Cluster and Cloud Computing – Lecture 1

Professor Richard O. Sinnott
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University of Melbourne
1st March 2018
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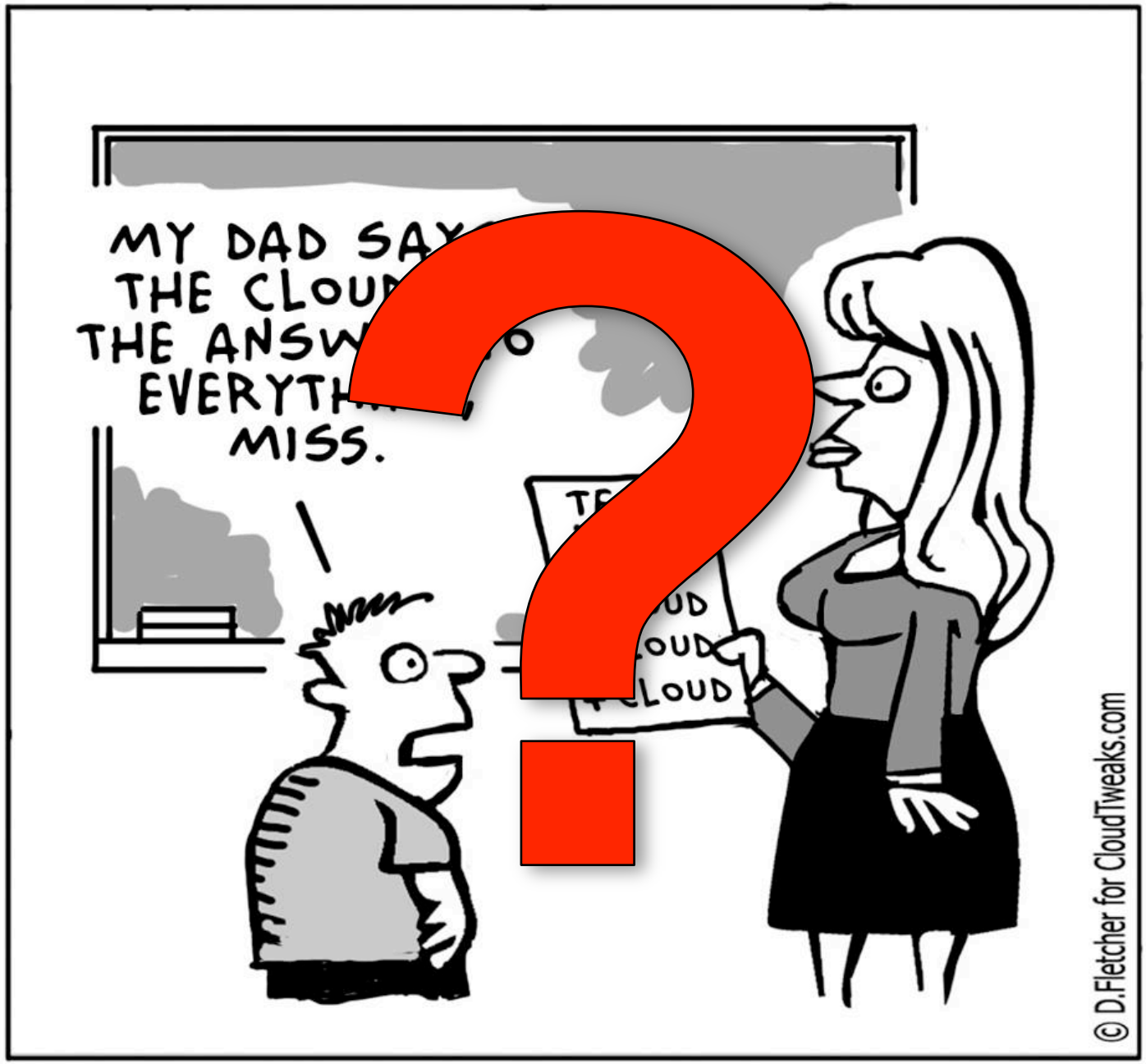
MY DAD SAY
THE CLOUD
THE ANSW
EVERYTH
MISS.
CLOUD
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Richard

Director, eResearch University of Melbourne

Chair in Applied Computing Systems, University of Melbourne

CEO Own Company (real time systems/telecoms)

BSc Theoretical Physics

Lecturer

Technical Director, Bioinformatics Research Centre University of Glasgow

Technical Director National e-Science Centre, University of Glasgow

PhD Distributed Systems

***Multiple** PhD/MSc supervised in this area*

Post-doc GMD Fokus Berlin

Distributed Systems Standards creator

MSc Software Engineering

Luca

MSc Statistics

IT Consultant for the World Bank, United Nations, European Union, Asian Development Bank

Committer at the Apache Software Foundation

GIS Software Engineer, ESRI

Data Architect, AURIN Project

Farzad

University of Melbourne
Doctor of Philosophy (PhD)

Internet of Things
Big Data
Cloud Computing

Software Engineer
(Big Cloud/ Twitter!!!)

Shiraz University
Bachelor of Science
IT

Sharif University of Technology,
Master of Science,
Information Technology

Project Portfolio

Completed

- National e-Science Centre (I, II, III)
- Dynamic Virtual Organisations for e-Science Education
- Biomedical Research Informatics Delivered by Grid Enabled Services
- GridNet, GridNet-2
- Grid Enabled Microarray Expression Profile Search
- Glasgow early adoption of Shibboleth
- Joint Data Standards Survey
- ESP-Grid
- HPC Compute cluster award // Sun industrial sponsorship
- OGC Collision
- OMII-Security Portlets // OMII-RAVE
- Integrating VOMS and PERMIS for Superior Grid Authorization
- NCeSS
- CESSDA PPP
- Pharming of Therapeutic RNA
- Grid Enabled Occupational Data Environment
- Towards an e-Infrastructure for e-Science Digital Repositories
- Grid enabled Biochemical Pathway Simulator
- Virtual Organisations for Trials and Epidemiological Studies
- A European e-Infrastructure for e-Science Repositories
- Modelling, Inference and Analysis for Biological Systems up to the
- Drug Discovery Portal
- Parliamentary Discourse
- Scots Words and Placenames
- Qvolution stress management survey system
- Advanced Grid Authorisation through Semantic Technologies Shir
- AlstromUK VRE
- Grid-enabled Virtual Safe Settings
- Clinical Streaming
- Enhancing Repos
- Proxy Credential A
- Scottish Bioinform
- Generation Scotla
- Breast Cancer Tis
- Data Managemen
- Meeting the Desig
- EU FW7 AvertIT
- EU FW7 EuroDSI
- NeSC Research P
- NeSC Information
- ESF Network for Study of Adrenal Tumors
- Scottish Health Informatics Platform for Research (SHIP)
- National E-Infrastructure for Social Simulation (NeISS)
- EU R4SME Diagnosis of Parkinsons Disease (DiPAR)
- Automating River Pollution Detection (CAPIM)
- Endocrine genomics Virtual Laboratory (endoVL)
- DSDNetwork Australasia

On-Going

- EU European Platform for Study of Wolfram, Alstrom, Bardet Biedl (EuroWABB)
- Multicenter prospective study of biochemical profiles of monoamine-producing tumors (PMT Study)
- European Society of Hypertension Study on Pheo/PGL
- International DSD
- EU FW7 European Network for Study of Adrenal Tumors Cancer Research Platform (ENSAT-CANCER)
- VicHealth Health Indicators and Spatial Objective Data
- jury Research Platform
- Research Infrastructure Network (AURIN)
- ng portal
- study of environmental factors on onset of T1D
- es Data Network (ADDN)
- hann-Pick A, B and C Registry
- Data Journalism in the Big Data Era
- ned 18F-fluorodeoxyglucose positron emission tomography and 123I-maging for Adrenal Neoplasia
- mics Health Alliance (variant DB)
- ncryption/Decryption and Secure Deletion
- n of Pancreatic Beta Cells
- eric Physics and Climate Research)
- nd Urban Environments
- cs-based strategies for improved diagnosis and treatment of endocrine
- sumption database and mobile app
- ytics Research Environment
- Clinical Research Network
- ustralian Adrenal Alliance
- arch Software Solutions (PRESS)
- Mobile applications for the Environmental Determinants of Islet Autoimmunity
- Twitter data analytics for business
- Mobile Applications for Patients with Neuroendocrine Tumours
- Systems Genomics Support Platform
- SWARM: Smartly-aggregated Wiki-style ARgument Marshalling (SWARM)
- ORCA Cognitive Assessment Platform
- VicSpin Victoria-wide Flu Surveillance System
- ElectraNet LIDAR
- VectorNZ Lidar

Examples used throughout

Course Contents

- Lectures 1 & 2 – 1st March
  - Information Session & How we got here (Distributed Systems, Grid…)
    - Richard Sinnott
- Lectures 3 & 4 – 8th March
  - Domain Drivers – tour of some big data projects
    - Richard Sinnott
- Lectures 5 & 6 – 15th March
  - Parallel Systems, Distributed Computing and HPC/HTC
    - Richard Sinnott
- Lectures 7 & 8 – 22nd March
  - HPC @ UniMelb and Practicalities of HPC/HTC
    - Richard Sinnott, Lev Lafayette & Farzad Khodadadi
    - Linux and HPC practicalities and welcome to Spartan!!!
    - Using mpi4py / MPJ workshop

Programming Assignment handed out (23rd Mar – due 9th April)

Course Contents

- Lectures 9 & 10 – 29th March
  - Cloud Computing – Programming Clouds: Getting to grips with NeCTAR
    - Richard Sinnott & Farzad Khodadadi
    - Introduction to Cloud Computing
    - Getting to grips with OpenStack/NeCTAR
    - Scripting for the Cloud (Introduction to Boto & Ansible demonstration) workshop

Easter Break 30th March – 8th April

Second Programming Assignment handed out (9th April – 11th May)

- Lectures 11 & 12 – 12th April
  - Big Data and Related Technologies
    - Luca Morandini (Data Architect, AURIN)
    - Big Data V-challenges, Cap Theorem and noSQL technologies
    - CouchDB workshop
- Lectures 13 & 14 – 19th April
  - Service-oriented architectures & Other Things Needed for Assignment II
    - Farzad Khodadadi & Luca Morandini
    - SOA & SOAP vs ReST
    - Hands-on examples of coding/demonstrating SOAP, ReST
    - Code versioning systems and GitHub (Git) workshop

Course Contents… ctd

- Lectures 15 & 16 – 26th April
  - Big Data Analytics
    - Luca Morandini
    - Big Data Technologies – Hadoop, HDFS, Spark, …
    - Hadoop cluster on Cloud and practical application workshop
- Lectures 15 & 16 – 3rd May
  - Cloud Underpinnings and Other Things
    - Richard Sinnott & Farzad Khodadadi & Yao Pan
    - Virtualisation background
    - Compare and Contrast EC2 with NeCTAR Research Cloud
    - Microhosting Environments (Docker)
    - Discussion of 2nd Programming Assignment
- Lecture 17 & 18 – 10th May
  - You (+ pizzas!)
    - "Some" teams randomly chosen to present their assignment II
    - 15minutes each

Course Contents… ctd

- Lecture 21 & 22 – 17th May
  - Security and Clouds & demonstration of assignments
    - Richard Sinnott & You
    - "Some" more teams randomly chosen to present their assignment II
    - 15minutes each

- Lecture 23 & 24 – 24th May
  - Subject Review and Working Through Past Papers
  - Feedback and SES
    - Richard Sinnott

At the end of the course….

