

vl-e



virtual laboratory for e-science



BiG Grid

the dutch e-science grid

De BiG Grid e-Infrastructuur *digitaal onderzoek verbonden*

David Groep, Nikhef

KennisKring Amsterdam

28 october 2009

(abbreviated version)





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Broadband network soon to be o

By Ryan Emery
April 07, 2008 03:44am

BY the time Australia upgrades its broadband network, it could be obsolete - thanks to a high-speed network in Geneva.

The new network, called "the grid", is more than 10 times faster than a typical broadband connection.

It is a system of fibre-optic cables and modern fibre-optic routers and other music catalogues can be downloaded within two hours.

The grid, devised by scientists at CERN, the European Nuclear Research, and helped by the Large Hadron Collider, will also transmit holographic data for the price of a telephone call.

... professor David Britton, of the University of Glasgow in Scotland, says the network is "a game-changer".



De Telegraaf Digitaal

maandag 21 april

ma 07 apr 2008, 12:29

Internet binnenkort 10.000 keer sneller

door onze redactie

AMSTERDAM - Het internet zoals wij dat kennen kan binnenkort wel eens sterk verouderd zijn. De wetenschappers die aan de wijk stonden van het huidige internet zijn namelijk bezig met een variant die tot 10.000 keer sneller zal zijn dan het snelste huidige breedbandnetwerk.

10:44 Zoon aangezien voor kalfje

10:32 Opcesten sinds 2000 verduubeld

10:30 Stelling NAVO moet meer...

10:09 Zoonje afmaken

De LArge Hadron Collider, de deelpvsmellier van het Europese onderzoeksbureau CERN.

CERN," zegt professor David Britton, van de universiteit van Glasgow in de Schotland.

en in Zwitserland dat de LArge Hadron Collider de deelpvsmellier van het Europese onderzoeksbureau CERN is. Het is een van de grootste wetenschappelijke projecten ter wereld. Het kostte tot nu toe al meer dan 5 miljard dollar en zal uiteindelijk kosten van 5,5 miljard dollar. Het is een van de grootste wetenschappelijke projecten ter wereld. Het kostte tot nu toe al meer dan 5 miljard dollar en zal uiteindelijk kosten van 5,5 miljard dollar.

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Make sure you're coming to us

Crash as video demand soars

... within two years under the pressure of booming demand for video.

... the world wide web

Webwereld

ALTIJD HET LAATSTE ICTNIEUWS

Tip ons Archief Whitepapers

Nederland grote hulp bij grid-project

Dinsdag 26 april 2005, 15:54 - Acht computercentra, waaronder het Nederlandse Sara, zijn met elkaar verbonden om binnen tien dagen 500 terabyte aan data uit te wisselen.

Bij het zogenoemde LHC Computing Grid-project zijn diverse Nederlandse instellingen betrokken waaronder het Nederlandse Sara en het Nikhef. De centra gaan de LArge Hadron Collider (LHC) testen.

Doel van het project is om voldoende reken-, opslag- en netwerkfaciliteiten te verschaffen om wetenschappelijke experimenten te laten slagen.

De verbindingen zullen binnen tien dagen ononderbroken gegevens uitwisselen met een getimede snelheid van 600 Mbps. In totaal zal er aan het einde ongeveer 500 terabyte (512.000 gigabyte) aan data zijn verstuurd. Waarmee er gebruik zou zijn gemaakt van een eenvoudige 512 Kbps-verbinding zou hiervoor 250 jaar nodig zijn", aldus de organisatie.

Onderzoekers staan te dringen om plaatsje op Nederlands wetenschappelijk grid

» BIG GRID officieel gelanceerd

Op het BIG GRID-lanceeringsmoment in de zomer van 2005 hebben de onderzoekers van de Universiteit van Groningen en de Universiteit van Leiden de handen in elkaar geslagen om de Nederlandse wetenschappelijke grid te lanceren. Het is een van de grootste wetenschappelijke projecten ter wereld. Het kostte tot nu toe al meer dan 5 miljard dollar en zal uiteindelijk kosten van 5,5 miljard dollar.

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e-Infrastructure for Research

World Wide Web (1990) – sharing information

Grid (1997) – sharing computers and storage

Clouds (2007) – commoditizing the Grid

more than one place on earth



more than one science!

What Makes
e-Research Happen ...



more than one computer

more than ...

And Why Do We Need It?

