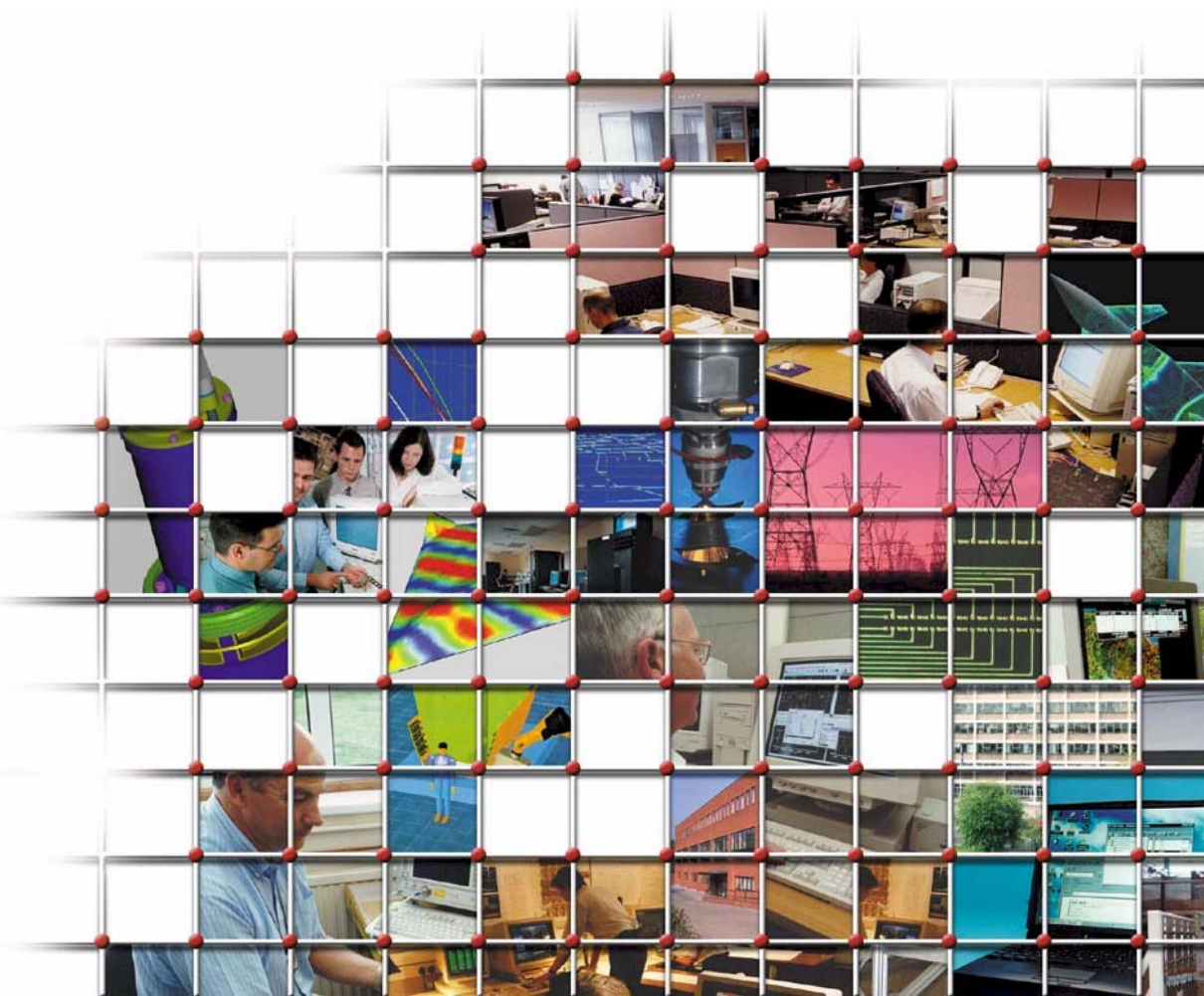




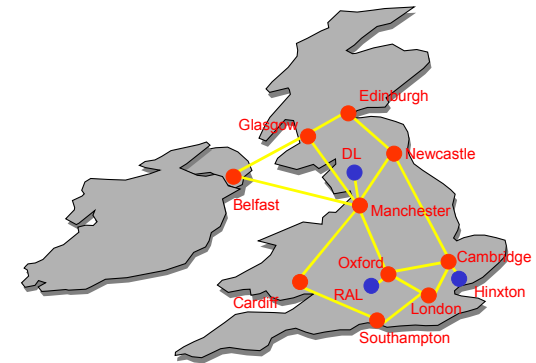
BAE SYSTEMS

Delivering the Grid Vision in CAE

Alan Gould
BAE SYSTEMS
Advanced Technology Centre
Alan.Gould@baesystems.com



e-Science



‘e-Science is about global **collaboration** in key areas of science and the **next generation of infrastructure** that will enable it.’

Dr John Taylor, Director General of Research Councils

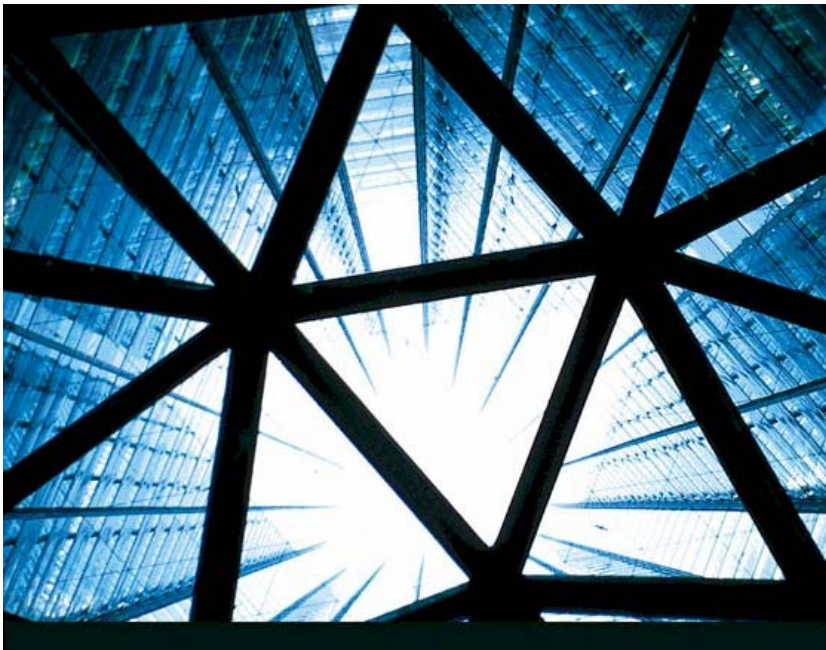
... hence **e-Engineering** - collaborative engineering enabled by Grid.

The Grid as an enabler for Virtual Organisations

“Virtual Organisation”

refers to a temporary or permanent **coalition** of geographically **dispersed** individuals, groups, organisational units that pool resources, capabilities and information to achieve a **common objective**.

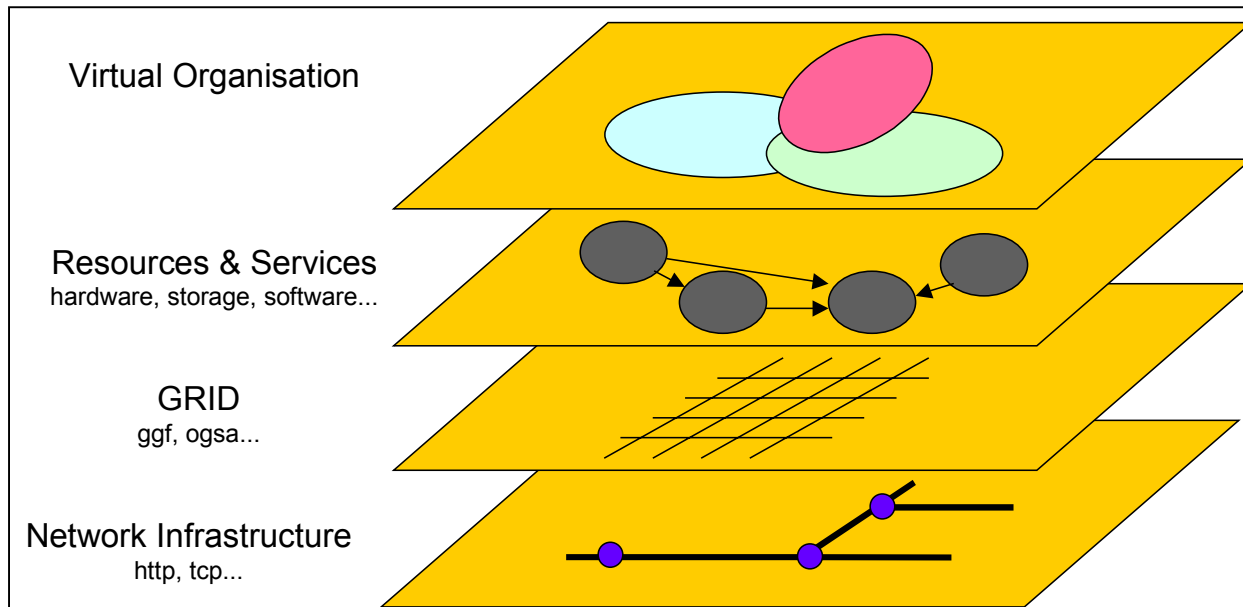
These units may or may not belong to the same physical corporation or may be entire companies.