- You will…
  - Understand more about the history of cluster and Cloud computing and the current state of the art
  - Know more of the domain drivers that are shaping this area – especially the current flavour of the month "big data"
  - Understand more on parallel systems, multi-core software development
  - Be able to use HPC/HTC systems
  - Be able to use Cloud resources
  - Be able to develop applications running on the Cloud
  - Learning about next generation data management systems
  - Be savvy with web based systems development
  - Work on a non-trivial software system development as part of a team (=how it nearly always works in the real world!)
  - Learn more the pulse of cities!
  - Have software experiences that are in great demand

    Many of my ex-students have jobs in this space (reference machine!!!)
  - Have visited a data centre

Lecture Slides

- On the web before lecture
- They may be updated slightly before the lecture to reflect recent developments
  - Or cover materials that folk want more details on from previous lectures
- Other sources of materials
  - Key papers
  - Interesting articles
  - Snippets from the web
  - Crib sheets for Cloud Computing
  - Crib sheets for HPC

Course Assessment

- Assignments
  - During semester worth 50%
  - Expected to take about 40+ hours
- Written examination
  - A written examination (two hours) at the end of the semester worth 50%
- All components must be completed satisfactorily to pass the subject
  - At least 50% in all assignments + exam

Assessments

- Assignment 1 – 10 marks
  - HPC exercise (search/analyse large text file)
- (Team) Assignment (40 marks)
  - Social media analytics on the Cloud
  - Team-based approach
  - Self organise vs be organised
    - Importance of being a team player!
    - Peer review…
- Exam – 50 marks
- Note
  - Importance of original work
    - Collusion “seriously frowned” upon
    - Use of Turnitin & MOSS

Computational Resources

- Departmental Computing Resources:
  - You all have access to PCs in the lab with Linux and Eclipse installed
  - Any local issues then talk to CIS technical staff
- HPC systems
  - SPARTAN cluster – general purpose cluster for UniMelb
    - Provisioned last year
    - Reasonable grunt, but… UniMelb!
- Cloud resources
  - NeCTAR research cloud – www.nectar.org.au
  - 30,000 servers across Australia (availability zones)
    - Small (4Gb), medium, large, xlarge, xxlarge (64Gb)
    - MUCH more on NeCTAR later

Student Evaluation Survey

- (Told I should provide this info!!!)

	Resp. #	Resp. %	Freq(1)	Freq(2)	Freq(3)	Freq(4)	Freq(5)	Mean
1. Overall, the experience gained through this subject has been intellectually stimulating	95	59.38 %	5	1	10	27	52	4.26
2. Overall, this subject has been well co-ordinated	95	59.38 %	5	3	11	29	47	4.16
3. Overall, this subject has been supported by useful learning resources	95	59.38 %	4	4	9	33	45	4.17
4. Overall, this subject has been well-taught	94	58.75 %	5	3	18	32	36	3.97
5. Focusing on my own learning in this subject, I have been required to work at a high standard	95	59.38 %	4	1	3	29	58	4.43
6. Focusing on my own learning in this subject, I found the assessment tasks useful in guiding my study	95	59.38 %	5	5	4	23	58	4.31
7. Focusing on my own learning in this subject, I received valuable feedback on my progress	95	59.38 %	4	1	7	37	46	4.26
8. Focusing on my own learning in this subject, I learnt new ideas, approaches and/or skills	95	59.38 %	4	1	3	25	62	4.47
9. Focusing on my own learning in this subject, I learnt to apply knowledge to practice	95	59.38 %	4	1	3	25	62	4.47
10. Focusing on my own learning in this subject, I have been part of a group committed to learning	94	58.75 %	5	1	4	29	55	4.36

Questions?

The Buzz

Top 10 Strategic Technology Trends for 2013

1. Mobile Devices Battles
2. Mobile Applications & HTML5
3. Personal Cloud
4. Internet of Things
5. Hybrid IT & Cloud Computing
6. Strategic Big Data
7. Actionable Analytics
8. Mainstream In-Memory Computing
9. Integrated Ecosystems
10. Enterprise App Stores

Gartner

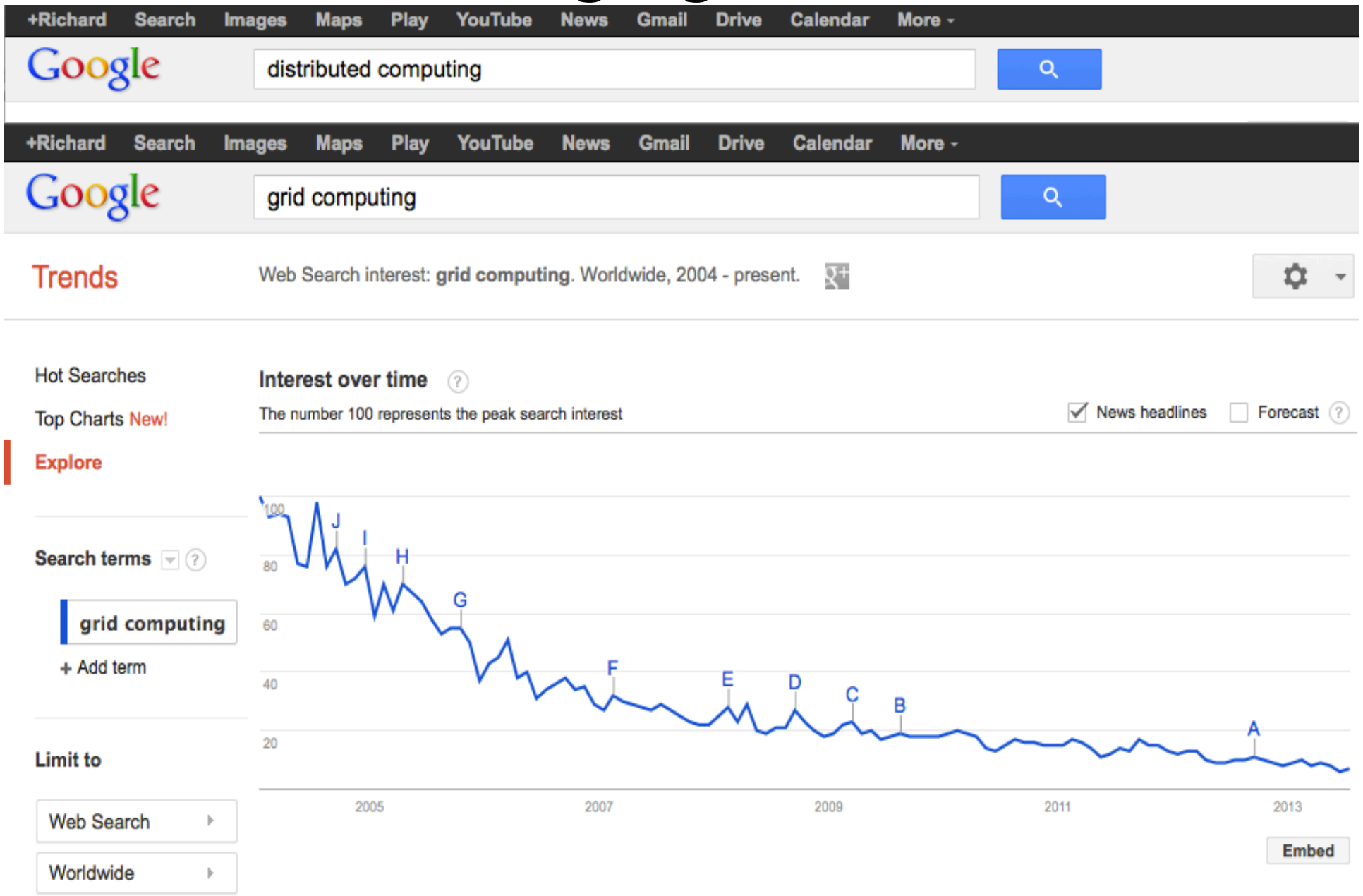
Big Data Drives Rapid Changes in Infrastructure and $232 Billion in IT Spending Through 2016

12 October 2012

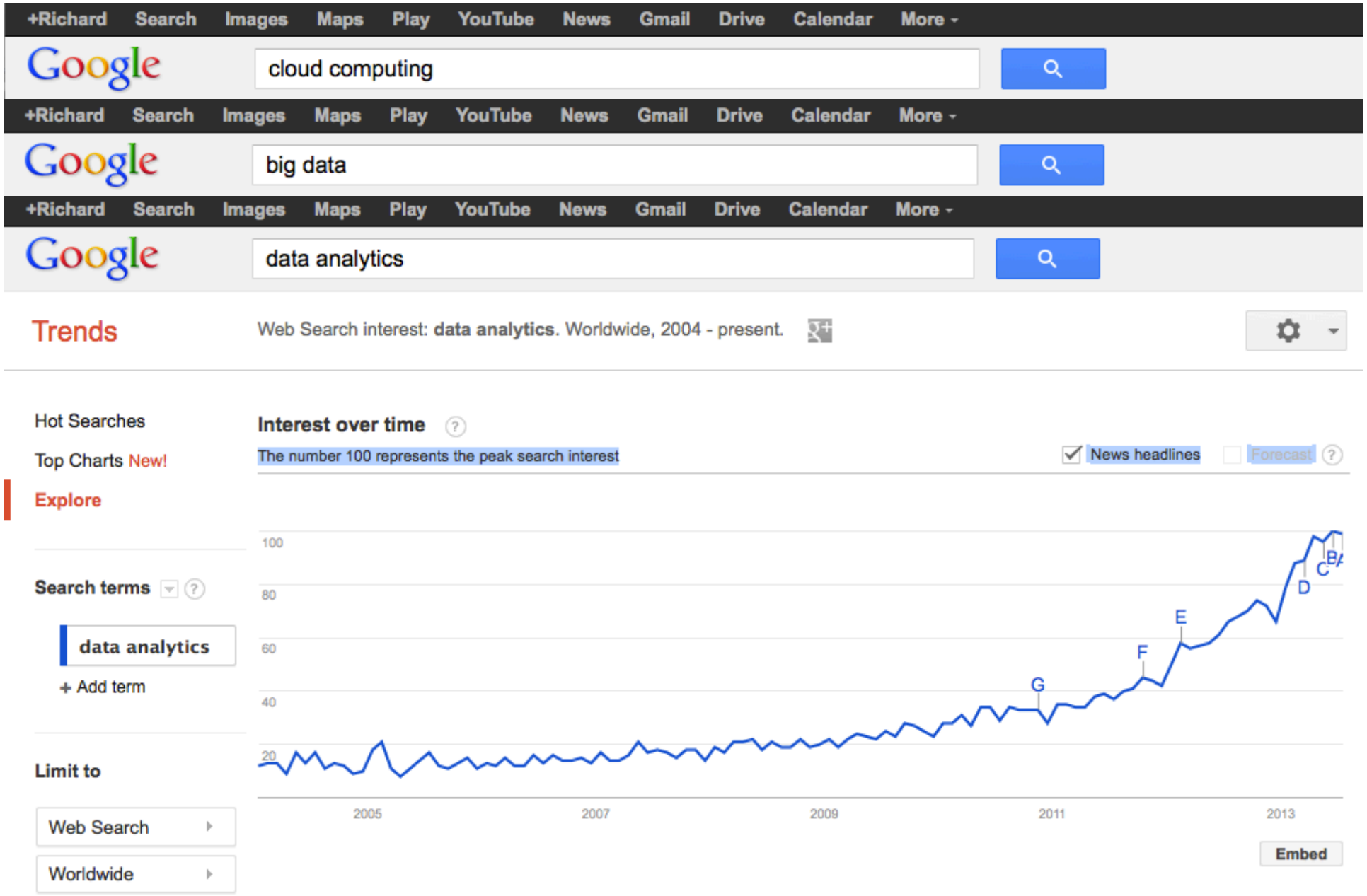
Mark A. Beyer John-David Lovelock Dan Sommer Merv Adrian

Big data has become a major driver of IT spending. The benefits to organizations for adding big data to their information management and analytics infrastructure will force a more rapid cycle of replacing existing solutions.