**Enhanced Science needs more and more computations and
Collected data in science and industry grows exponentially**

The Bible	5 MByte
Your own digital photographs	5 MByte/image
Bio-informatics databases	500 GByte each
Refereed journal papers	1 TByte/yr
Satellite world imagery	5 TByte/yr
Large Synoptic Survey Telescope	30 Tbyte/day
Internet Archive 1996-2002	100 Tbyte
Web downloads for Google indexing	4 PByte/yr
Large Hadron Collider physics	20 PByte/yr
Astronomy tomorrow: SKA	365 PByte/yr

1 Petabyte = 1 000 000 000 Megabyte

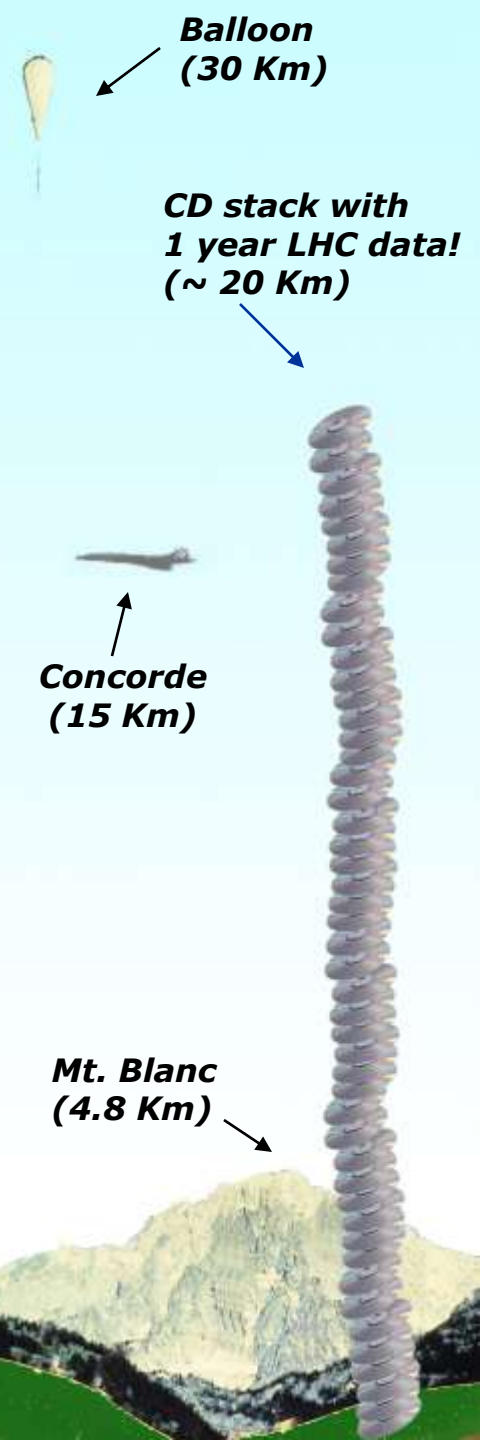
Computing for Sub-Atomic Physics

Example: the Large Hadron Collider

- looking at the fundamental forces of nature
- 27 km circumference
- Located at CERN, Geneva, CH