*After: Ian Foster,
Carl Kesselman
& Steve Tueke*

VOGON

- Virtual Organisation using Grid-enabled, Objective-led Networking.
- The networking that we are concerned with is not primarily file exchange, but rather **direct access** to computers, software, data and other resources (including people), in order to perform a **specific collaborative task**.
- This sharing is, necessarily, highly controlled, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs.



Aerospace sector - collaboration is a way of life

Large scale, long-term cooperation.

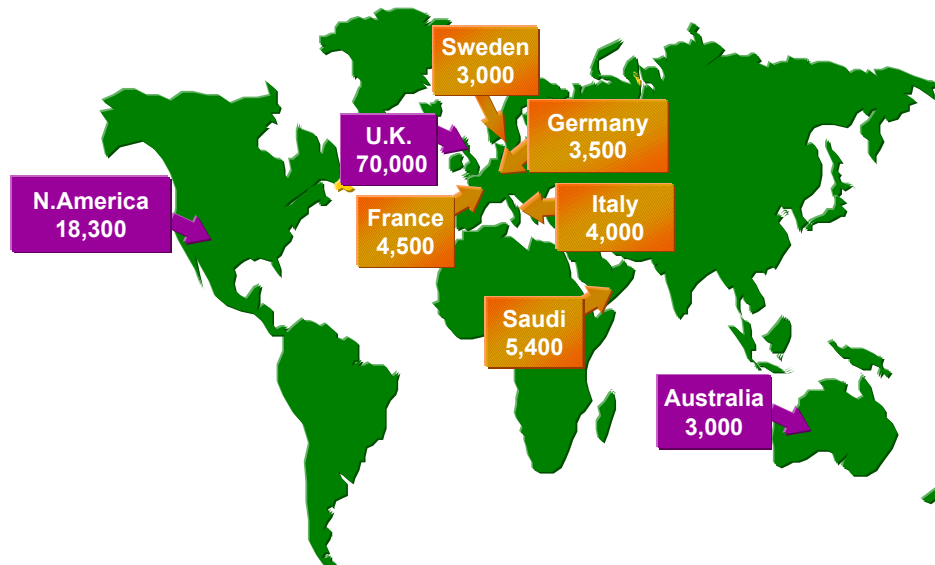
JSF: Lockheed, Northrop, BAE,
P&W, RR...
plus partners, suppliers etc.



IHI(Japan) partners RR (Trent 900 LP blades)
also GE/P&W (GP7200 compressor)
(both destined for Airbus A380).

Relevance to BAE SYSTEMS

- View BAE SYSTEMS as a network of programmes. These programmes are typically large (1000's of engineers, £bn value).
- Each programme has 100s of collaborators, risk sharers & suppliers. The participants on one programme are likely to be competitors in others.
- We have ~80 separate offices in the UK, +12 other countries all connected by a WAN.



Relevance to BAE SYSTEMS

- However, the nature of our business creates a need for very sophisticated security arrangements to prevent information being transferred in breach of contractual, military or international trade regulations.
- These requirements are generally fulfilled by maintaining software (and physical) barriers between internal sub-networks and across international boundaries.
- Our networking abilities are therefore sub-optimal with respect to connectivity, knowledge sharing and collaboration.
- Any technology that will improve this situation could have a significant impact on the synergies and efficiencies we are able to bring to a given programme.



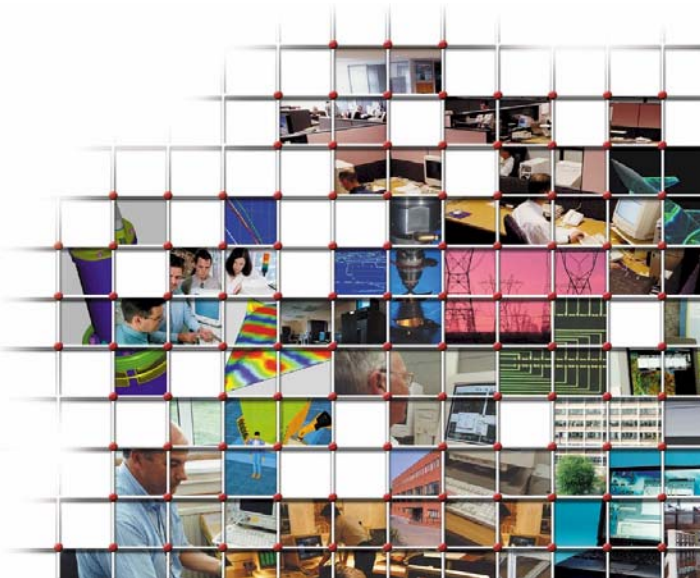
Solution?

- Will Grid technology allow us to map our IT and other organisational capabilities to our programmes?
- Net effect could be a quantum leap in efficiency, effectiveness and agility.



Approach

- *Grid* breaks down into two key areas:
- The delivery of capability over the Internet in the form of services.
 - *Offers a new way to access software, hardware, data, and information.*
- The ability to form and manage dynamic, scalable virtual organisations.
 - *Offers a new way to organise, manage, control and participate.*



“Grid is not a technology - it is a way of working.”
Prof Chris Clegg, Sheffield University

BAEgrid

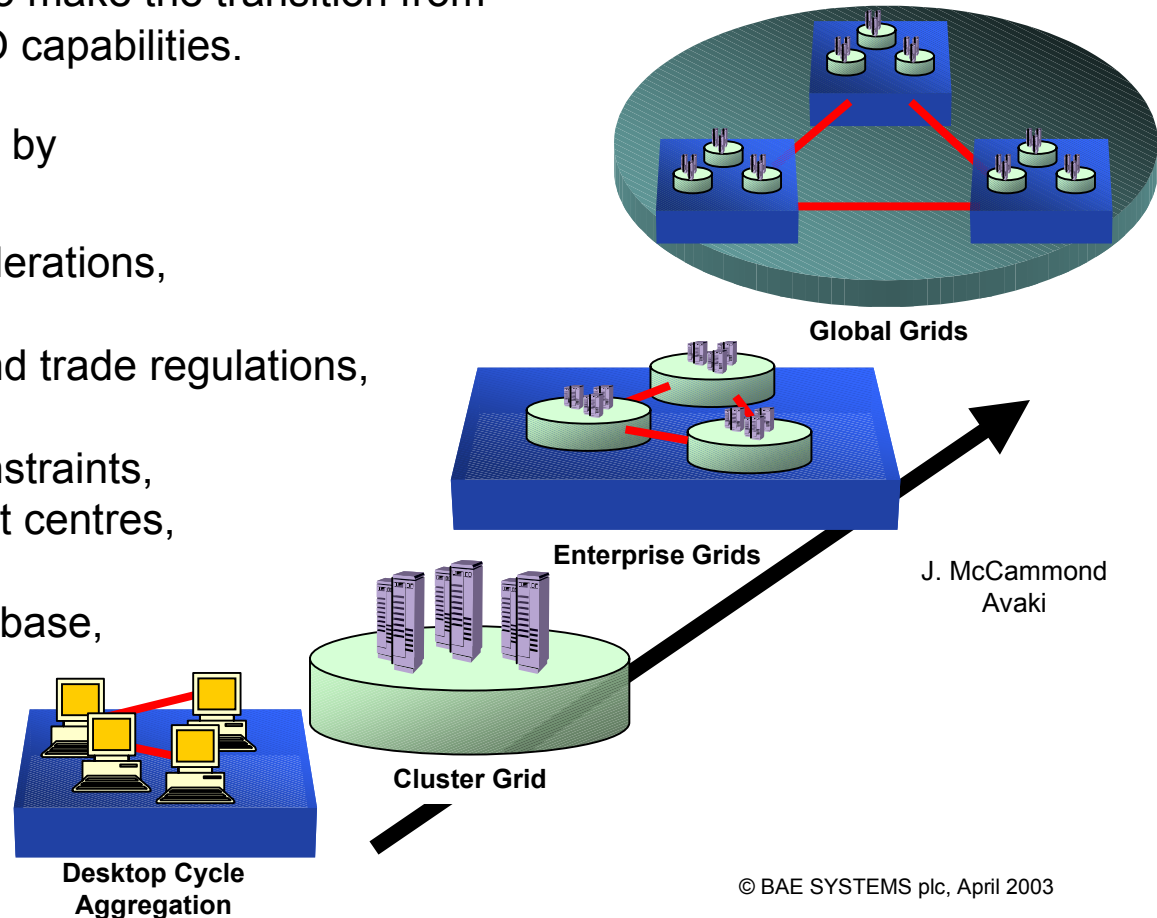
- A prototype infrastructure for Scenario-based deployment and de-risking.
- Aim to have the world's most sophisticated aerospace intra-grid



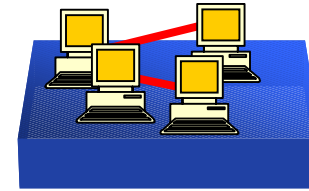
- Enabled by:
 - our internal R&D initiatives;
 - our ability to access the UK e-Science and EU IST programmes;
 - Partnering with, and influencing the vendor community.