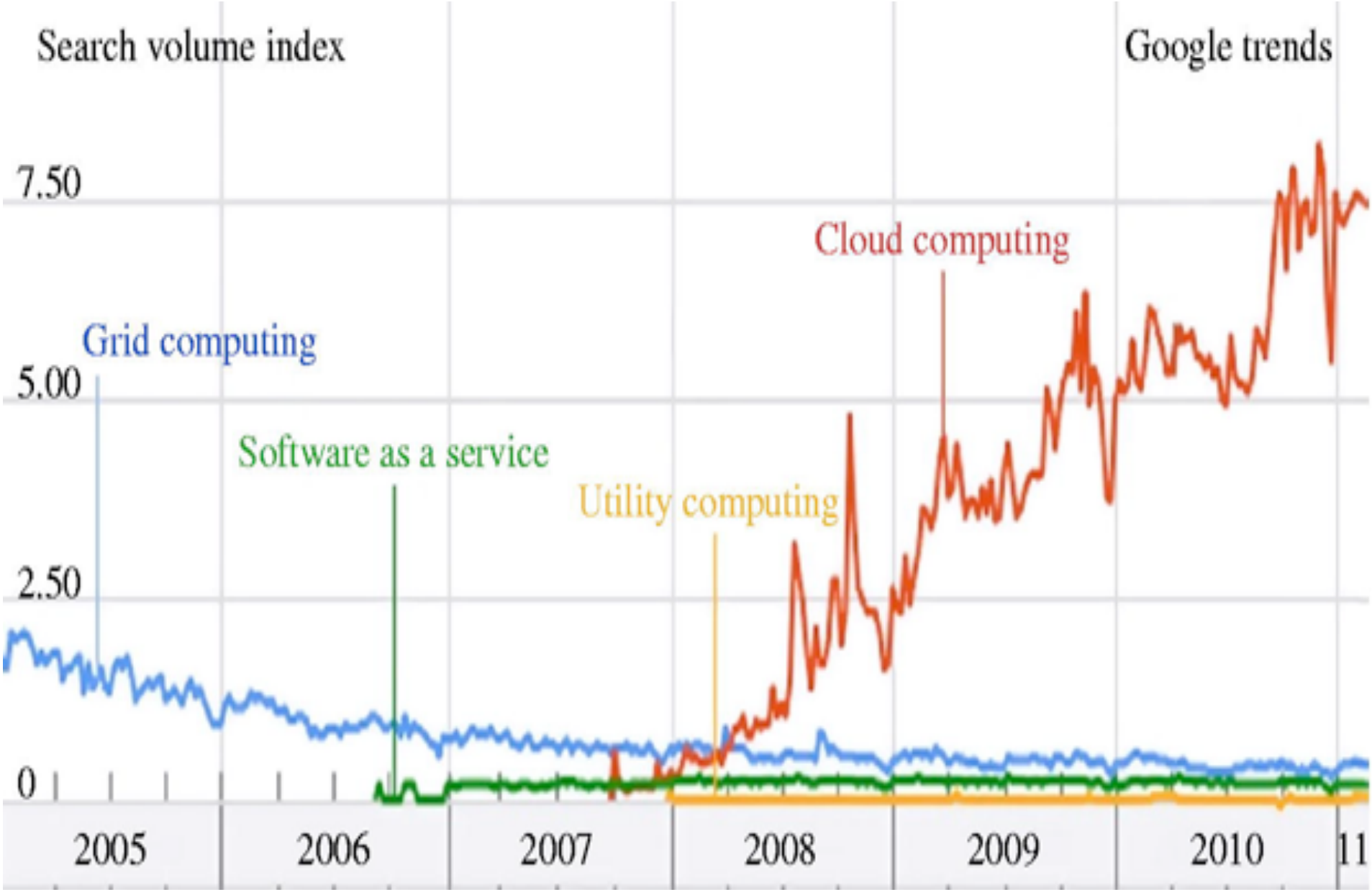
The not so long ago buzz…



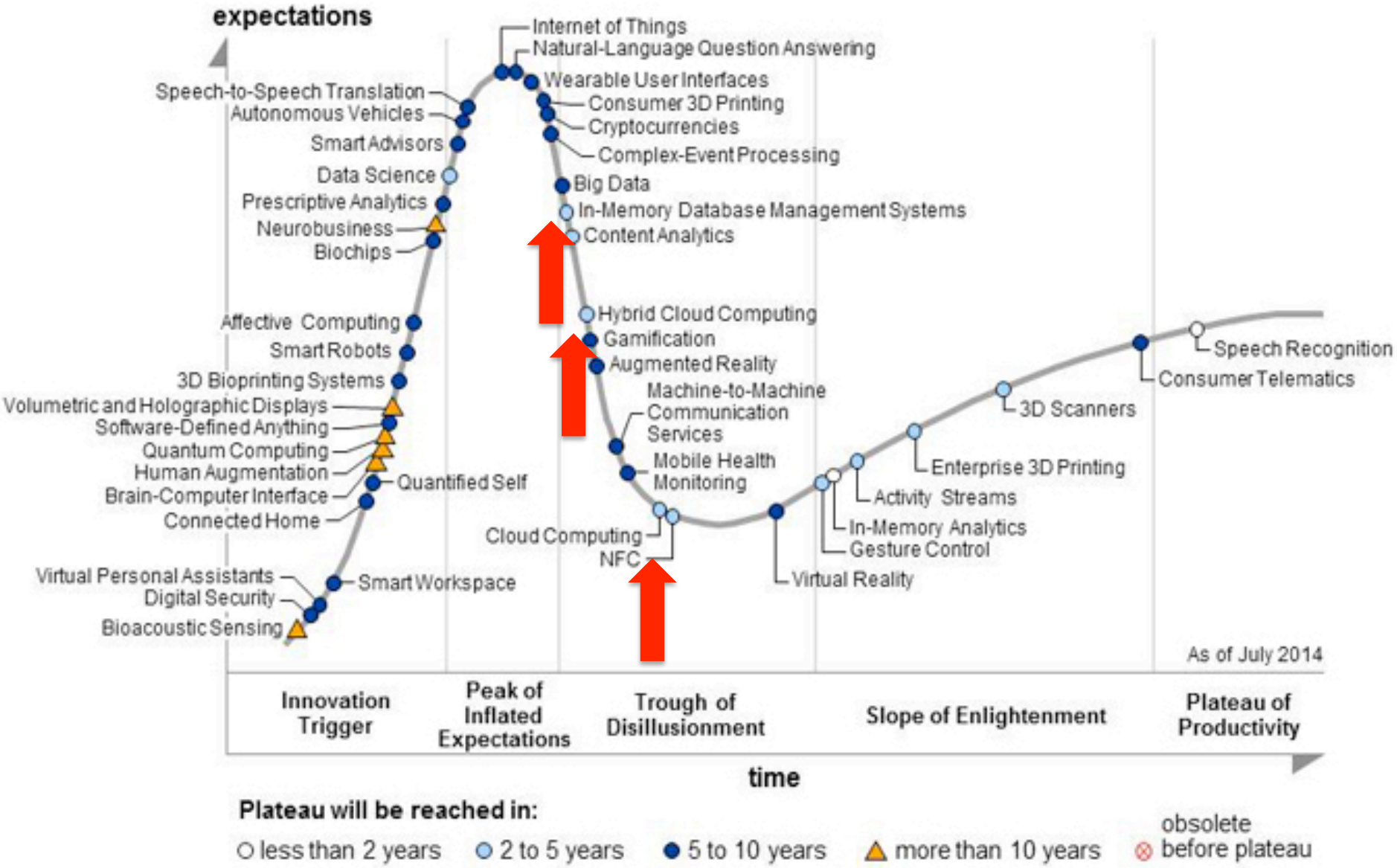
The latest buzz…



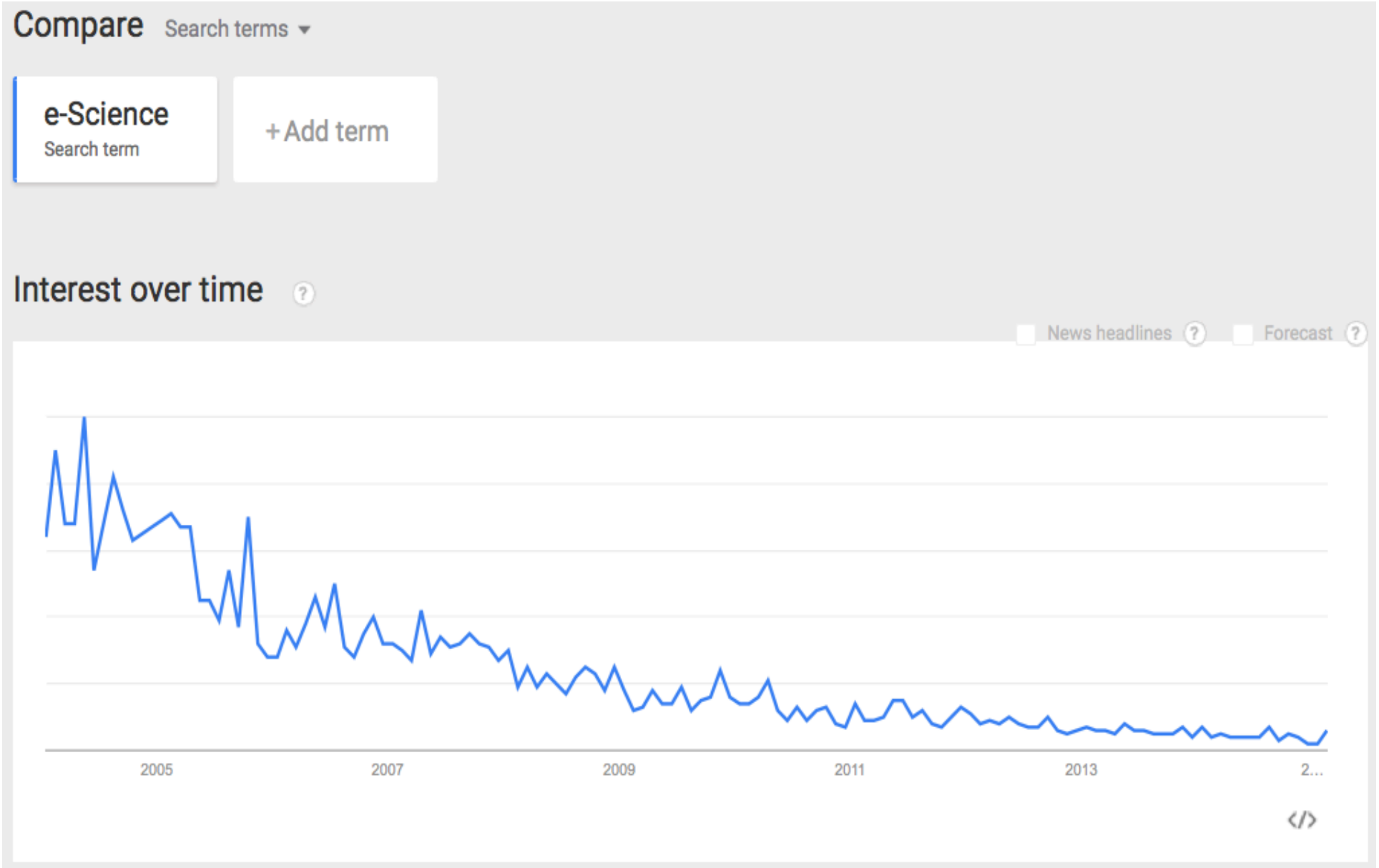
The cycles we go through…



The Hype Cycle... (Gartner 2015)