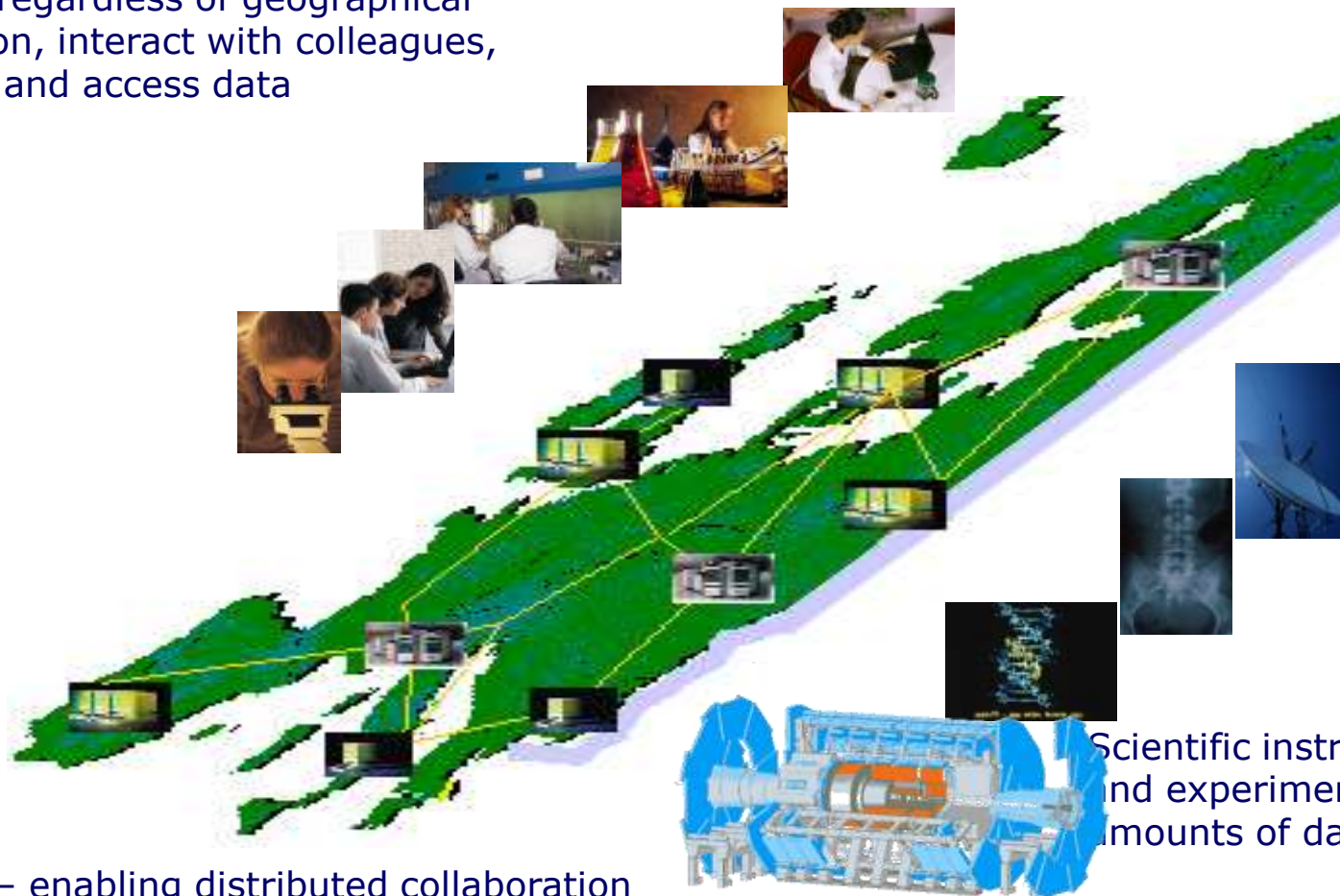
~ 20 000 000 Gigabyte per year

~ 60 000 modern PC-style computers



Beyond the Web: Grids for e-Science

Work regardless of geographical location, interact with colleagues, share and access data



Scientific instruments, libraries and experiments provide huge amounts of data

Grid – enabling distributed collaboration

- Software enables resource sharing
- Community building and collaboration
- Access resources at any place
- Move your work around the world, or in to the Cloud



WISDOM

Initiative for grid-enabled drug discovery
against neglected and emergent diseases



European Commission

Information Society
and MediaAUVERGNE
CORSE REGIONAL D'AUTONOMIE

SHARE

EGEE
Enabling Grids
for E-science

AuverGrid



ASGC

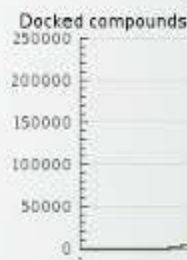
MBRACE
Grid
Network of excellenceBioinfoGRID
Bioinformatics Grid Application for the scientist

Jobs per Site



NUMBER OF DOCKED COMPOUNDS.....	241200
IN SILICO COST.....	8.712 €
IN VITRO ESTIMATED COST.....	120.600 €
CPU.DAYS CONSUMED.....	363
SUCCESS RATE.....	83 %

Docked Compounds vs. Time



- 47 sites
- 15 countries
- 3000 CPUs
- 12 TByte disk

over 46 million ligands virtually docked on malaria and H5N1 avian flu viruses in less than a month