Vision

- The ultimate outcome on a 10-year timescale is to enable an *engineering organisation* to make the transition from “Enterprise” to “Global” VO capabilities.
- i.e. one that is constrained by
 - geographic diversity
 - national security considerations,
 - commercial sensitivity,
 - international treaties and trade regulations,
 - competition rules,
 - cross-subsidisation constraints,
 - internal markets & profit centres,
 - complex supply chains,
 - a world-wide customer base,
 - etc...



2002 Foundation Study

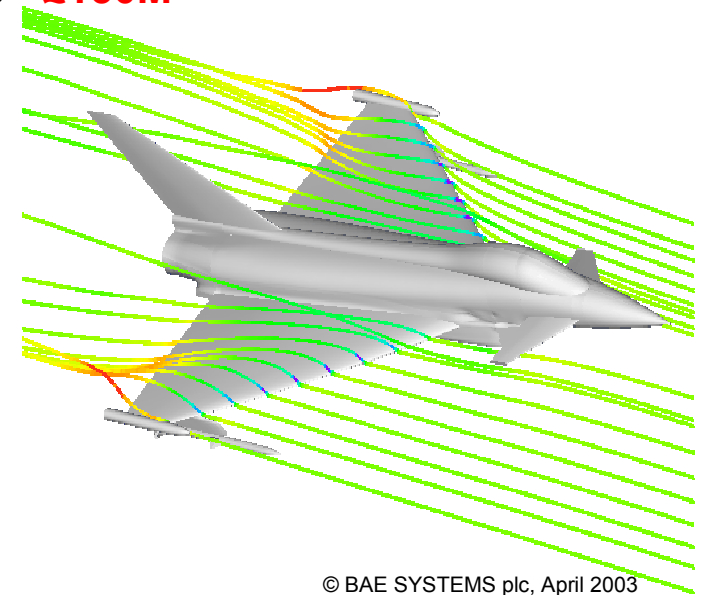


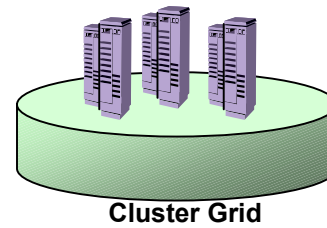
Desktop Cycle
Aggregation

BAE SYSTEMS



- **Making IT work harder by federating local systems**
- GRID software can hunt down and utilise idle computing power while being unobtrusive and locally conformant.
- BAE SYSTEMS owns around **63,900** desktop machines. At an average of 200MFlops and 256MB, this represents a distributed resource of **12.7 Tera-Flops** with **16.3 Tera-Bytes**. Acquisition cost for a facility of this size would be **~£150M**
- Every **1%** of our existing resources could deliver **£1.5M** worth of computing.
- Off-loads local supercomputing facilities, opens up new opportunities.
- **Business case actually rather weak - Applications and processes aren't ready...**

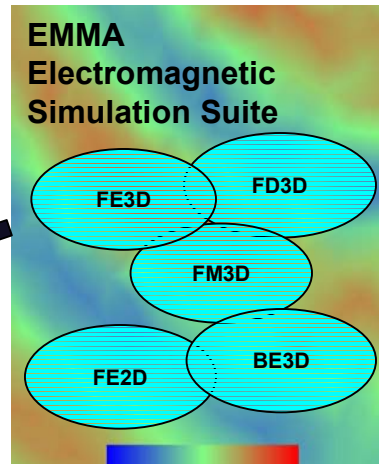
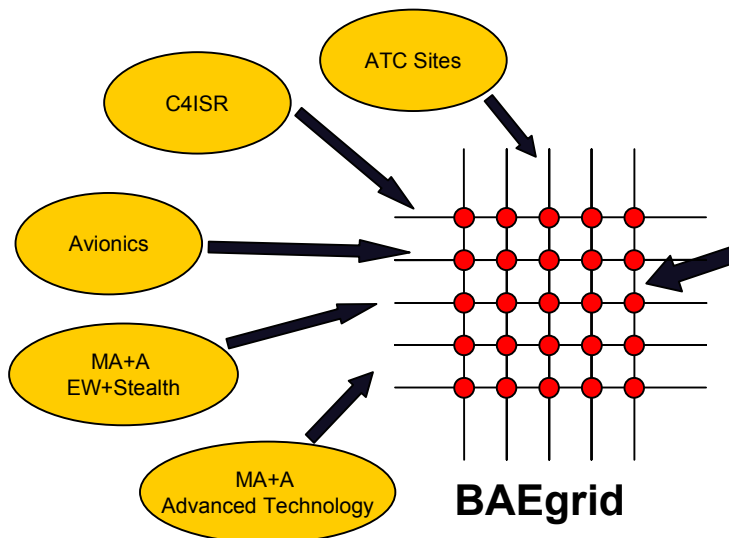




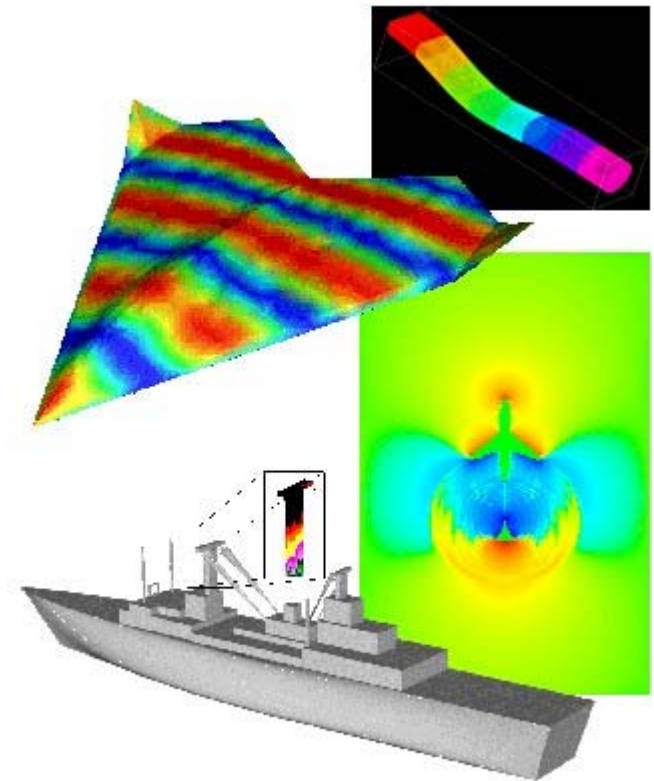
2002 Foundation Study

Internal web-services

- Efficient delivery and support of capability.
- Aim to make it anywhere within the Company from any browser-enabled access point.