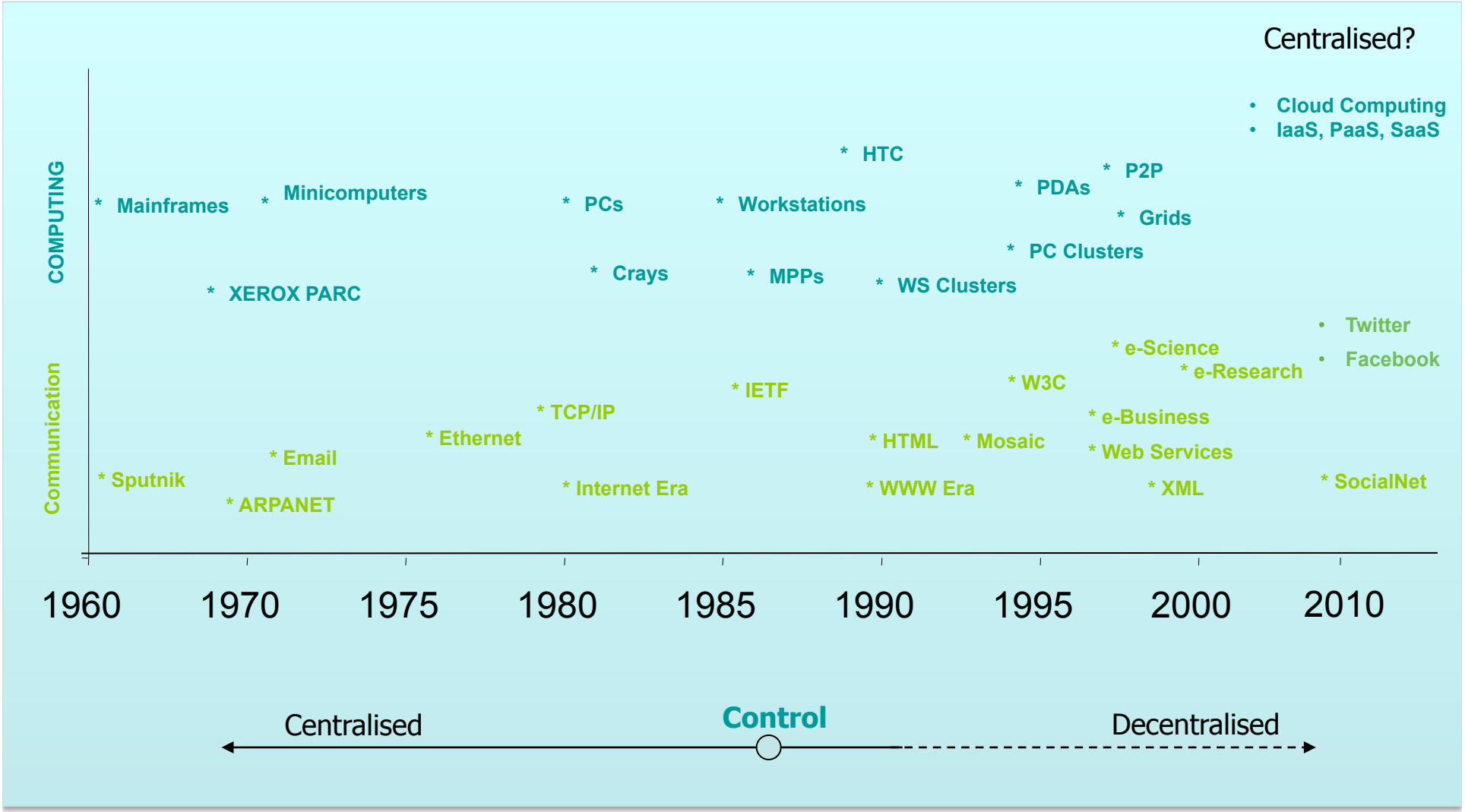
Not just IT trends…



Lessons…

- Don’t be fooled by the hype
  - Marketing and business drivers
- The basic principles of software engineering persist
  - NeSC -> MeG experiences
    - Data processing,
    - Distributed systems,
    - Security …
- Learning from experiences is key
  - But obviously working on/with the bleeding edge can do no harm (for grants or on CVs)

Computing and Communication Technologies (r)evolution: 1960-…!



What's in a name…

- Centralised system
  - *Single physical (centralised) system. All resources (processors, memory and storage) fully shared and tightly coupled within one integrated OS*
- Parallel system
  - *All processors either tightly coupled with centralised shared memory or loosely coupled with distributed memory. Inter-process communication through shared memory or through some form of message passing*
- Distributed system
  - *Multiple autonomous computers with their own private memory, communicating through through some form of message passing over a computer network*

Cloud Computing….

- …is a colloquial expression used to describe a variety of different types of computing concepts that involve a large number of computers that are connected through a real-time communication network (typically the Internet). *Cloud computing is a jargon term without a commonly accepted non-ambiguous scientific or technical definition.* In science, cloud computing is a synonym for distributed computing over a network and means the ability to run a program on many connected computers at the same time. The popularity of the term can be attributed to its use in marketing to sell hosted services in the sense of application service provisioning that run client server software on a remote location.

Wikipedia 2013

Cloud Computing….

- …Proponents claim that cloud computing allows companies to avoid upfront infrastructure costs, and focus on projects that differentiate their businesses instead of on infrastructure. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and enables IT to more rapidly adjust resources to meet fluctuating and unpredictable business demand. Cloud providers typically use a "pay as you go" model. This can lead to unexpectedly high charges if administrators do not adapt to the cloud pricing model.

Wikipedia 2016

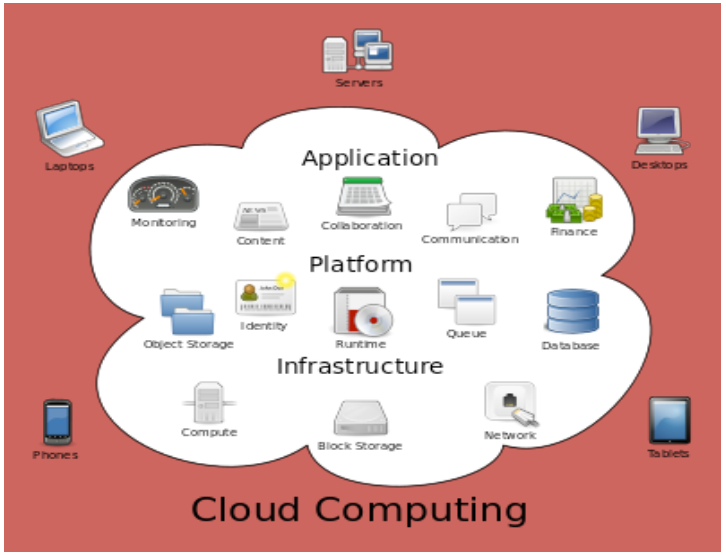
Cloud Characteristics

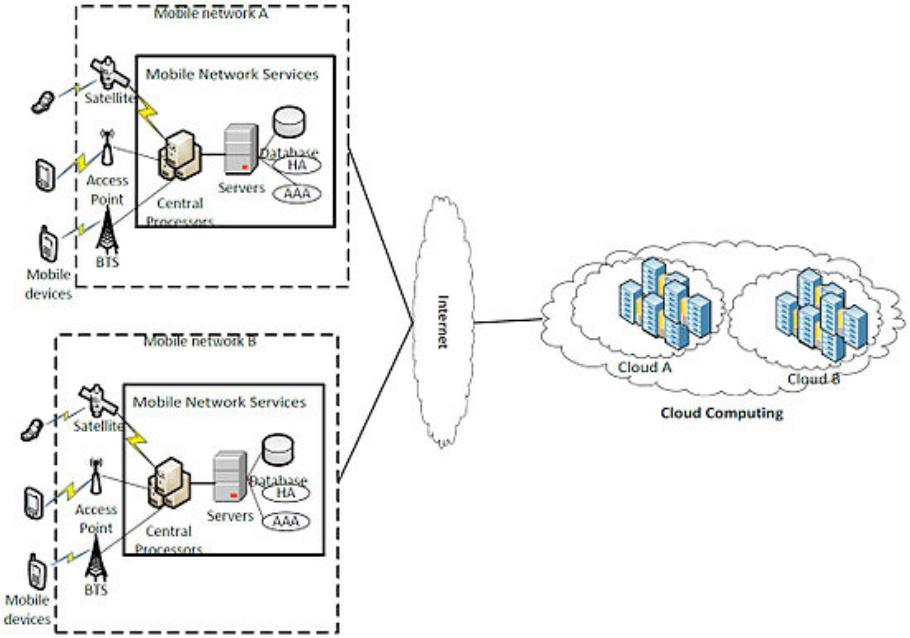
- Five essential characteristics:
  - *On-demand self-service.* A consumer can provision computing capabilities as needed without requiring human interaction with each service provider.
  - *Networked access.* Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous client platforms.
  - *Resource pooling.* The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model potentially with different physical and virtual resources that can be dynamically assigned and reassigned according to consumer demand.
  - *Rapid elasticity.* Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly upon demand.
  - *Measured service.* Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service.

    – National Institute of Standards and Technology

Cloud Computing….