Science and Corporate Grids

Big science is not alone

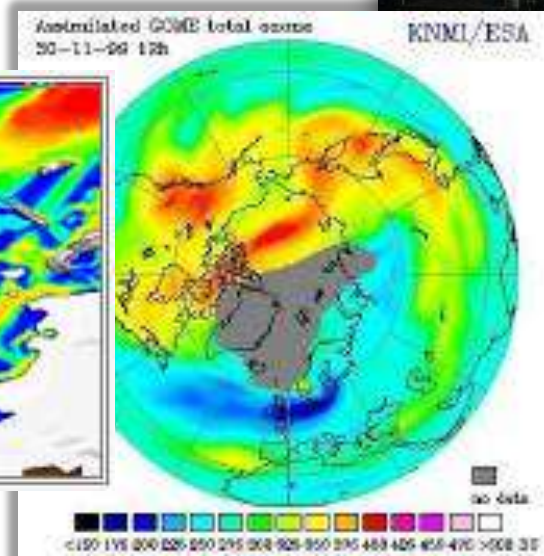
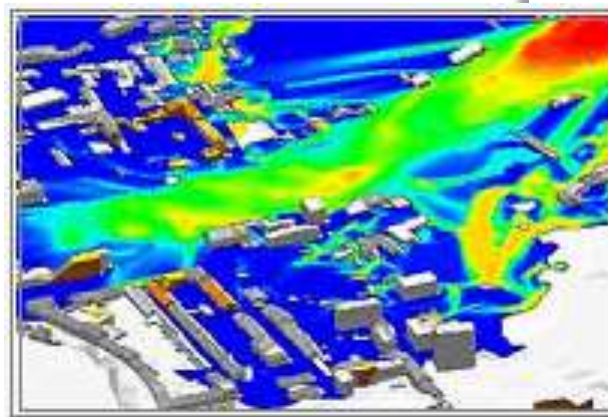
Medical imaging

Aerospace modelling air flow and stress

Finance rapid what-if analyses (oops!)