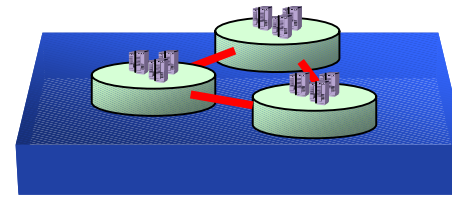


Corporate capabilities

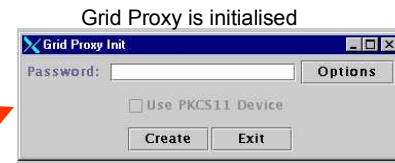


2002 Foundation Study

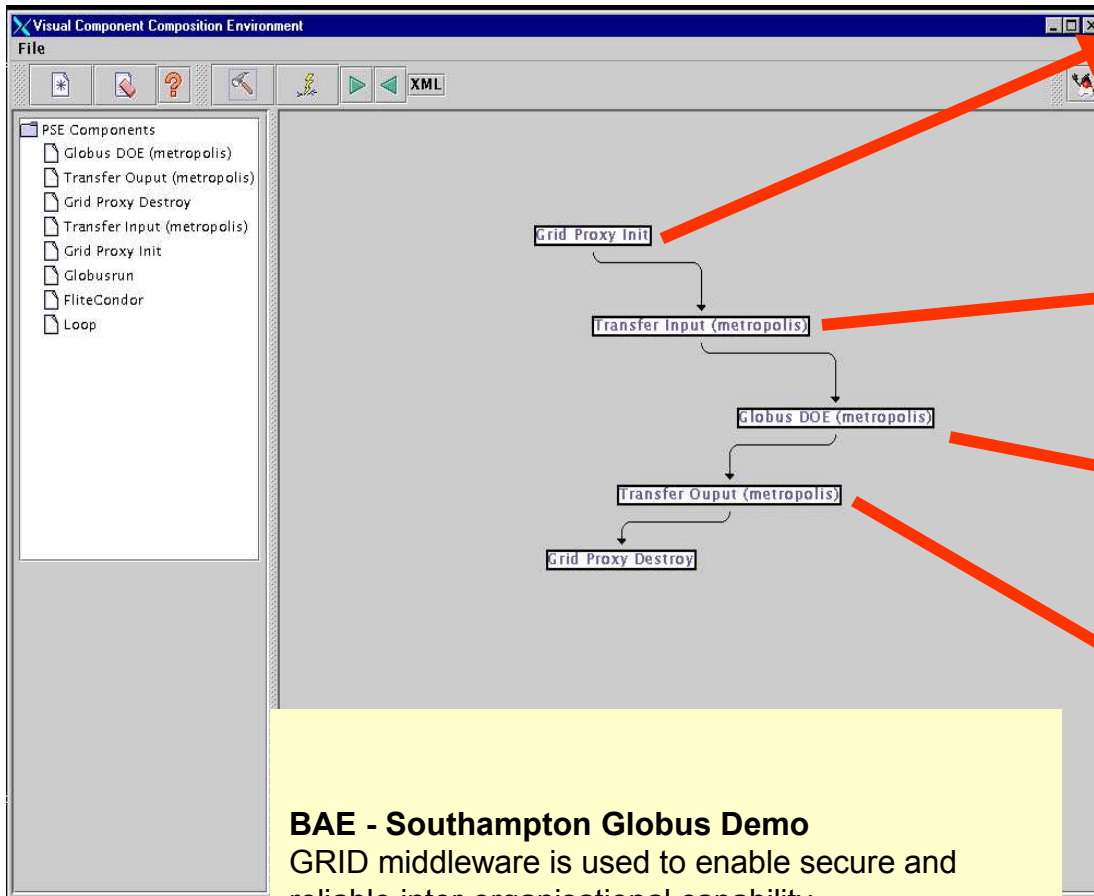
Seamless, dynamic integration of capability



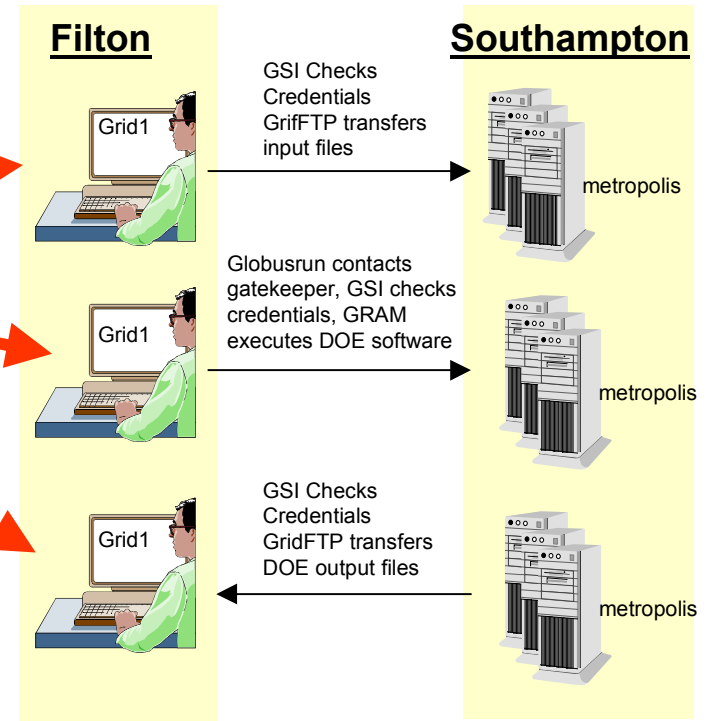
Enterprise Grids

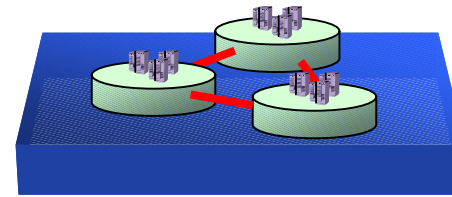


Grid Proxy is initialised



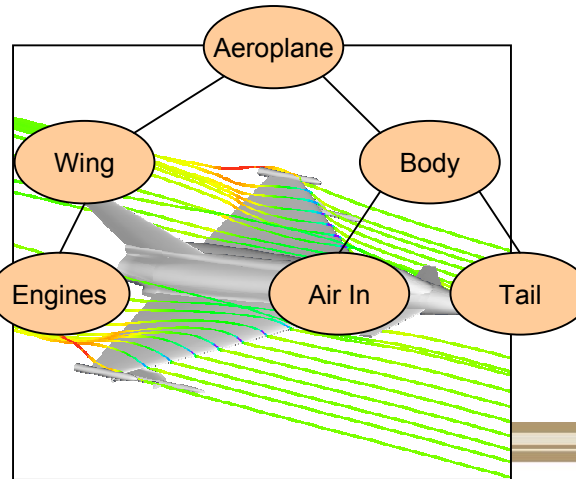
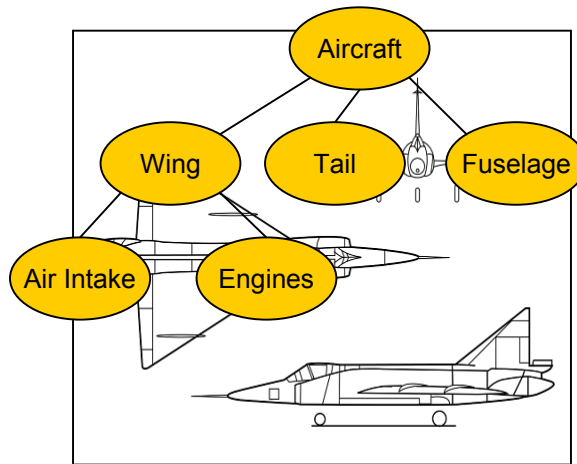
BAE - Southampton Globus Demo
 GRID middleware is used to enable secure and reliable inter-organisational capability.





Enterprise Grids

2002 Foundation Study

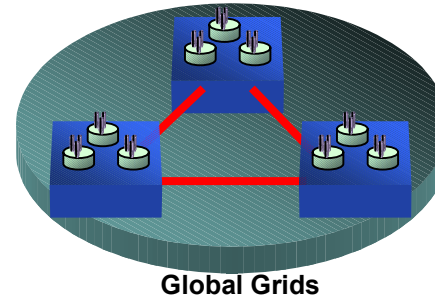


PDM to PDM communication

State-of-the-art, automated meaning negotiation for engineering system interoperability.

Aims to reduce manual process that currently costs >\$50M world-wide.

System 1 Database					System 2 Database						
1	Init. Velocity	speed	100	metre.second ⁻¹	Negotiate	1	Init. Velocity	speed	100	metre.second ⁻¹	Negotiate
2	Angle	plane_angle	1	radian	Negotiate	2	Angle	plane_angle	1	radian	Negotiate
3	Mass	mass	1	kilogram	Negotiate	3	Mass	mass	1	kilogram	Negotiate
4	Gravity	acceleration	9.82	metre.second ⁻²	Negotiate	4	Gravity	acceleration	9.82	metre.second ⁻²	Negotiate
5	Time Elapsed	time	1.4	second	Negotiate	5	Time Elapsed	time	1.4	second	Negotiate