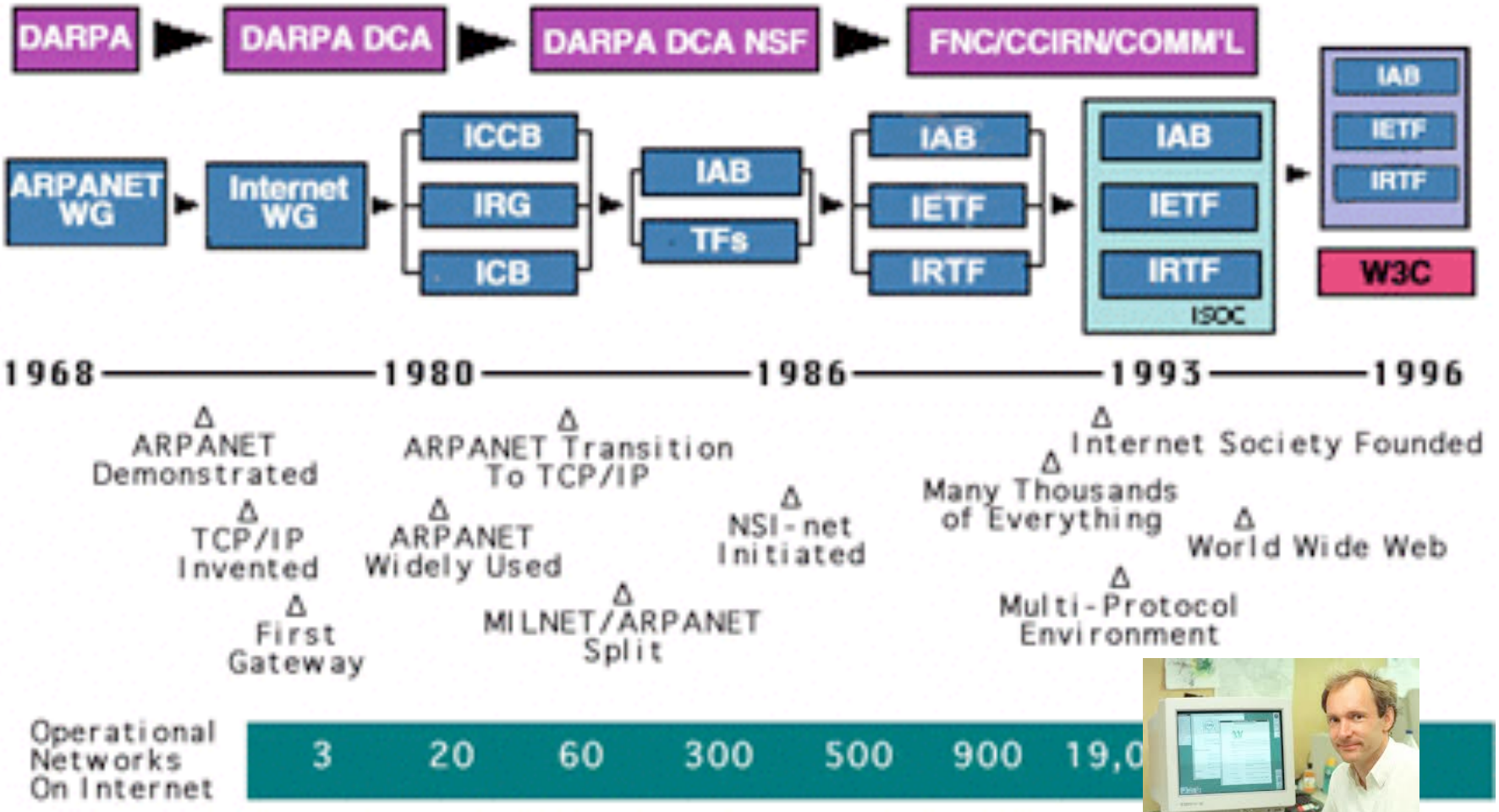
- Flavours
  - Compute clouds
    - Amazon Elastic Compute Cloud
    - Azure
    - …
  - Data clouds
    - Amazon Simple Storage Service
    - Google docs
    - iCloud
    - Dropbox
    - …
  - Application clouds
    - App store
    - Virtual image factories
    - Community-specific
  - Private, public, hybrid, mobile, health, … clouds
    - …





Break…?

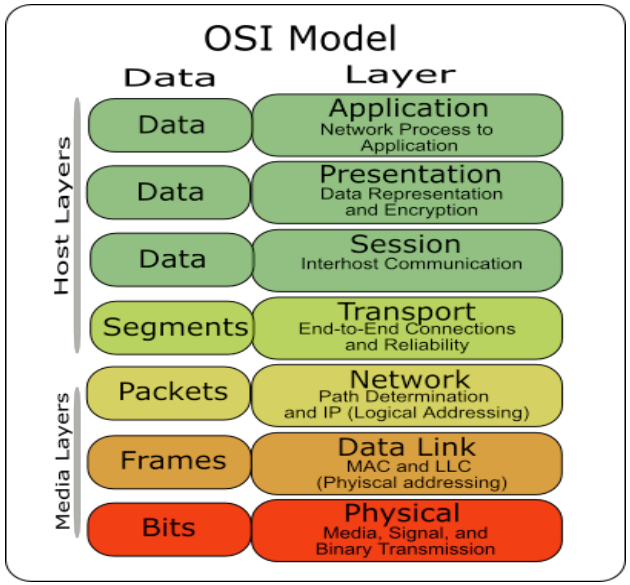
In the beginning….

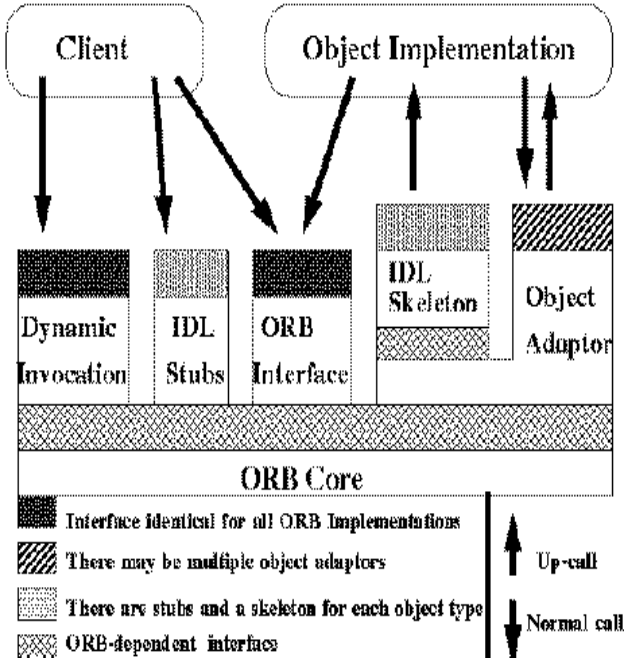


- http://www.internetsociety.org/internet/what-internet/history-internet/brief-history-internet

Distributed Systems - A Very Brief History

- Once upon a time we had standards
  - With very detailed conformance, consistency and compliance demands
    - Services, protocols, inter-operability, …
- Then we had more standards
  - Open distributed processing
  - With slightly less rigorous compliance demands
    - OMG Common Object Request Broker Architecture (CORBA)
    - Distributed Computing Environment
    - Multiple technologies
      - Client server, remote procedure call, …





Key distributed systems focus mid-90s

- Transparency and heterogeneity of computer-computer interactions
  - finding/discovering resources (trader!),
  - binding to resources in real time,
  - run time type checking,
  - invoking resources
  - c

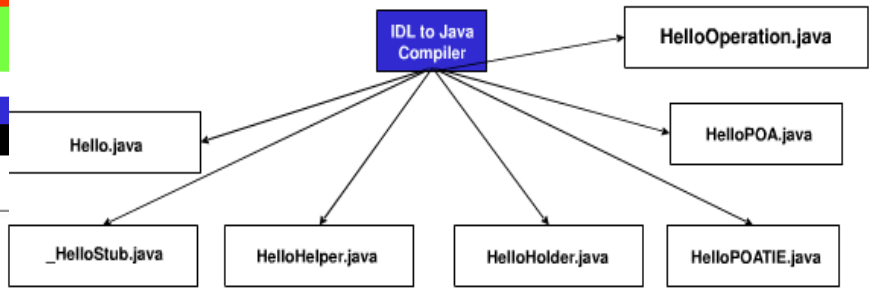
Computer-computer interaction focus

Client.java

```
public class Client {
    public static void main(String[] a
    String iorFile = "week1.ior";
    try {
        File file = new File(iorFile);

        if (!file.exists()) {
          System.err.println("Error: File " + iorFile + " does not exist!!");
          System.exit(1);
        }
        ORB orb = ORB.init(args, null);

        BufferedReader reader = new BufferedReader(new FileReader(file));
        String string_ref = reader.readLine();
        reader.close();
        org.omg.CORBA.Object obj = orb.string_to_object(string_ref);

        Hello server = HelloHelper.narrow(obj);
        String response = server.getTime();
        System.out.println(response);
        ...
    }
}
```

2. Compiling Hello IDL

```
$ idl -ir -d generated hello.idl
```



(Simplified)

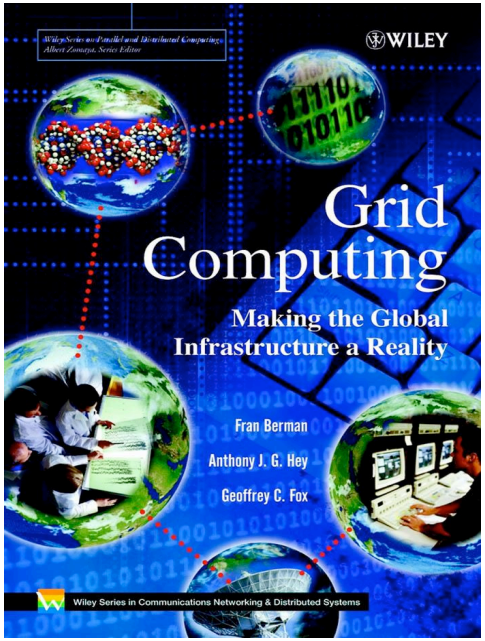
```
public static void main(String[] args) {
        String iorFile = "week1.ior";
        org.omg.CORBA.ORB orb = org.omg.CORBA.ORB.init(args, null);

        // Get reference to the root POA
        POA rootPoa =
                POAHelper.narrow(orb.resolve_initial_references("RootPOA"));
        // Activate the POA Manager - else no requests will be processed!!
        rootPoa.the_POAManager().activate();

        HelloImpl servant = new HelloImpl();

        // Create a CORBA reference for the servant
        org.omg.CORBA.Object obj = rootPoa.servant_to_reference(servant);

        PrintWriter writer = new PrintWriter(new FileWriter(iorFile));
        writer.println( orb.object_to_string( obj ));
        writer.flush();
        writer.close();

        // OK, now just sit back and wait for the action....
        orb.run();
        ...
    }
}
```

Challenges of earlier distributed (networked) system implementations

- Complexity of implementations
  - Middleware bloat and lock-in
  - Vision and challenges of reality
- Vendor specific solutions
  - AnsaWare
  - IBM Distributed SOM / Component Broker
  - Microsoft Network OLE
  - IONA Orbix
  - Visigenic Visibroker
  - BEA ObjectBroker
  - HP ORBPlus and Distributed SmallTalk
  - Expersoft PowerBroker
  - Other ORB's
    - Less mature standards
- Scale of the problem area
  - Telecoms, banking, …
  - The growth (boom!) of the web

Distributed Systems History…ctd

- Enter the web era
  - My first ftp 1993 put/get files to/from Australia
  - Then the web pretty much exploded
- Peer-peer processing
  - File sharing …
- Scaling of…
  - machines,
  - people,
  - domains of application
- Grid computing
  - From computer-computer focus
  - To organisation-organisation focus



Circa 2001

e-Research and the Grid

'e Research is about global collaboration in key areas of science, and the next generation of infrastructure that will enable it.'

Research will change the dynamic of the way science is undertaken.'