Climate modelling

Flood prediction

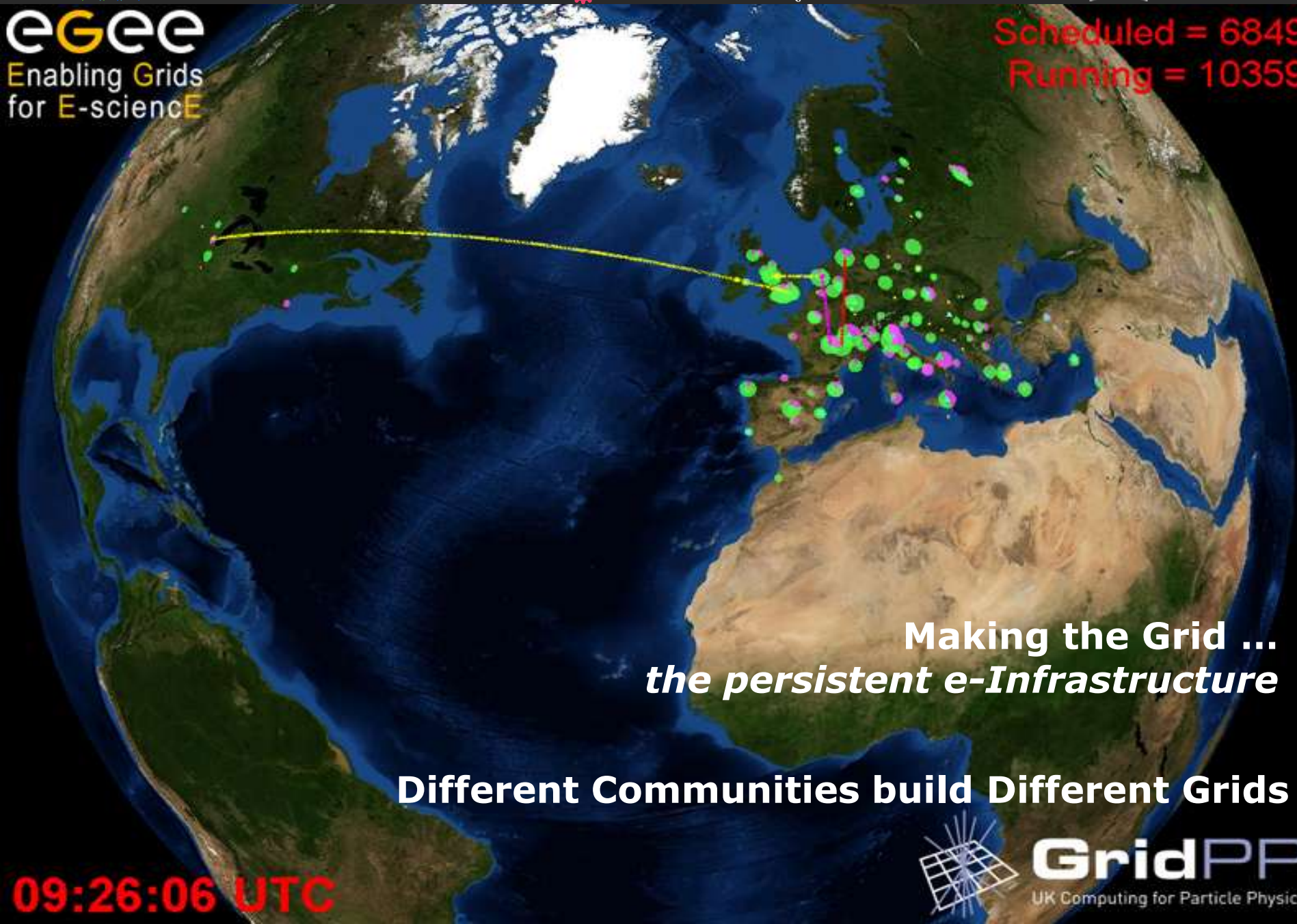


But although the parallelism is convenient, managing complexity in a large-scale environment is not ... and cooling and power constraints limit the data centre ... the grid could help do the work in the 'greenest' place



eGEE
Enabling Grids
for E-science

Scheduled = 6849
Running = 10359



Making the Grid ...
the persistent e-Infrastructure

Different Communities build Different Grids

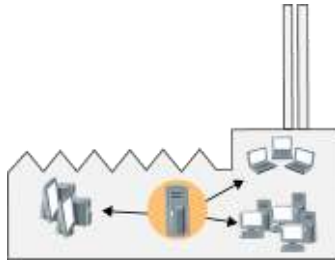
09:26:06 UTC



GridPP

UK Computing for Particle Physics

Enterprise Grids



Finance
Pharma
Aerospace
Cinema

*Large clusters
Dedicated or
Virtual Private Networks*

'the Cloud'
Amazon
Google
SalesForce.com
...

*Backup-as-a-Service
Software-as-a-Service
Infrastructure-as-a-Service*

Commoditized services
Available to SMEs
... and even consumers
Different name, same concept!



Contributed 'Volunteer' Computing



Many applications fit a 'client-server' model

– 'it does not matter where the computer or data is' –

and if you have mainly compute tasks and little data,
even idle home PCs can contribute compute power

– although network bandwidth is limited ...



Pioneered ~ 1996 by
SETI@home
and 'distributed.net'

BOINC: generic
middleware for
'volunteer' grids:
2005

[Download Folding@home](#)



go to boinc.berkeley.edu for information and links to projects

Conveniently Parallel Computing

Lab A

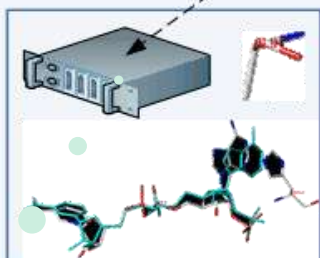
**Find ligands from the bowl
that match the molecule!**



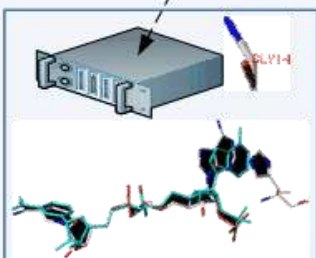
I can try all of
them in parallel!

Computer centre B

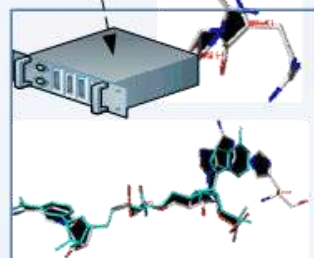
Send results back



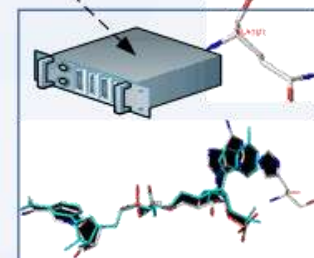
Grid Site



Grid Site



Grid Site



Grid Site

Does it fit?