2002 Foundation Study

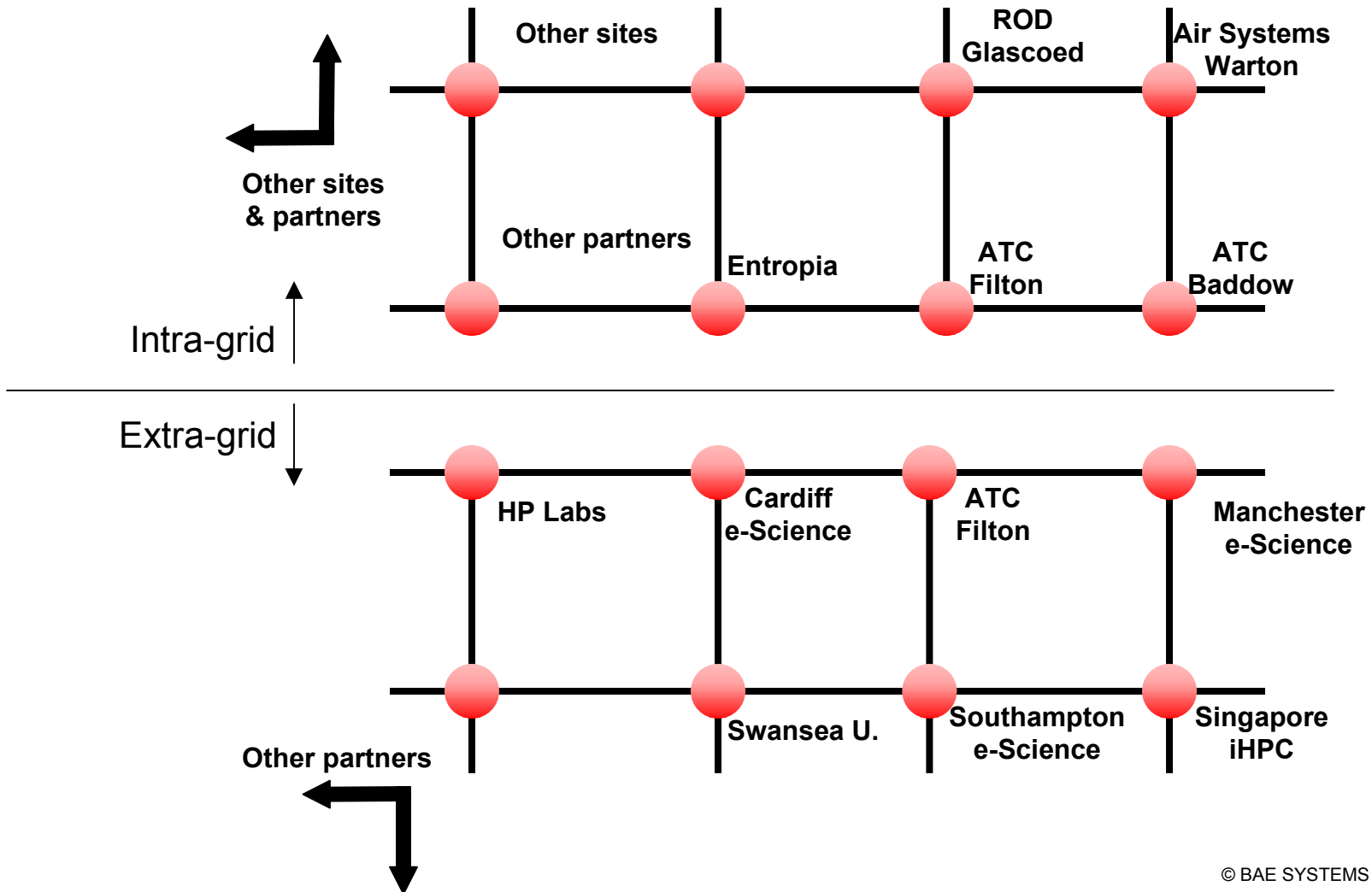
AccessGrid

Multi-streaming, multi-site,
multi-channel collaboration system.

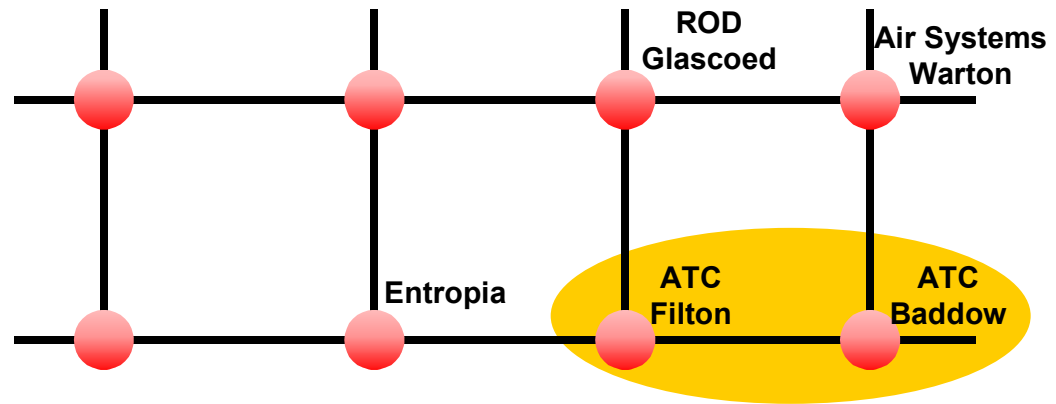
Potential for “collaborative persistence”.



BAEgrid - a "laboratory" for Grid research



VOGON1 - e-Engineering S.O.



Collaborators:

- ATC Filton
- ATC Baddow

Objective:

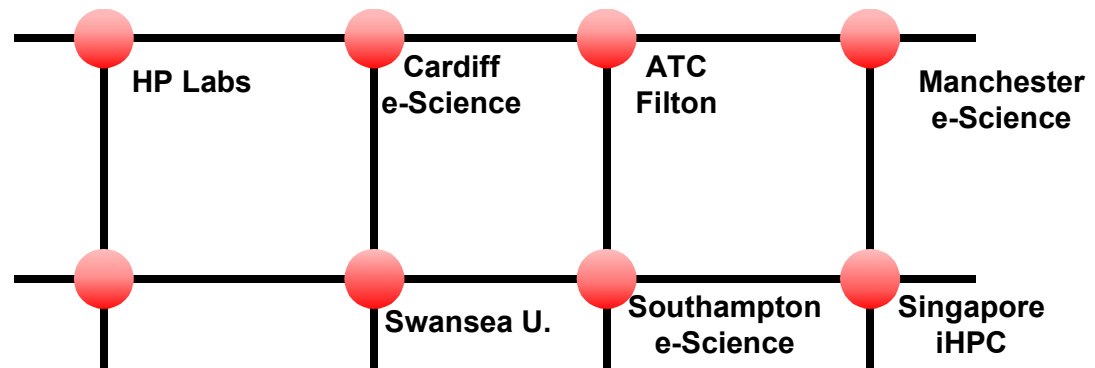
- To deliver the Strategic Option

Resources:

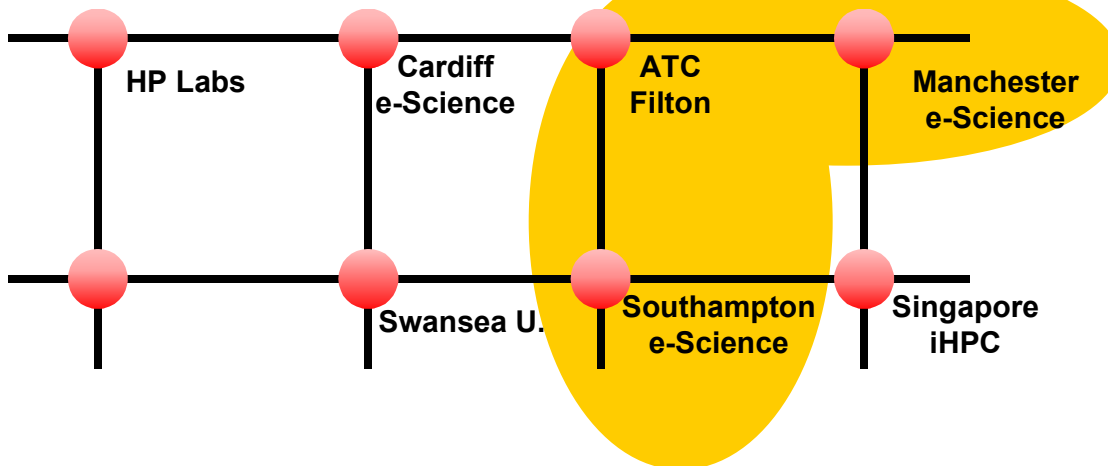
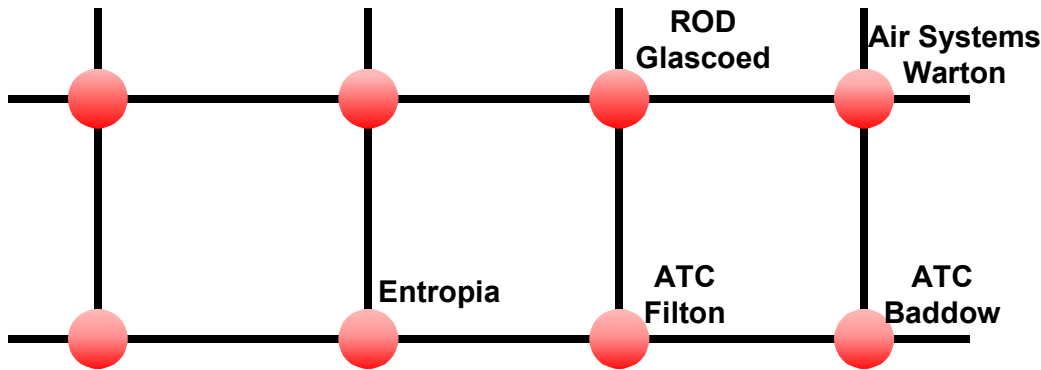
- Condor pool
- AccessGrid

Duration:

- 2003 -



VOGON2 - GEODISE



Collaborators:

- ATC Filton
- Southampton e-Science
- Manchester e-Science
- Others: Fluent, RR, Oxford...