John Taylor
Director General of Research Councils
Office of Science and Technology

Grid is infrastructure used for e-Science

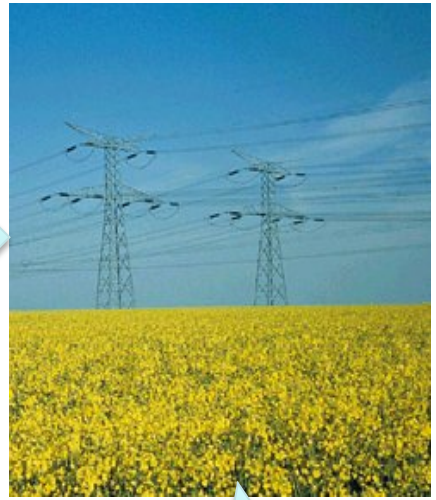
- Power Grid Metaphor: compute and data resources on demand

Major investment by UK Govt (£250m+) to realise this vision

- Across ALL Research Councils (+ EU + industry + …)
- Cyber-infrastructure, European Grid Initiative, Superscience,

From presentation by Tony Hey

The Grid Metaphor



Overcoming heterogeneity…

Guide to International Plugs & Sockets

www.interpower.com
formerly Panel Components Corporation
P.O. Box 115, Oskaloosa, IA 52577 (USA)
Call: (641) 673-5000 Fax: (641) 673-5100
E-mail: info@interpower.com
Toll-free (U.S./Can./P.R./V.I.)
Call toll-free: (800) 662-2290
Fax toll-free: (800) 645-5360

Rev. 8-05

Continental European

For use in Germany, Austria, Finland, the Netherlands, Norway, Sweden, France/Belgium, and other countries utilizing the CEE 7 standard. *(Note: Sweden requires use of socket with separate mounting bracket. France/Belgium require use of different socket types.)* The CEE 7/7 is non-polarized.

For black (88010920) or brown (88010820) plug

Plug with Strain Relief

Part Number	**88010801**
Type	CEE 7/7
Color	Gray
Rating	16A/250VAC
Approvals	

For black (88010611) socket

Screw-Mount Socket

Part Number	**88010610**
Type	CEE 7
Color	Ivory
Rating	16A/250VAC
Approvals	

Panel-Mounting Socket

Part Number	**88010500**
Type	CEE 7
Color	White
Rating	16A/250VAC
Approvals	

For black (88010210) socket

Duplex Socket

Part Number	**88010200**
Type	CEE 7
Color	Ivory
Rating	16A/250VAC
Approvals	

For black (88010390) socket

Socket with Strain Relief

Part Number	**88010400**
Type	CEE 7
Color	Ivory
Rating	16A/250VAC
Approvals	

For black (88010350) socket

Panel-Mount Socket

Part Number	**88010300**
Type	CEE 7
Color	Gray
Rating	16A/250VAC
Approvals	

IP 54 "splashproof"

Europlugs

Interpower Europlugs are wirable. Once shut, they cannot be reopened. For use in Germany, Austria, Finland, the Netherlands, Norway, Sweden, France/Belgium, and other countries utilizing the CEE 7 standard.

Plug

Part Number	**88040030**
Type	CEE 7/16
Color	Black
Rating	2.5A/250VAC
Approvals	

Australian

Plugs and in-line sockets are also acceptable for use in New Zealand according to the New Zealand Ministry of Energy. Interpower Corporation also offers hospital-grade and higher aperage re-wireable plugs and sockets. See www.interpower.com for more information.

Plug

Part Number	**88010713**
Type	AS/NZS 3112
Color	White
Rating	10A/250VAC
Approvals	Department of Fair Trading

Panel-Mounting Socket

Part Number	**88010512**
Type	AS/NZS 3112
Color	White
Rating	10A/250VAC
Approvals	Department of Fair Trading

In-line Socket

Part Number	**88010411**
Type	AS/NZS 3112
Color	White
Rating	10A/250VAC
Approvals	EANSW

Danish

Use a Danish plug on products to be sold in Denmark. Although the Continental European CEE 7-style plug fits into the Danish socket, the plug will not be grounded, presenting an extreme safety hazard. Medical and data versions also available. See www.interpower.com.

Plug

Part Number	**88010741**
Type	Afsnit 107-2-D1
Color	Gray
Rating	13A/250VAC
Approvals	

Panel-Mounting Socket

Part Number	**88010541**
Type	Afsnit 107-2-D1
Color	White
Rating	13A/250VAC
Approvals	

French/Belgian

France and Belgium use a variation of the CEE 7 socket which contains a male grounding pin and shuttering. The CEE 7/7 plug used throughout Continental Europe has a receptacle for this pin and can be used in France and Belgium. France and Belgium now require safety shuttering on all of their sockets.

Panel-Mounting Socket

Part Number	**88010550**
Type	CEE 7
Color	Ivory
Rating	16A/250VAC
Approvals	—

Panel-Mounting Socket

Part Number	**88010321**
Type	CEE 7
Color	Gray
Rating	16A/250VAC
Approvals	

IP X4 "splashproof"

Indian/South African

Old British Standard (BS 546) used in India and parts of Southern Africa.

For black (88010230) plug

Plug

Part Number	**88010763**
Type	BS 546
Color	White
Rating	15A/250VAC
Approvals	—

For black (88010220) socket

Panel-Mounting Socket

Part Number	**88010561**
Type	BS 546
Color	Ivory
Rating	15A/250VAC
Approvals	—

Israeli

Plug

Part Number	**88010780**
Type	SI 32
Color	White
Rating	16A/250VAC
Approvals	

Panel-Mounting Socket

Part Number	**88010580**
Type	SI 32
Color	White
Rating	16A/250VAC
Approvals	

Italian

Note: This plug is **non**-polarized.

Plug

Part Number	**88010771**
Type	CEI 23-16/VII
Color	Gray/Charcoal
Rating	10A/250VAC
Approvals	

Panel-Mounting Socket

Part Number	**88010572**
Type	CEI 23-16/VII
Color	Silver/Metallic
Rating	10A/250VAC
Approvals	

Japanese Grounding Adapter

When exporting products to Japan or other parts of the world (such as Central America) where 2-wire, non-polarized mains power is typical, include a grounding adapter to ensure that products will be grounded. Shown below is a 3-wire to 2-wire adapter with non-polarized blades.

Grounding Adapter

Part Number	**88100011**
Type	JIS 8303
Color	Black
Rating	15A/125VAC
Approvals	

Swiss

Plug

Part Number	**88010732**
Type	SEV 1011
Color	Black
Rating	10A/250VAC
Approvals	

Push-In Mounting Socket

Part Number	**88010530**
Type	SEV 1011
Color	White
Rating	10A/250VAC
Approvals	

In-Line Socket

Part Number	**88010431**
Type	SEV 1011
Color	Black
Rating	10A/250VAC
Approvals	

Panel-Mounting Socket

Part Number	**88010330**
Type	SEV 1011
Color	Gray
Rating	10A/250VAC
Approvals	

IP X4 "splashproof"

United Kingdom/Ireland

Line and neutral contacts of socket are shuttered to minimize accidental entry of an object other than mating plug.

Europlug Converter

Part Number	**88050010**
Type	BS 5733
Color	White
Rating	2.5A/250VAC
Approvals	

Plug with integral 13A fuse. For black (88040021)

Plug

Part Number	**88040011**
Type	BS 1363
Color	White
Rating	13A/250VAC
Approvals	

Panel-Mounting Shuttered Socket

Part Number	**88010621**
Type	BS 1363
Color	White
Rating	13A/250VAC
Approvals	—

Line and neutral contacts are shuttered. For black (88010980)

In-Line Shuttered Socket

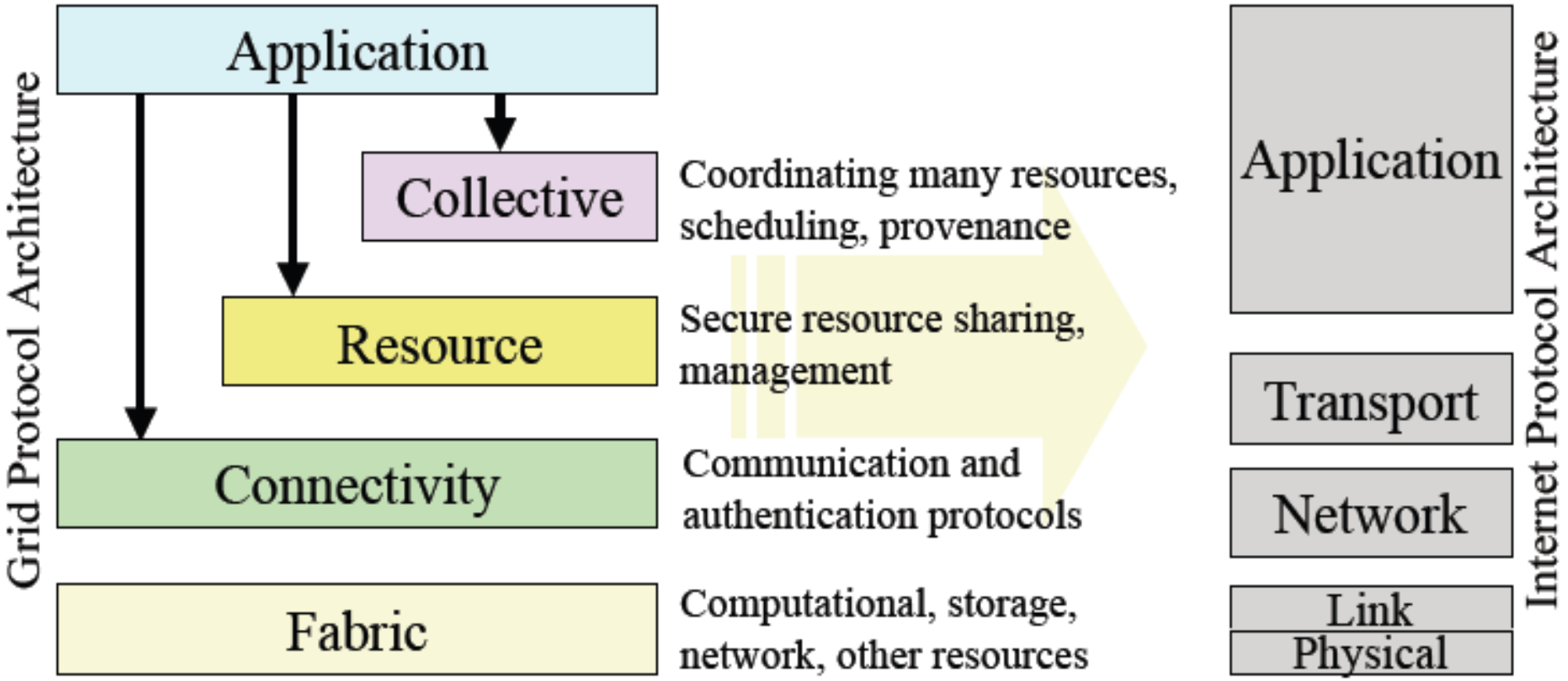
Part Number	**88010422**
Type	BS 1363
Color	White
Rating	13A/250VAC
Approvals	—

This is only a small sample of Interpower international rewireable plugs and sockets. North American plugs and sockets also available. For specifications of these and additional plugs and sockets, see our web site (www.interpower.com) or catalog. Call for a free copy of Interpower's *Export Designer's Reference & Catalog 10*.

