Emerging Technologies for Collective [Computational] Intelligence

Keynote Talk

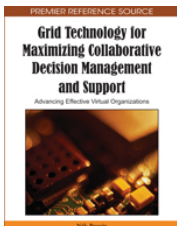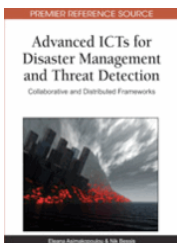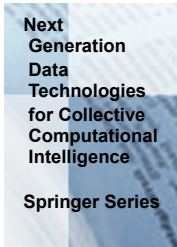Prof Dr Nik BESSIS[1, 2]

nik.bessis@beds.ac.uk

[1]School of Computing and Maths

University of Derby, UK

[2]Department of Computer Science and Technology

University of Bedfordshire, UK

**http://www.beds.ac.uk/departments/computing/staff/nik-bessis**

my Research

- *Managed over £0.5m and led or involved in £2m funded projects in the last 5 years*
  - *Currently co-investigator in Multi-Scale Visualization (MSV), a EU funded project*

- *Research interests*
  - *Applicable computing, Emerging technologies, Data grids/push, Clouds, Crowds, Web 2.0, Disaster management…*

- *Research team's work of international excellence*
  - *Published over 75 publications in the last 3 years*
  - *Three best paper awards in 2009*
  - *Chair in conferences/workshops/tracks in 2010-11*
    - *IADIS CT-2010, ICADIWT-2010: DIACT-2010, 3PGCIC-2010: EDTCI-2010, INCoS-2010, CIDM-2010, AINA-2011: GP2PSC, PARELEC-2011, SCOPE-2011, IADIS-2011, CISIS-2011, IMIS-2011, EIWDT-2011…*

- *Many international collaborations*
  - *Ex-WP6 CoreGrid Partners, Switzerland*
  - *US, Spain, Italy, Greece*
  - *Always looking for more :D*
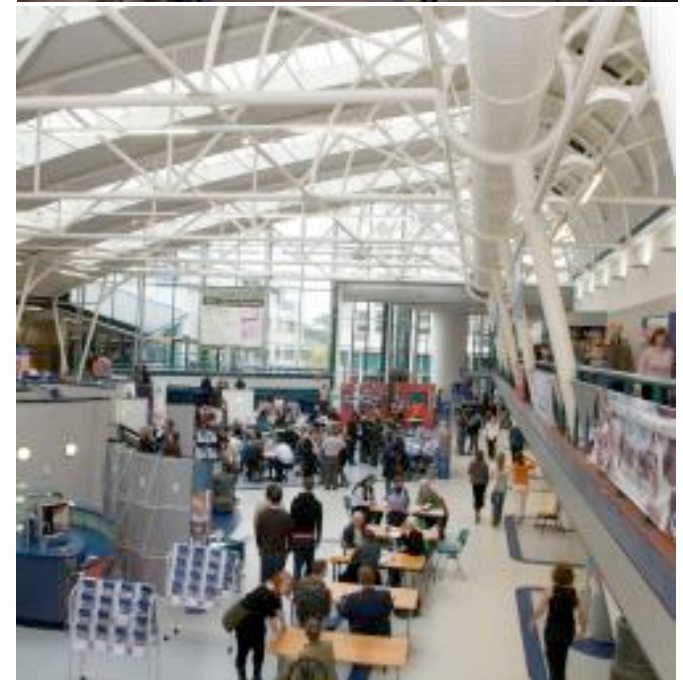
Outline

- *The purpose of this talk is to discuss:*

  1. Concepts of Web Communities & Virtual Organizations
  2. Concepts of Emerging Technologies
  3. Research and Development Projects
  4. Trends: Clouds and Web 2.0 - What's next? Crowds?
  5. Future trends & the vision: bringing everything together to enable collective computational intelligence

- *Q&A/Discussion*

Motivation (the Holon)

<u>So many advances yet:</u>

- *Everyone has questions - No-one has all the answers*
- *Resources are always an issue*
- *Need a **collaborative, collective and computational [all-in one] intelligence approach** to solve big problems*

- ***Enabling a context aware exploitation that is achievable via dynamic <u>intra-</u> and <u>inter-</u> communication, cooperation and collaboration (c-cube) between shared electronic resources regardless of their structure, place and time***

- *High-level benchmark to achieve*
- *Brings challenges and rewards*
- ***Need to think BIG (holistically)!***

Web Communities (WCs)

De Vries and Kommers (2004) state that virtual communities permit users with common interests to keep in touch with each other, which in turn, lead to **fostering social cohesion** and make possible the interaction between members via the means of a virtual space.