Objective:

- Knowledge-enabled complex problem solving for collaborative design

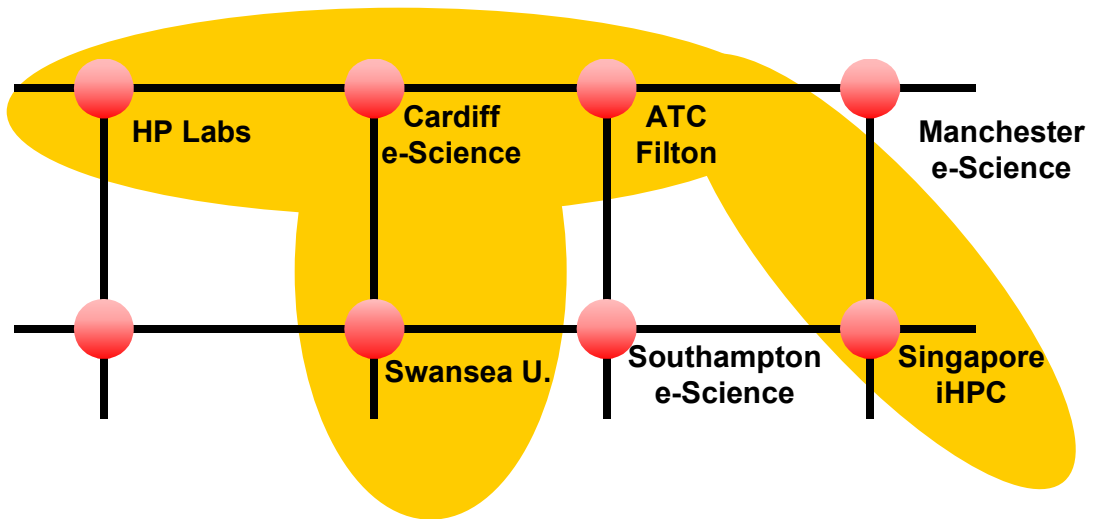
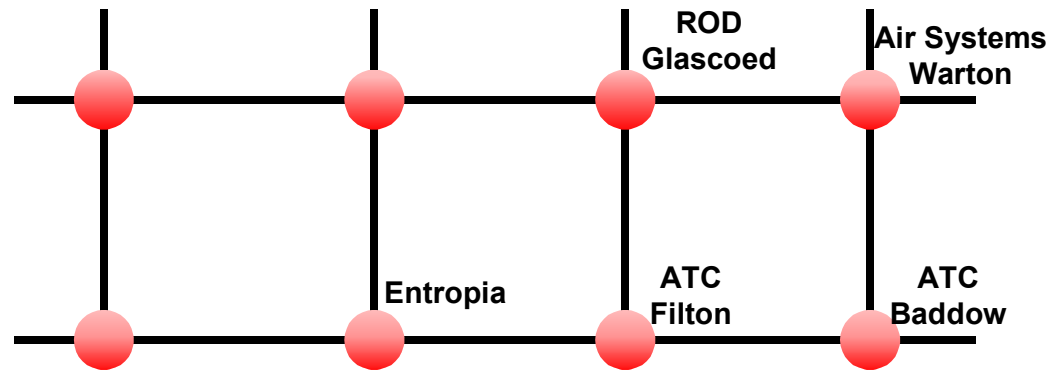
Resources:

- Computing
- Middleware development
- Analysis software
- Integration systems.

Duration:

- 2002 - 2004

VOGON3 - GECEM



Collaborators:

- ATC Filton
- Singapore iHPC
- Cardiff e-Science
- Swansea Uni.
- HP Labs

Objective:

- Development and execution of large-scale CEM computations.

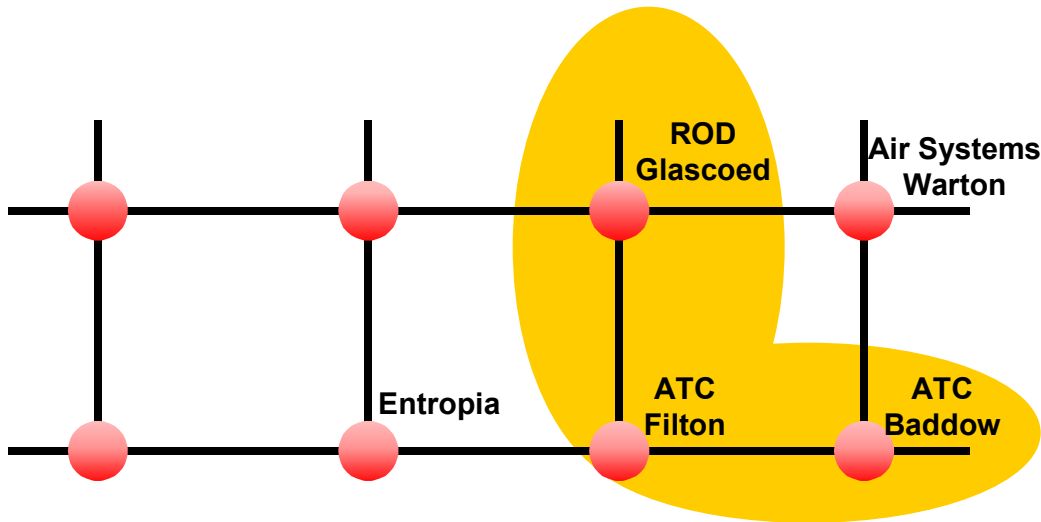
Resources:

- Computing
- Analysis software
- VR facilities.

Duration:

- 2003 - 2004

VOGON4 - RO Defence



Collaborators:

- ATC
- RO Defence, Glascoed

Objective:

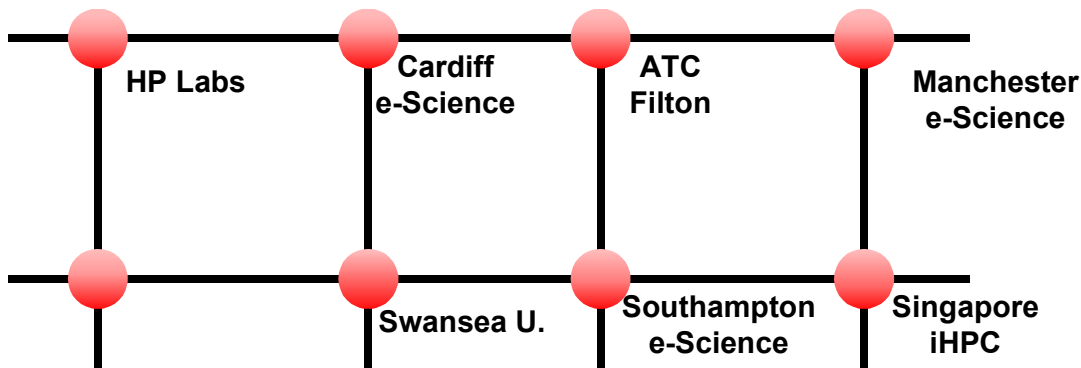
- To deliver analysis and computing resources to internal customers

Resources:

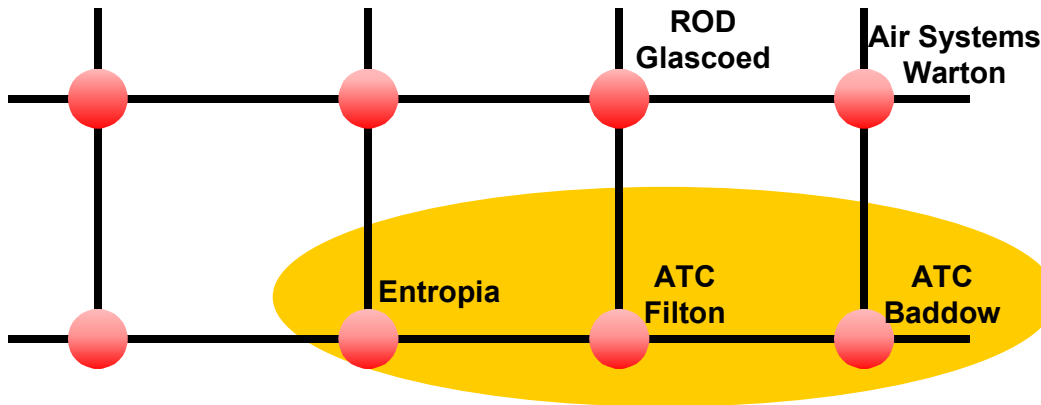
- Condor pool
- Analysis codes

Duration:

- 2003 -



VOGON5 - Cycle Aggregation Test-bed

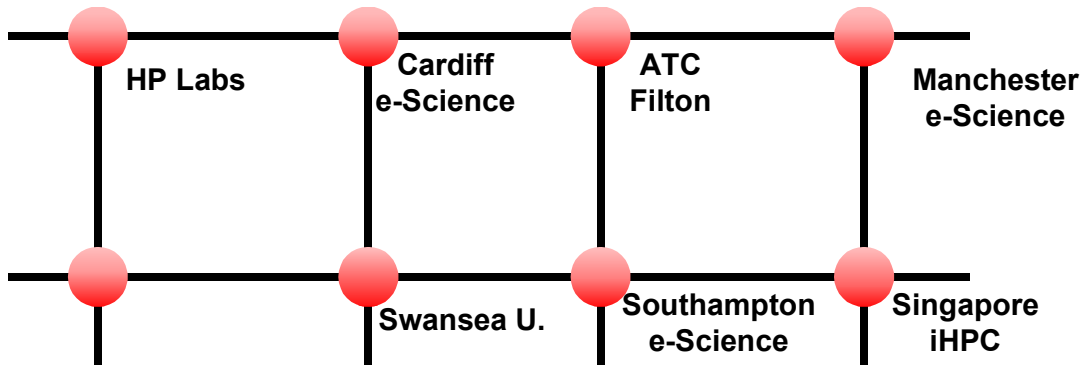


Collaborators:

- ATC
- Entropia Inc

Objective:

- To provide a commercial-strength testbed for cycle aggregation in an engineering context.