Order direct from our warehouse in Oskaloosa, IA

- No minimum order requirement
- Same day shipment available for stock item orders received by 6:00 p.m. Central Time
- Most items available from stock
- Free evaluation samples
- Assembly services available
- Technical support available

Typical (Compute) Grid Architecture



All sorted…?

Grid Standards

- Even increasing numbers and ever decreasing understanding and acceptance/adoption by implementers
  - Global Grid Forum
  - Open Grid Forum
  - OASIS
  - IETF
  - W3C
  - …

GGF

OpenGridForum
OPEN FORUM | OPEN STANDARDS

OASIS
The Organization for the Advancement of Structured Information Standards

IETF®

W3C
WORLD WIDE WEB
consortium

+ many more…

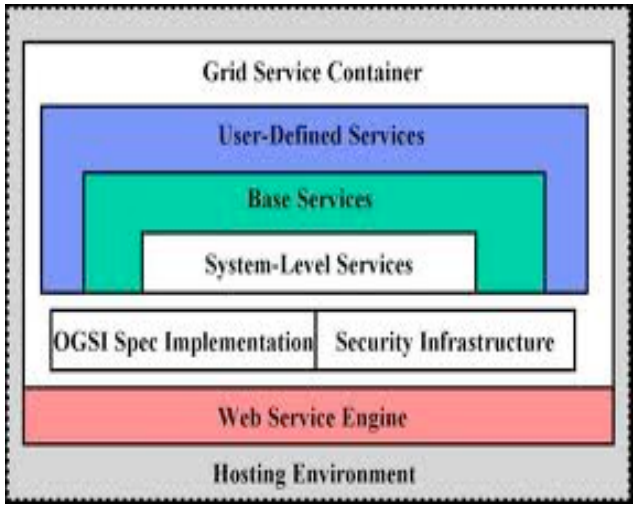
Grid Technologies… (~2002+)

- Globus Toolkit Project – www.globus.org
  - GT2 - Complex software system for large, scale distributed software systems development
    - Physiology of the Grid (Foster et al) *www.globus.org/alliance/publications/papers/ogsa.pdf*
      - *The Open Grid Services Architecture*
    - The Anatomy of the Grid: Enabling Scalable Virtual Organizations (Foster et al) http://dl.acm.org/citation.cfm?id=1080667
  - MANY MB of source code
    - Many software engineers worked in making this
      - and many more in making it work!!!

Grid Technologies… (~2004+)

- Move to service-based approach
  - The Open Grid Services Infrastructure (OGSI)
  - www.globus.org/toolkit/draft-ggf-ogsi-gridservice-33_2003-06-27.pdf
- GT3 – core technologies re-factored as "Grid Services"
  - stateful Web services
  - extension of Web services interfaces
  - asynchronous notification of state change
  - references to instances of services
  - collections of service instances
  - service state data augmenting constraints of XML Schema definition

the globus toolkit®
www.globustoolkit.org



Grid Technologies… (~2009+)

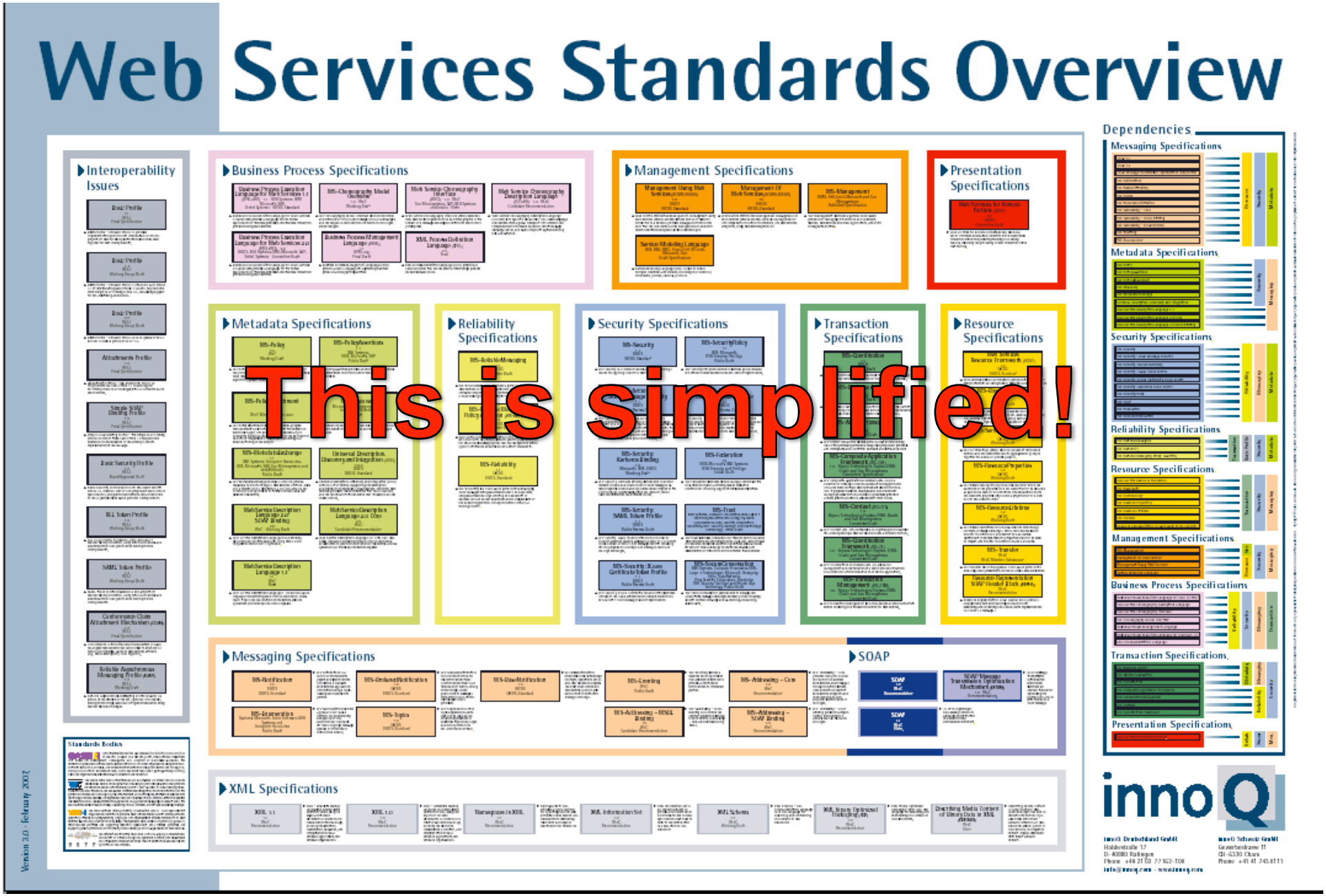
- Complete reassessment of OGSI approach to be "purer" web services
  - Web service resource framework (WSRF)
  - GT4 implemented this
    - Many software engineers hardened their skill sets using this (is one nice way of putting it!!!!)

The only way to make software secure, reliable, and fast is to make it small

AS Tanenbaum

- Also MANY other standards and efforts …
  - Business and commercial drivers
    - Vendors shaping standards to their commercial advantage

Flux of Web Service Standards



The nice thing about standards is that you have so many to choose from…

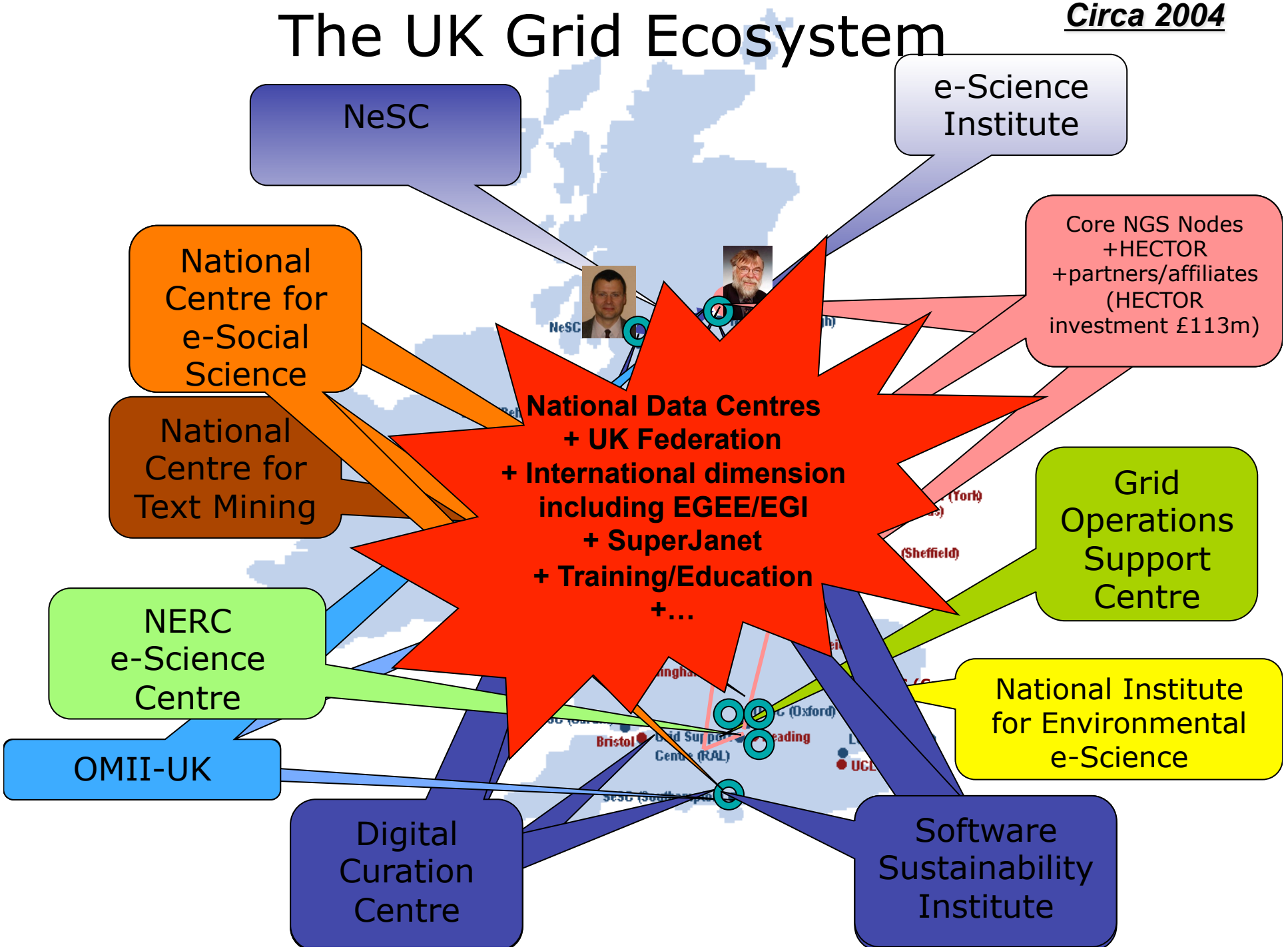
The development of robust Grid security infrastructures is very much dependent upon agreements on technologies and practices. Standardisation plays an extremely important role in this regard. With the move of the Grid community towards web services and service-oriented architectures, web service security standards and their associated implementations are crucial. Unfortunately it is the case that a multitude of specifications and proposals for web service standards have been promised and put forward, or merely promised. There are often cases of web service standards covering similar topics resulting in multiple competing specifications such as WS-Notifications and WS-Eventing; WS-ReliableMessaging and WS-Reliability; WS-Orchestration, WS-Co-ordination and WS-Choreography, along with the many varieties of workflow or business process languages that have been put forward to name but a few examples of the issues in the proliferation of web service standards. It is also the case that at the time of writing, many web services standards are only in working draft or draft status, often with no associated implementations or acknowledged conformance or interoperability definitions. Claiming conformance or compliance to a particular web service standard is thus often not possible (or meaningful!).