Similar references are also available from Rodrigues, Oliveira and de Souza (2004). Santos and Boticario (2008) describe web-based communities **as online meeting places where groups of people do not physically meet but communicate their ideas and feelings on shared topics of interests using the collaborative services** (or social software) offered by the web to regulate the activities of the participants. They also state that the second generation of web-based services (called Web 2.0), let people collaborate and share information online in new ways, leading to the so-called Community 2.0

These enable the production of experiential knowledge and as Hildrech et al. (2000) points out "... **improve** organizational **performance** by maintaining implicit knowledge, helping the **spread of new ideas and solutions**, acting as a focus for innovation and driving organizational strategy".

Web or Virtual Communities, Teams or Organizations have their roots from the **Community of Practice (CoP) notion (Wenger model)** and also share many of things including the notion of online collaboration for Outsourcing and Joint Endeavour. They have also used widely in the e-commerce sector.

Virtual Organizations (VOs)

A VO is a group of individuals whose members and resources may be dispersed geographically and institutionally, yet who __PURPOSEFULLY__ function as a coherent unit through a CI. A VO is typically enabled by, and provides shared and often real-time access to, centralized or distributed resources, such as power, data, applications, sensors, and experimental operations. Quite often, these resources use HPC as a core capability.

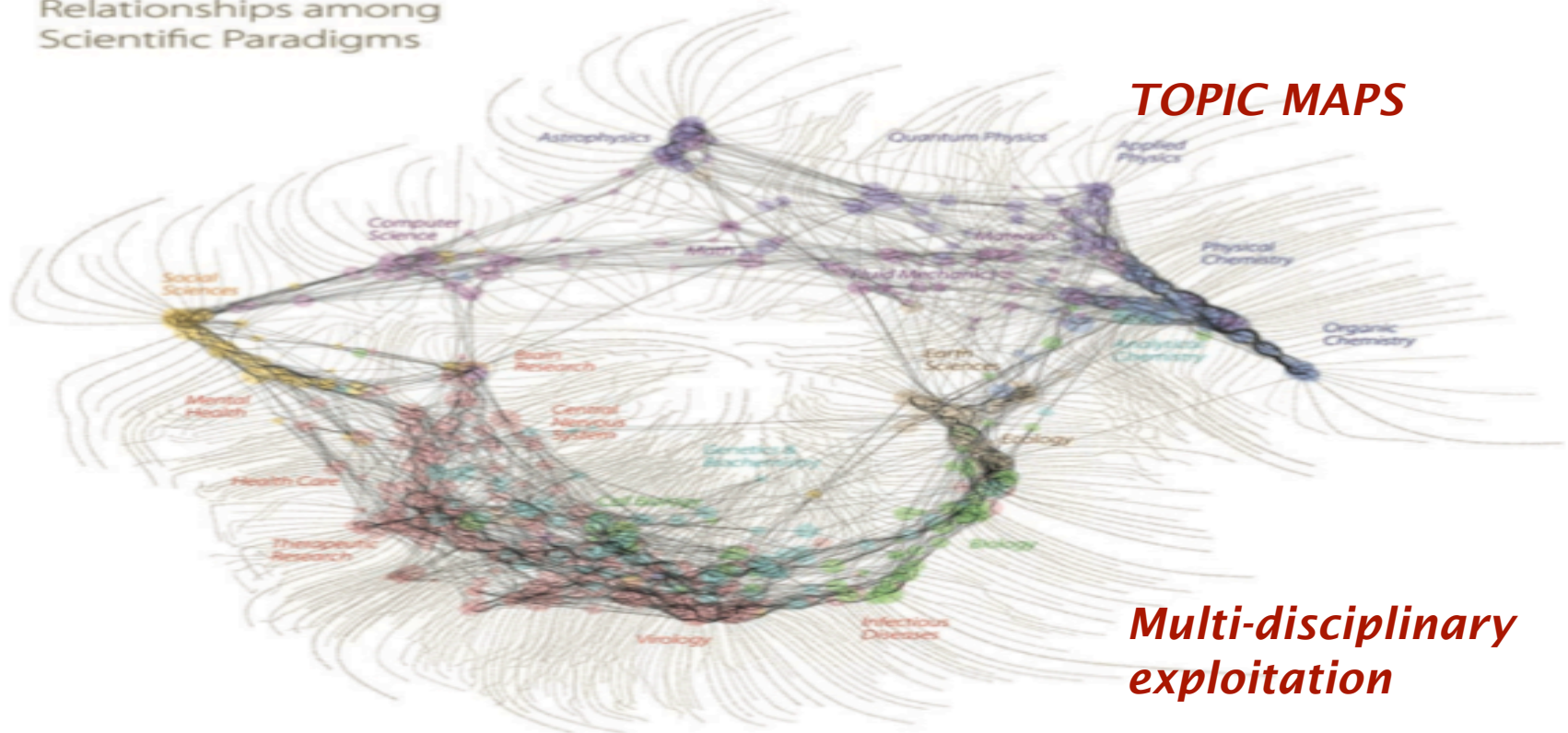**TOPIC MAPS**

Multi-disciplinary exploitation

Exhibit 36. The Topic Map was constructed by sorting roughly 800,000 scientific papers (shown as white dots) into 776 different scientific paradigms (red circular nodes) based on how often the papers were cited together by authors of other papers. Links (curved lines) were made between the paradigms that shared common members, and similar paradigms are nearer one another. Labels list common words unique to each paradigm.

BEYOND BEING THERE: A BLUEPRINT FOR ADVANCING THE DESIGN, DEVELOPMENT, AND EVALUATION OF VIRTUAL ORGANIZATIONS, Final Report from Workshops on Building Effective Virtual Organizations, National Science Foundation, May 2008.

6

IT evolution

P2P, Grids, Clouds, Managed shared VO …

?

Web Services

Internet standards

Custom solutions

1990	1995	2000	2010+

" ... Since the early days of mankind the primary motivation for the establishment of communities has been the idea that by being part of an organized group the capabilities of an individual are improved. The great progress in the area of inter-computer communication led to the development of means by which stand-alone processing sub-systems can be integrated into multi-computer 'communities'."

CONDOR   *Miron Livny, " Study of Load Balancing Algorithms for Decentralized Distributed Processing Systems.", Ph.D thesis, July 1983.*
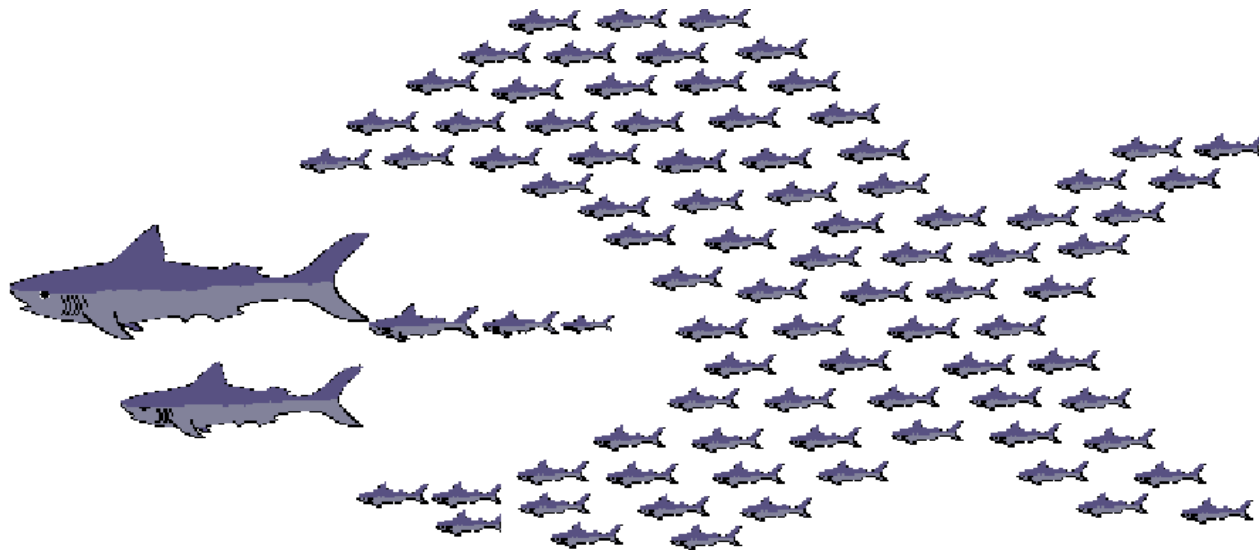
The "power" of harnessing multiple dispersed nodes can be greater than the world's biggest and fastest "Supercomputer"