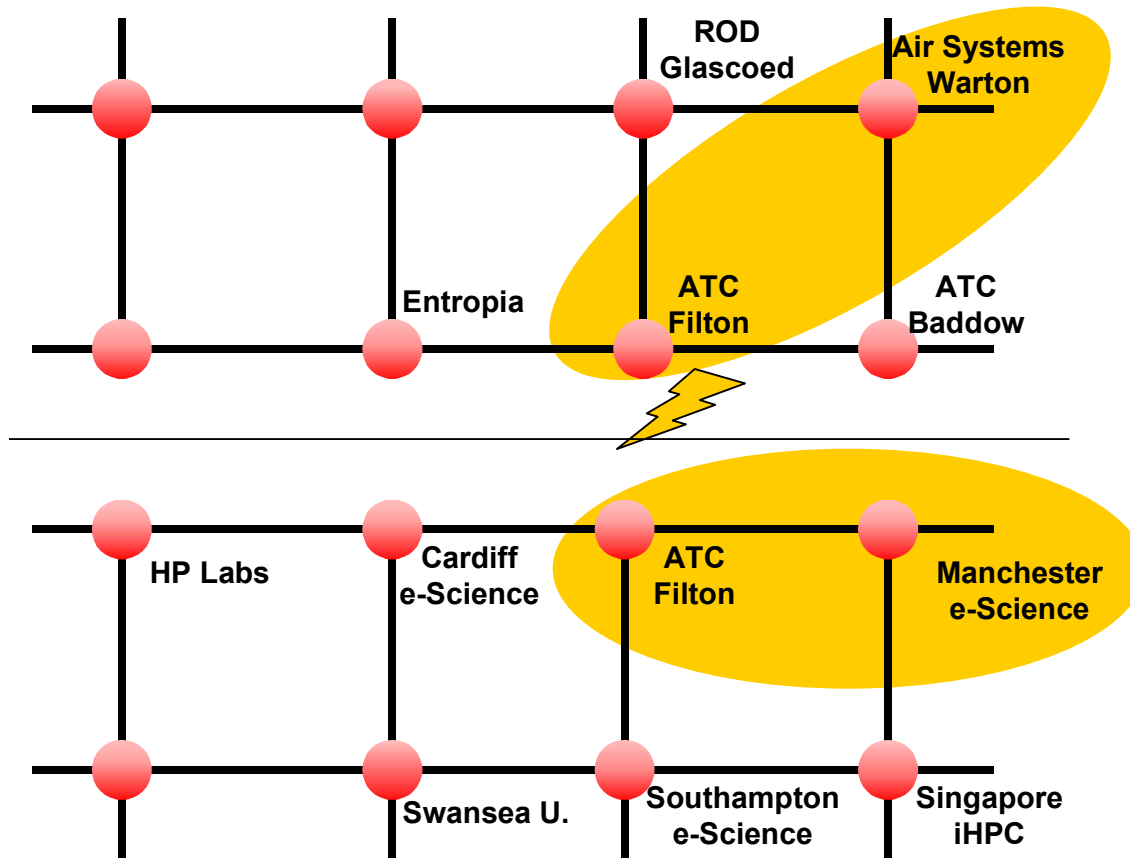
Resources:

- Condor pool
- Analysis codes
- Entropia's "DCGrid"

Duration:

- 2003 - 2004

VOGON6 - GEWiTTs



Collaborators:

- ATC
- Air Systems
- Manchester Uni.
- ARA

Objective:

- To provide a Grid-enabled test facility.

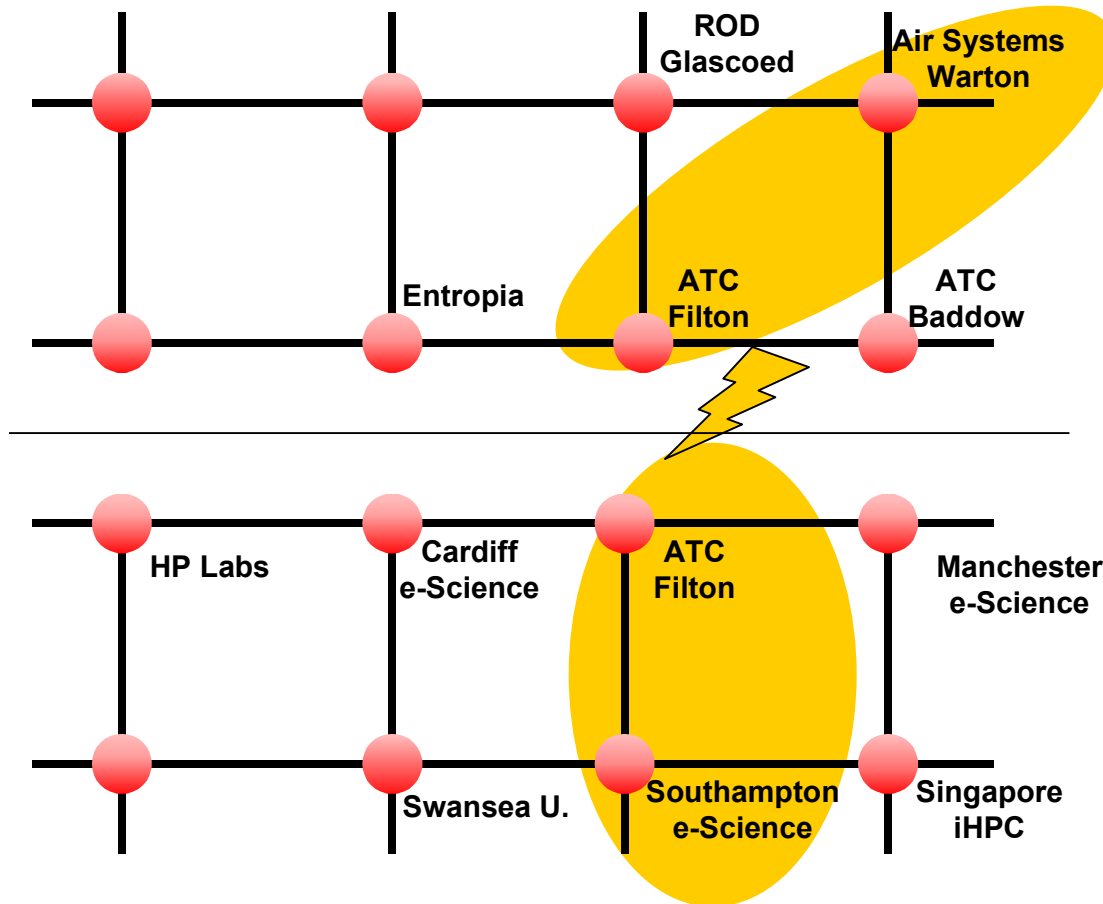
Resources:

- Wind tunnel
- Measurement systems
-

Duration:

- 2003 - 2005

VOGON7 - HPC for CFD



Collaborators:

- ATC
- Air Systems
- Southampton e-Science

Objective:

- To utilise Highly Parallel Computing facilities for CFD validation.

Resources:

- Analysis codes
- Supercomputers

Duration:

- 2003

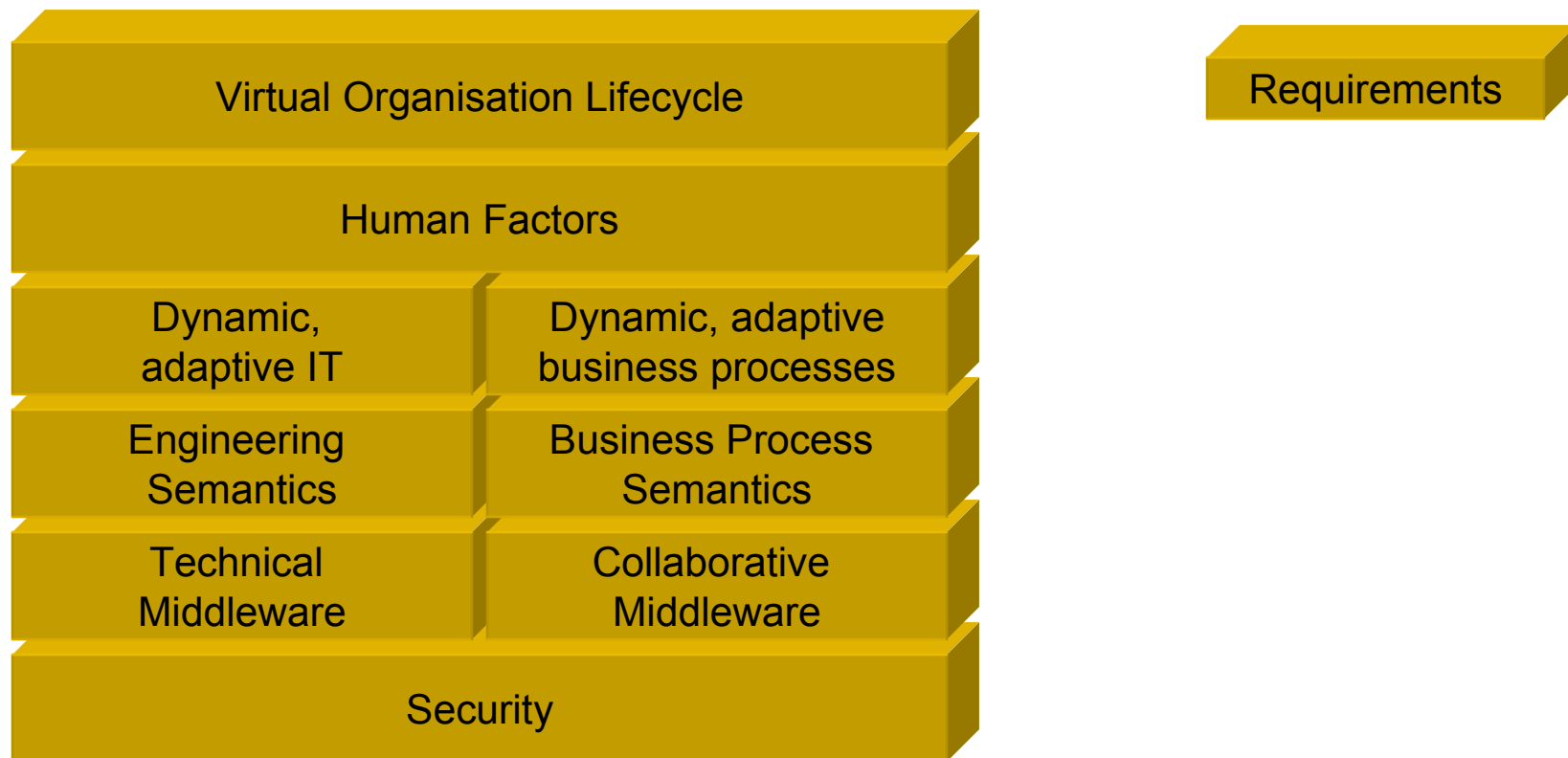
Short-term issues

- **Security.**
- **Infrastructure** → Bandwidth, interoperability...
- **Business case** → spend-to-save.
- **Application selection** → picking the right business area.
- **Legacy** (software and hardware).
- **Lack of Grid-enabled collaborators** → first phone syndrome.
- **Software** (& hardware) **suppliers** (e.g. licensing).
- **Semantics** → automating data transfer and business processes.
- **Grid-enabled business processes** → key to future VO's.

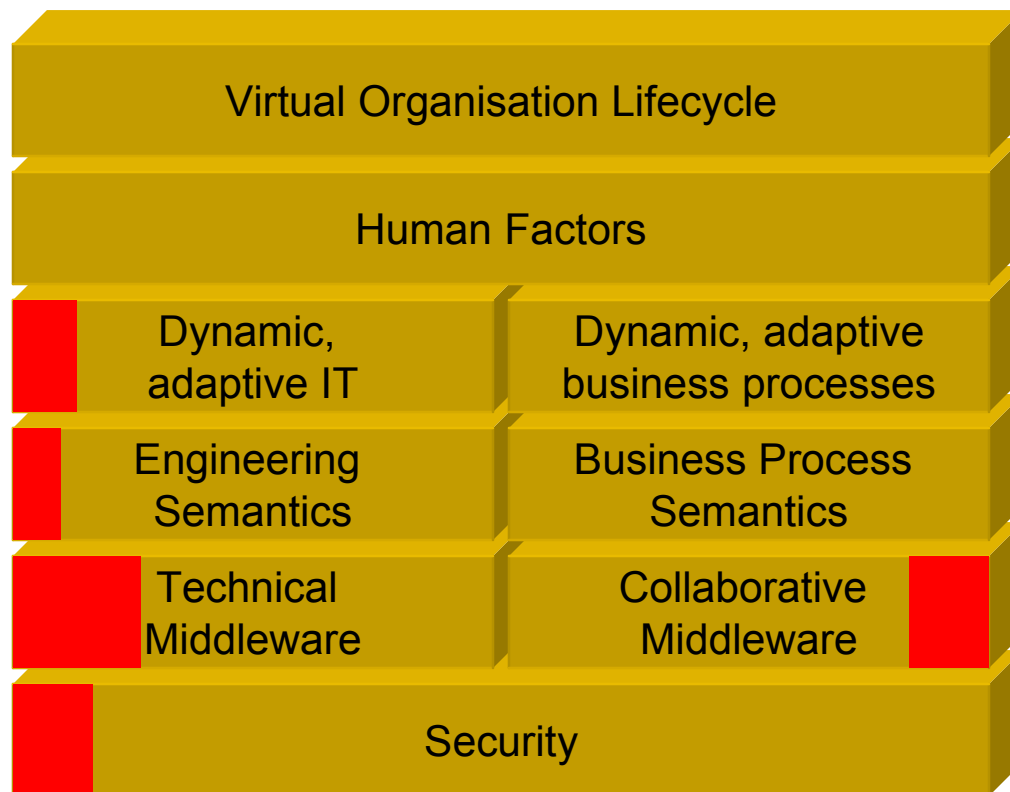
Longer-term Issues

- **Security**
 - Authentication, Authorisation, Delegation, Auditing, Integrity, Trust.
- **Interoperability**
 - Standards and Semantics across the business process.
- **Scalability**
 - Support for a wide range of dynamic, self-managed & on-demand collaborative business processes.

The Global Research Programme

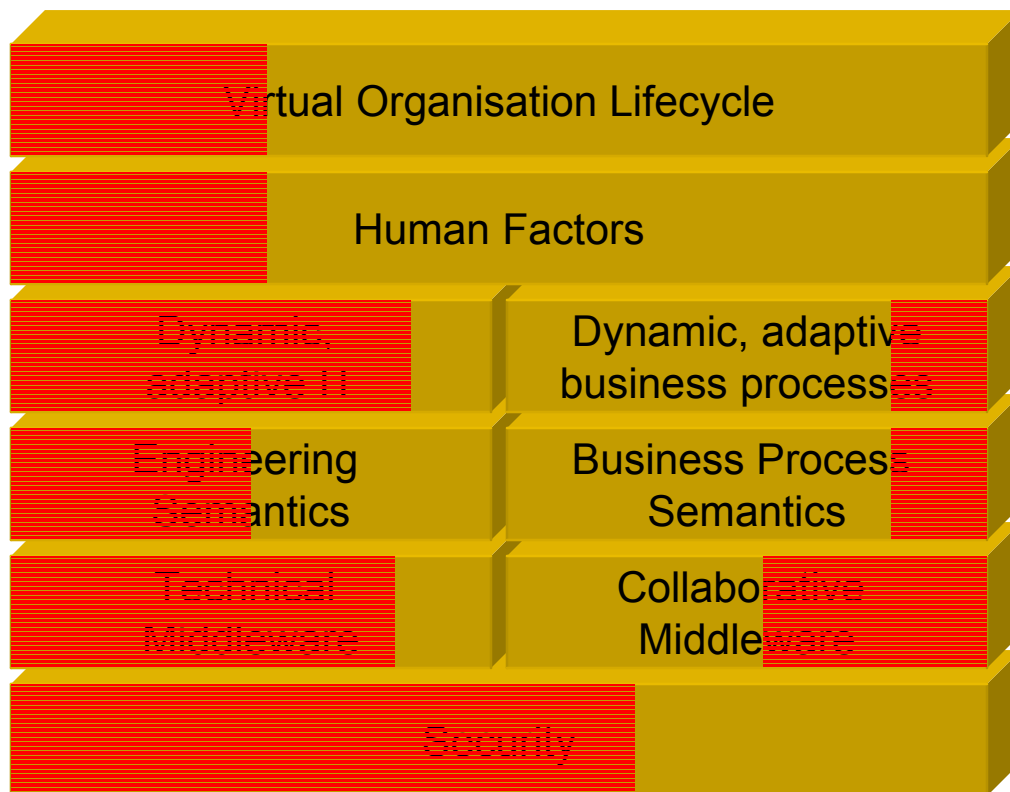


The Global Research Programme



What we have so far...

The Global Research Programme



Requirements

5 years time?

Grids in CAE

- The Grid vision is all about **collaboration**.
- The Grid vision can only be delivered *by* **collaboration**.
- Federating IT is the start, but the implications are radical...
- Now is a very good time:
 - Short term benefits can be delivered;
 - Grants are available;
 - Opportunities exist to monitor & influence developments;
 - Involvement of “end-users” is essential for success.