- scientific and research cluster grid computing -

BiG Grid

the dutch e-science grid

Nikhef (NDPF)

2550 processor cores
390 000 GByte disk
3x10000 Mbps networks

SARA (GINA+LISA)

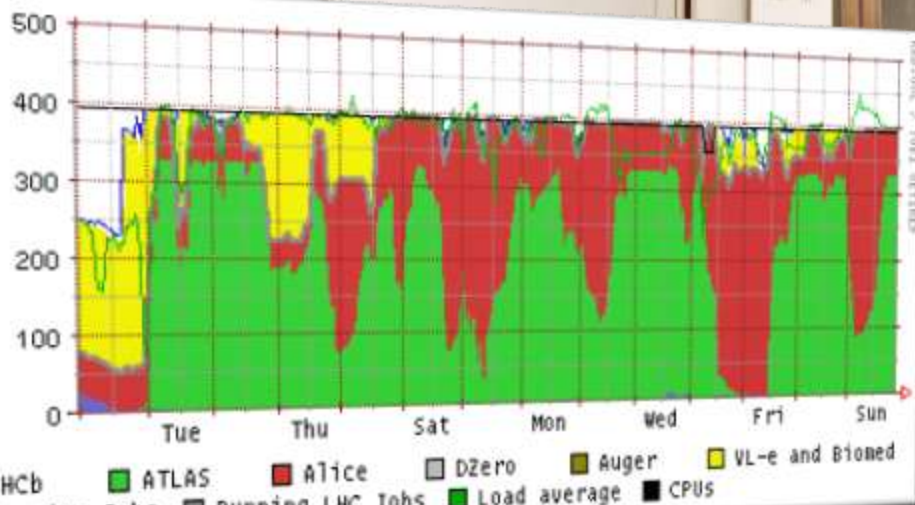
~2900 processor cores
850 000 GByte disk
1 500 000 GByte tape
4x 10 000 Mbps networks

RUG-CIT (Grid)