Background Examples (naïve's view)

Bassi and Kettunen (2008)

- **9-11, 2001, US**

  NY, Wall street

  Fires of +3,000^{0}C

  Steel construction building

  Would you send your rescue team for t_x if you knew that the building will collapse in t_{x-x_1}?
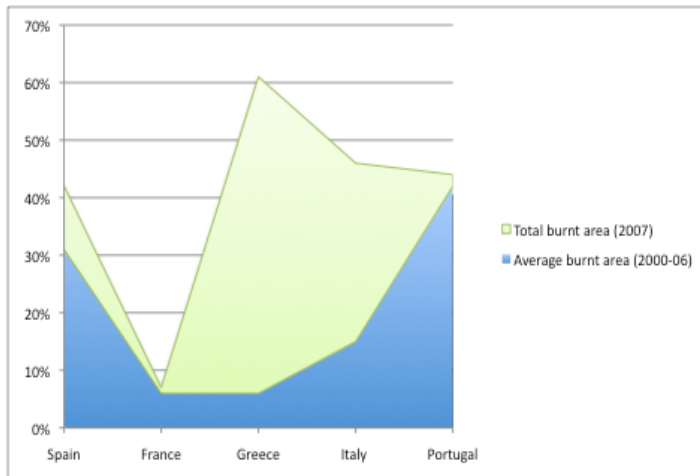
- ***In 2007, destructive forest fires occurred in Spain, Portugal, France, Italy and Greece.**

  Greece requested assistance 4 times through the EC Monitoring Information Centre during the June-August.

  The total burnt area in 2007 amounts over a quarter million of hectares, of which 2/3 burnt between the 24th-30th August.

  During these events 5,392 people were affected and 67 of them killed while the damage has been calculated to $1,750,000.

*BESSIS, N. and ASIMAKOPOULOU, E. (2008). Towards a Grid Aware Forest Fire Evacuation Warning System, Proc. International Disaster and Risk Conference, IDRC, 25th– 29th August, Davos, p.p.: 102-105.

- Forest fires occur in many places at the same time
- Fire-fighters need to split up in smaller teams
- Geological morphology, atmospheric conditions, etc...
- Humans do not follow instructions
- ICT and TV channels broadcasting images for a particular area at a given time instance

- Most fatalities occurred because people have been surrounded from the raging fire
- People have been found burned on roads or within their cars, as winds were changing directions

- *Think of a system that integrates data from multiple sources (including Google maps), uses computational power to run complex simulation scenarios and broadcasts automatically relevant and timely evacuation routes to relevant occupants*