It is also apparent that although many standards use the common prefix "WS-", this does not mean that there is an agreed WS-Architecture. This stems from a variety of reasons: vendor and commercial issues; political aspects and also the different bodies involved. For example the Internet Engineering Task Force (IETF) (www.ietf.org); the World Wide Web Consortium (W3C) (www.w3.org); the Organization for the Advancement of Structured Information Standards (OASIS) (www.oasis-open.org); and the Web Services Interoperability Organization (WS-I) (www.ws-i.org) are some of the most prominent bodies. The consequence of this profusion of standards and standards making bodies, and the lack of consensus on the core web service architecture, impacts directly upon development of Grid standards, architectures and associated implementations and middleware.

Me: Grid Security : Practices, Middleware and Outlook

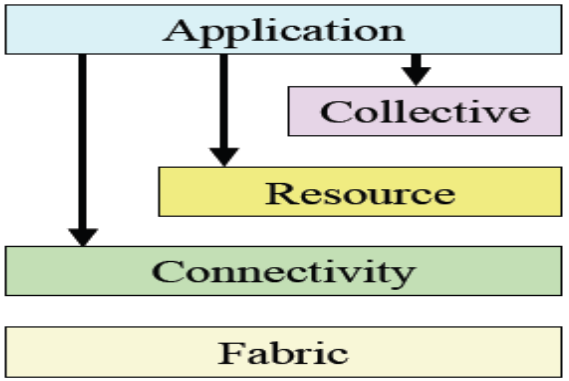
The UK Grid Ecosystem

Circa 2004



How hard can a compute Grid be…?

- Information Systems
  - What resources are available
    - Servers, CPUs, memory, storage, queues, OS, applications, databases, …
- Monitoring and Discovery Systems
  - What is the status of those resources
    - Queues empty/very full
    - Machines running for a week
    - Hard to tell for some applications…?
- Job scheduling/resource brokering
  - Please run these {jobs}
    - Fastest, most secure/reliable, cheapest …
      - Jobs need inter-process communication…?
        - » never get resources vs resource starvation
        - » Physics pilot jobs workaround
- Virtual organisation support
  - I'm a chemist and want to run my simulation



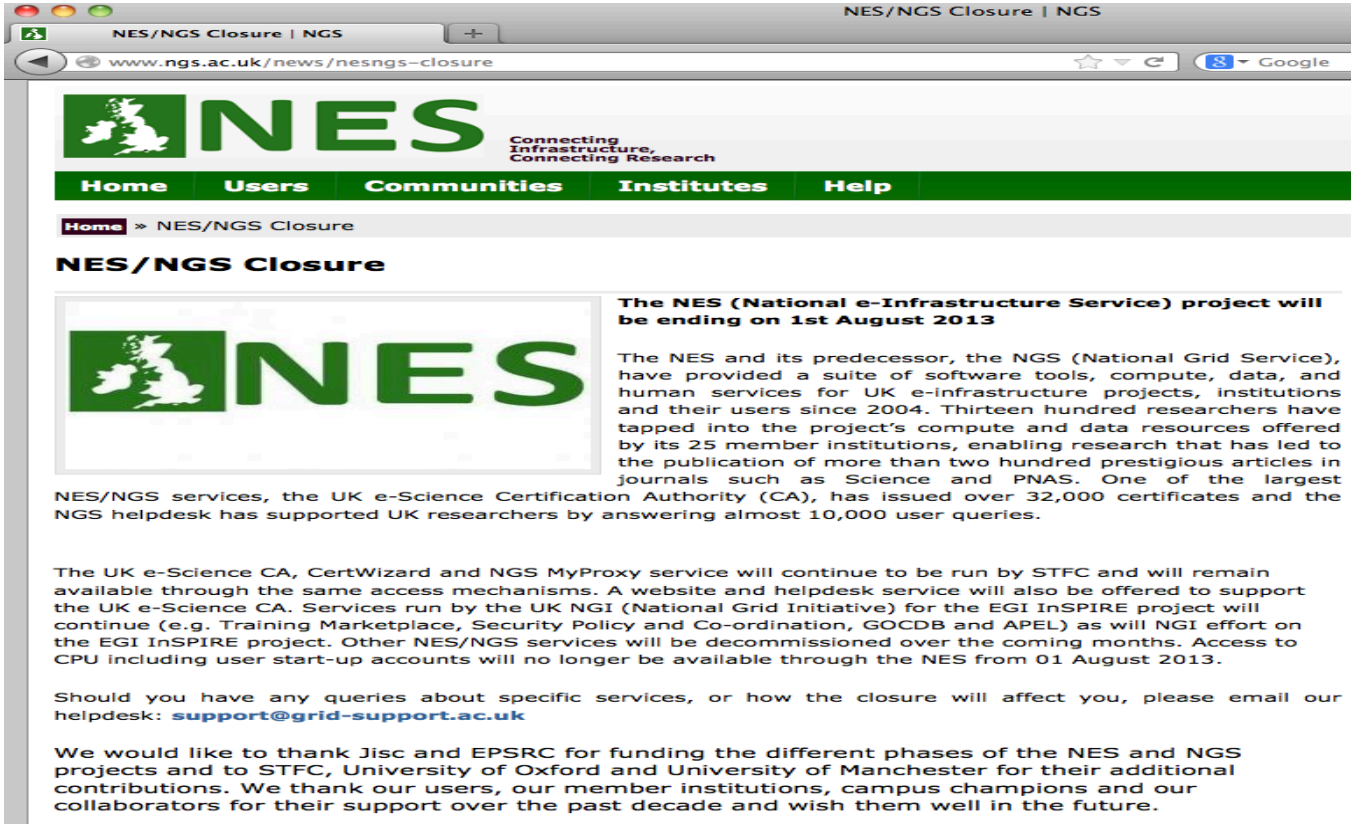
Fragility of it all…

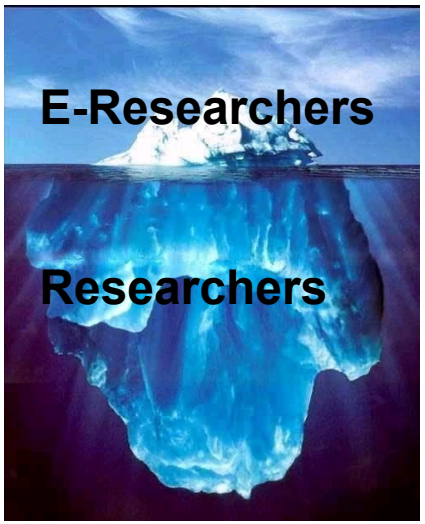
- How I broke the UK e-Science Grid…

Other Challenges

- Security
  - Public Key Infrastructures
    - *$> openssl pkcs12 -in cert.p12 -clcerts -nokeys -out usercert.pem!*

???? (more in later lectures)

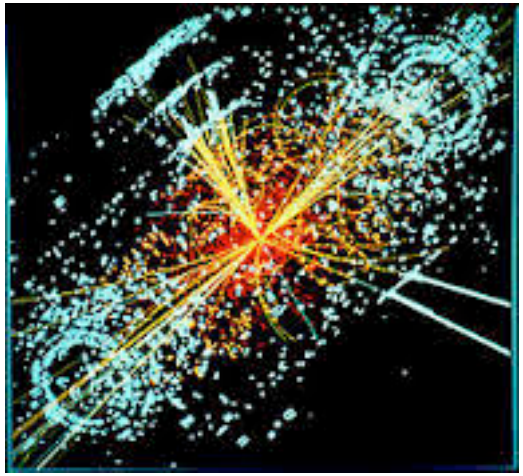


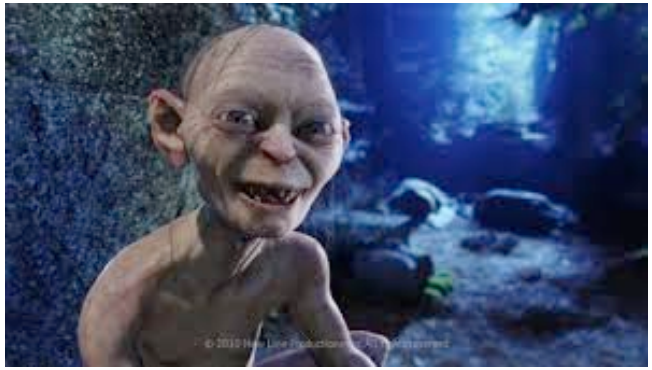


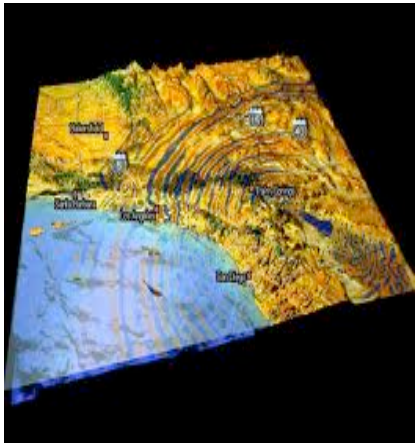
(NOT TO SCALE)

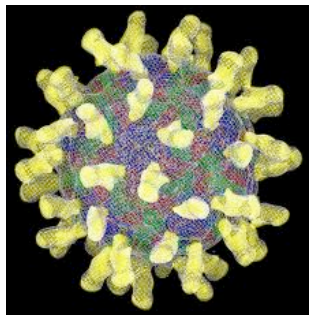
Doom and gloom…!?!?

- But…

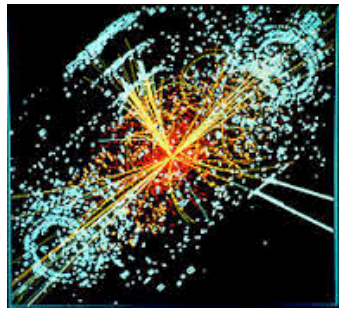








High Energy Physics?



- Why did/does Grid work for them…?
- Size, scale and resourcing
  - GridPP
  - Enabling Grids for e-Science (EGEE)
  - European Grid Initiative
    - Huge numbers of admins making systems tick over
      - (=not searching for Higgs Boson)
  - Heterogeneity vs homogeneity
    - Specific versions of operating system
      - Scientific Linux v4, v5
    - Specific versions of middleware
      - Unilateral updates/deployments
        - » globus-*, gLite-wms-*,
        - » edg-job-*, lcg-job-*, GANGA
  - Well-defined problem…

My philosophy since…

- Less focus on complex middleware stacks
  - FAR too much focus on technology issues
    - More on customer needs and making a difference
- And to inspire you (and make you think what you do with social media!!!)
  - A snapshot of what you will be doing with Twitter analytics!

Questions?