.eu
  - greatly increased reliability/availability and scope of services
  - Direct collaboration with other NGI/NRENS
- Eat your own dog food – if it tastes bad, don't be afraid to change it
- Remove barriers to access, usage and development
- Predicting, reporting, managing, implementing infrastructure services

Thank you !

- It's a community... there's no ”us” and ”you”
  - SAGrid on Facebook and Twitter
    - https://www.facebook.com/SAGrid
    - https://www.twitter.com/TheSAGrid
- There's place for everyone and there doesn't necessarily have to be only 1 leader

Bruce Becker: Coordinator, SAGrid | bbecker@csir.co.za | http://www.sagrid.ac.za