FFED-GPS model architecture

OGSA-DAIS: Open Grid Services Architecture-Data Access Integration Services

Keys:
S_GR: Subscribe
 to the Grid
 Register
S_GDSF:
 Subscribe to the
 Grid Data
 Service Factory
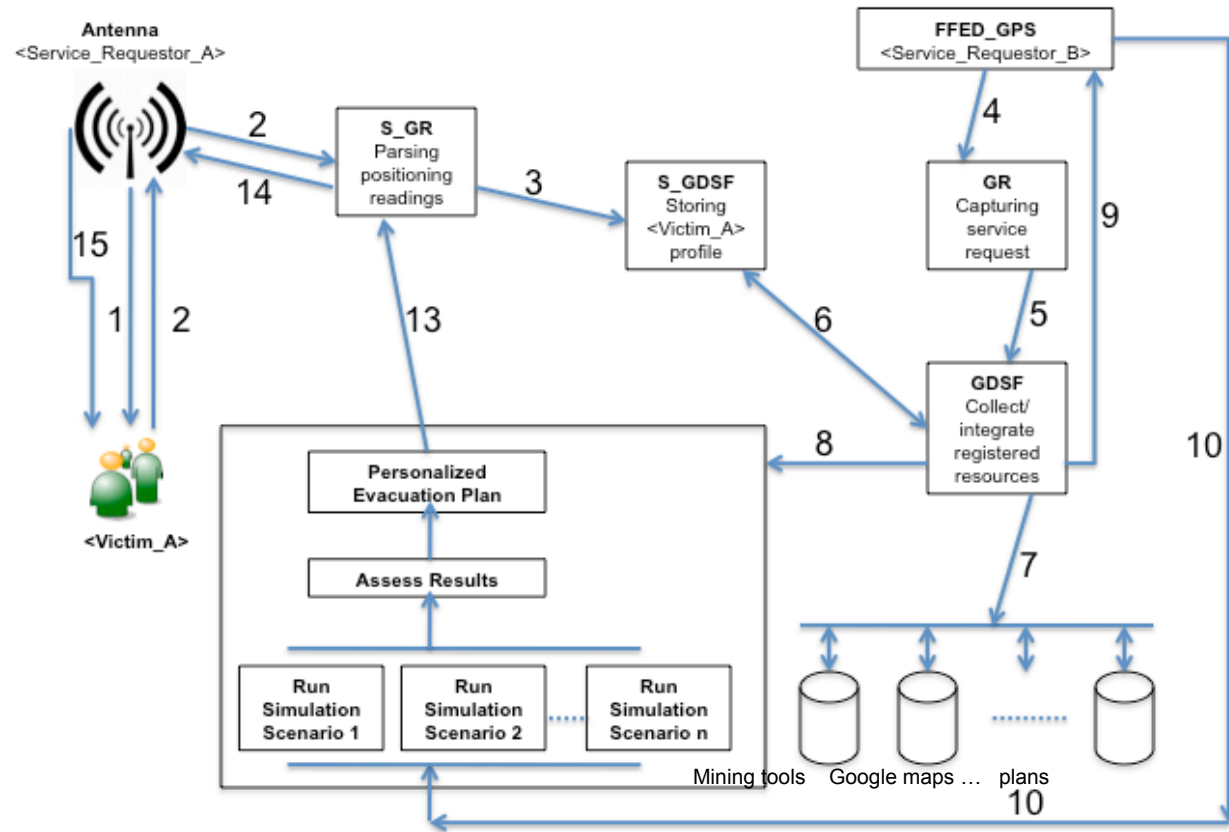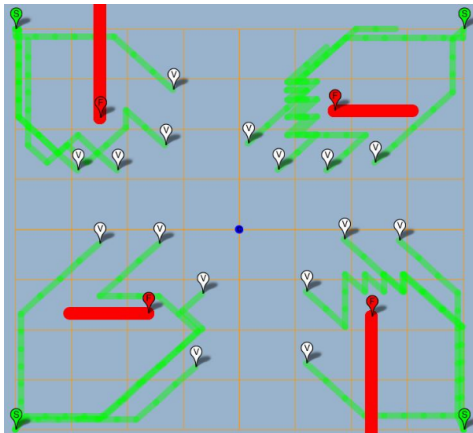
ASIMAKOPOULOU, E., BESSIS, N., VARAGANTI, R. and NORRINGTON, P. A Personalised Forest Fire Evacuation Data Grid Push Service – The FFED-GPS Approach. In: E Asimakopoulou and N Bessis (eds.). Advanced ICTs for Disaster Management and Threat Detection: Collaborative and Distributed Frameworks, IGI (2010).

Does Grid technology differ from:

- *Open Systems?*
- *Clusters and Parallel Computing?*
- *Distributed Computing? P2P?*
- *A lot! Grid is an enabling technology incorporating other paradigms in one! It brings everything together!*