> 200 processor cores
34 000 GByte disk
10 000 Mbps networks

Philips Research Eindhoven

416 processor cores
126 000 GByte disk
1 000 Mbps networks



Enabling the Grid – the Network

TRIUMPH (CA)
USLHCNET

LHC Optical Private Network

**10 000 Mbps dedicated
global networks**

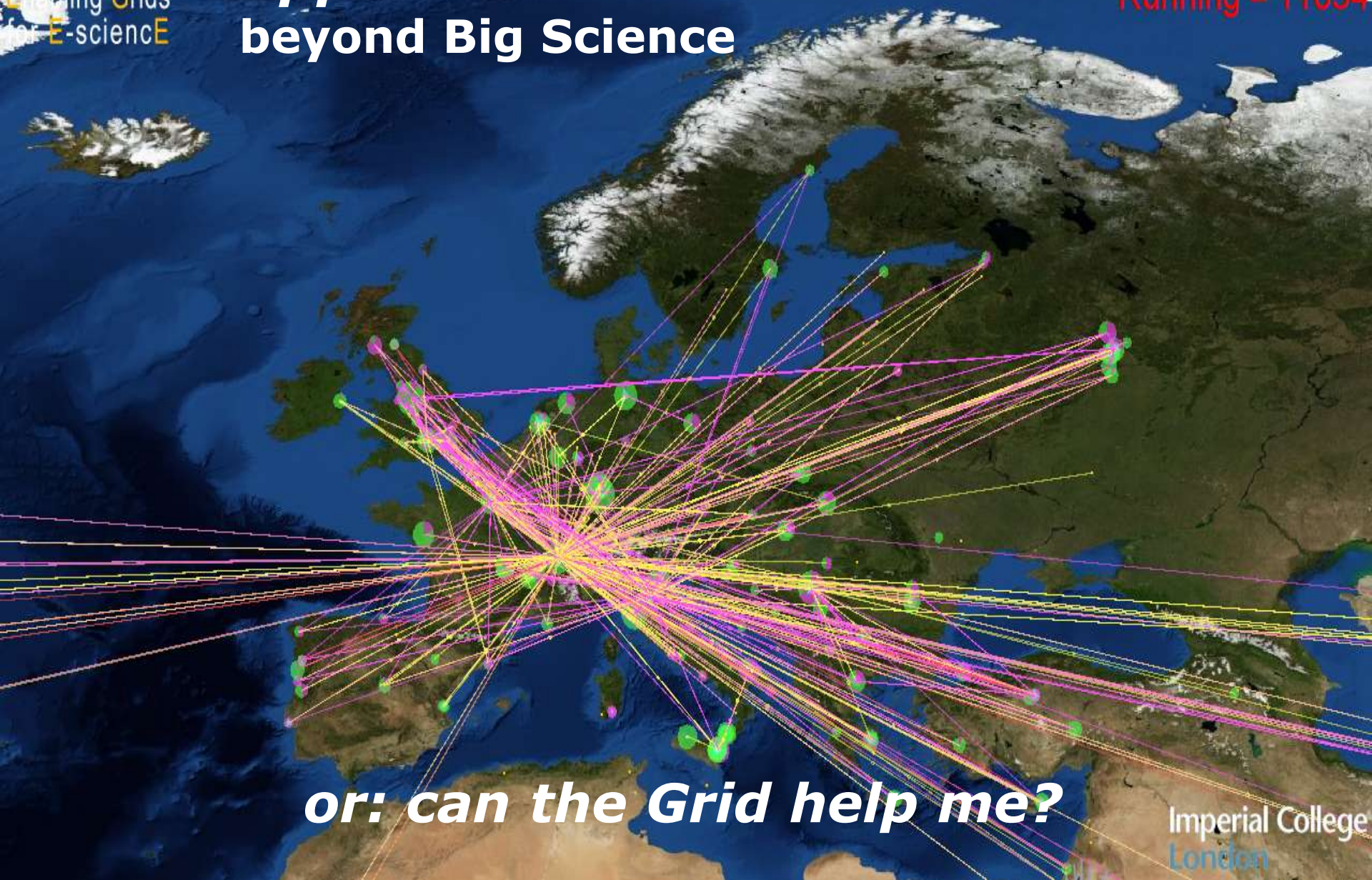


*“there’s always fibre within 2 miles from you –
where ever you are in the Netherlands
it’s just that last mile to your home that’s missing –
and a business model for your telecom provider...”*



Applications beyond Big Science

Scheduled = 9740
Running = 11034



or: can the Grid help me?

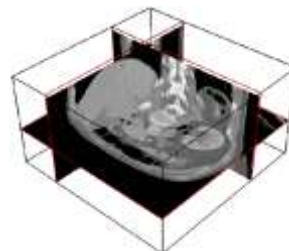
Image sources: VL-e Consortium Partners

Virtual Laboratory for e-Science



Data integration for genomics, proteomics, etc. analysis

Timo Breit et al.
*Swammerdam
Institute of
Life Sciences*



Medical Imaging and fMRI

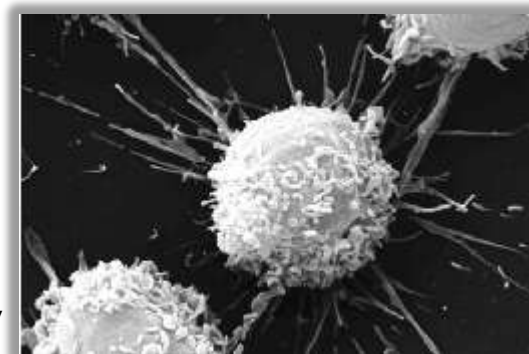
Silvia Olabbarriaga et al.
AMC and UvA IvI



Avian Alert and FlySafe

Willem Bouten et al.
*UvA Institute for Biodiversity
Ecosystem Dynamics, IBED
in ESA, SARA collaboration*

Bram Koster et al.
*LUMC
Microscopic Imaging group*



Molecular Cell Biology and 3D Electron Microscopy



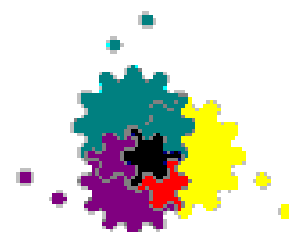
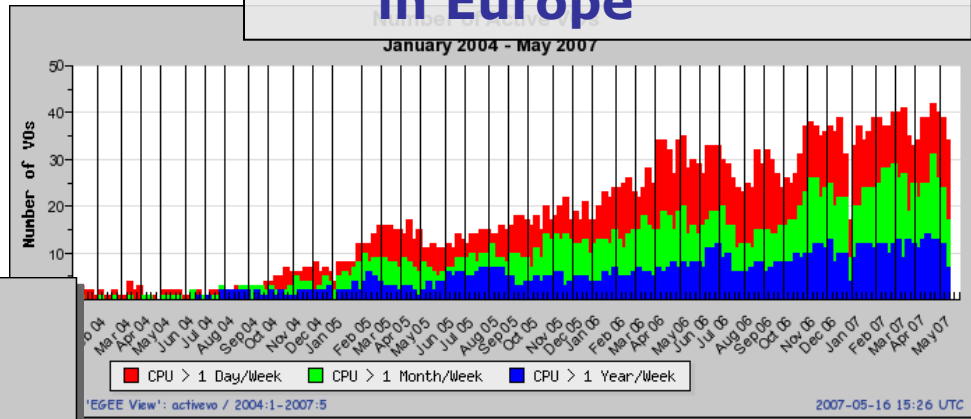
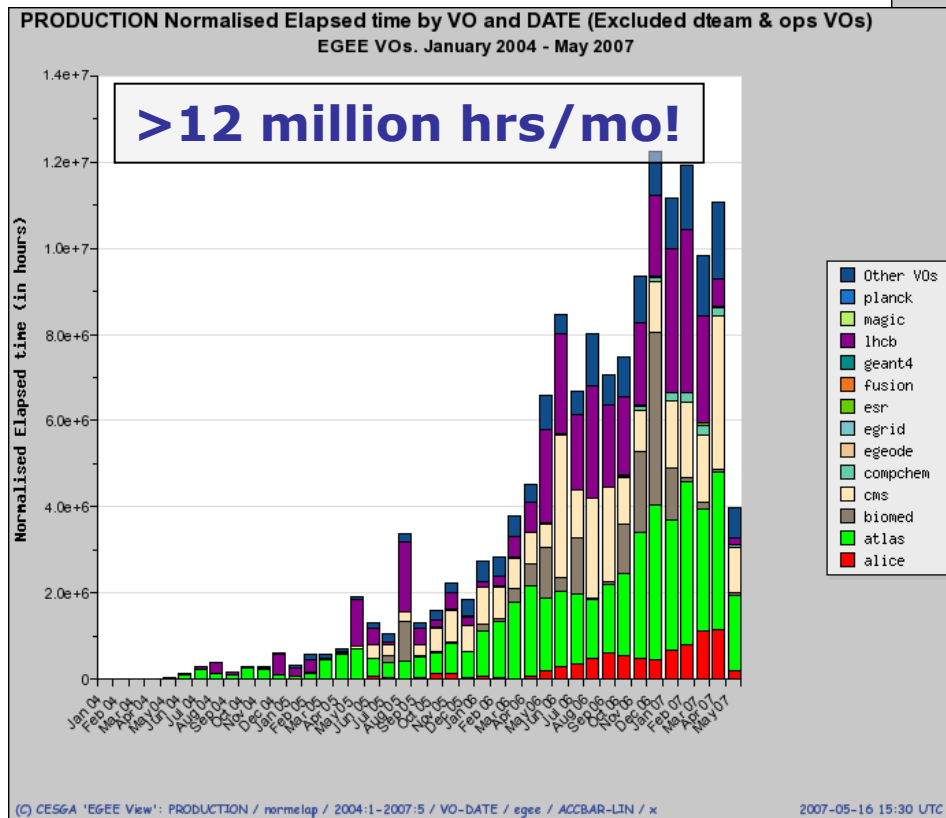
Grid Infrastructures Work!



Number of **active** VOs in EU since 2004

260 distinct communities in Europe

Compute usage since 2004 by VO



www.biggrid.nl

BiG Grid
the dutch e-science grid

over 35 science communities hosted in NL

Energizing the Data Centre – the next challenge

Floor space is no longer the limiting factor in data centres, its energy!

Rating of the power socket dominates the cost of in commercial housing

Our BiG Grid tenders drive vendors to offer the latest in Green IT hardware

We probably have the largest number, world-wide, of the energy efficient L5520 Intel CPUs at the Amsterdam Science Park

Energy consumption is as important as investment price

And maybe ...

Grid computing, and fast networks, can help move energy-intensive calculations to where energy is plentiful ... and it could even follow the sun

It's important to be where the network is –better: be right on top!

... and we are powered by 'green electricity' from renewable sources ☺ ...



vl-e

<http://www.vl-e.nl/>
<http://www.biggrid.nl/>
<http://www.nikhef.nl/grid/>



BiG Grid

the dutch e-science grid