- **Grid is a dynamic, enabling paradigm supporting synchronous and asynchronous resource utilization in a c-cube mode and it has been purposefully developed for solving <u>well-known scientific problems</u>…**
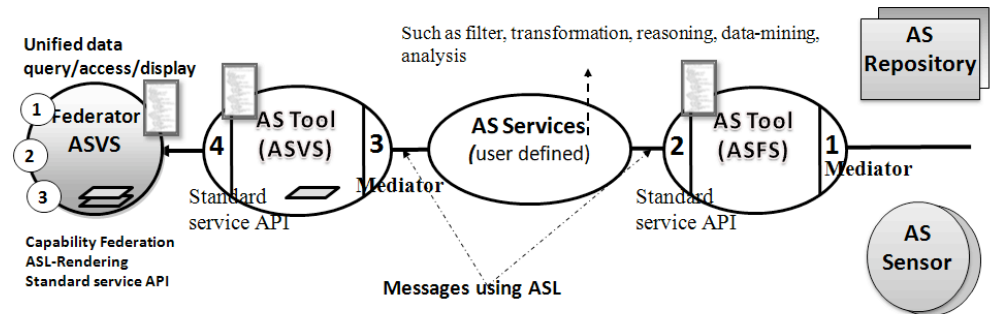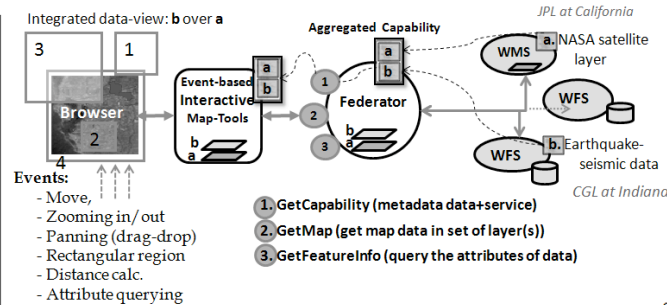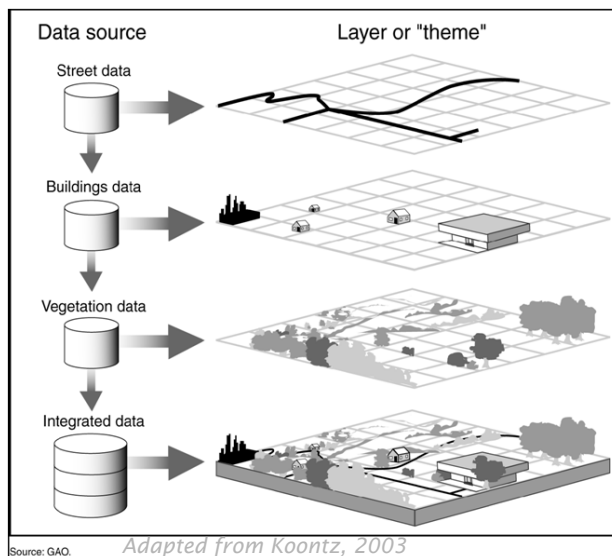
SCIER Project
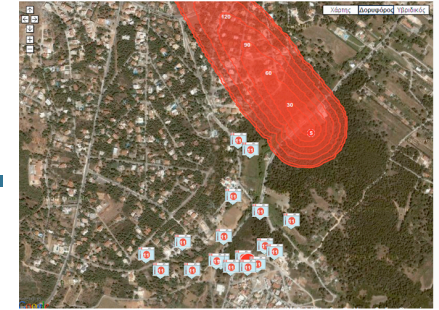
- The Sensing and Computing Infrastructure for Environmental Risks (SCIER) system constitutes an integrated platform capable of delivering to the authorities and the citizens valuable real time information regarding natural hazards that may affect the wildlife urban environment.

- SCIER aims at providing the functionality needed for detecting, monitoring and forecasting the hazard's evolution. Sensors spread in the region monitor environmental parameters (e.g., temperature, humidity, wind direction and speed) and feed the data to predictive models running in the computing infrastructure.
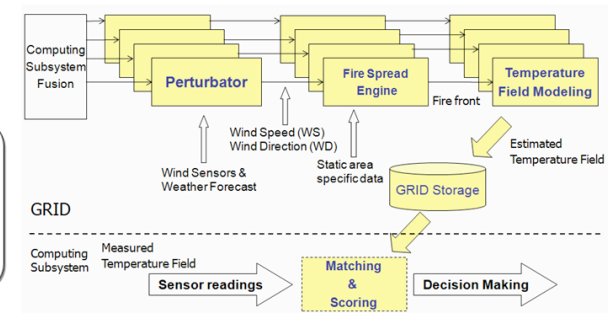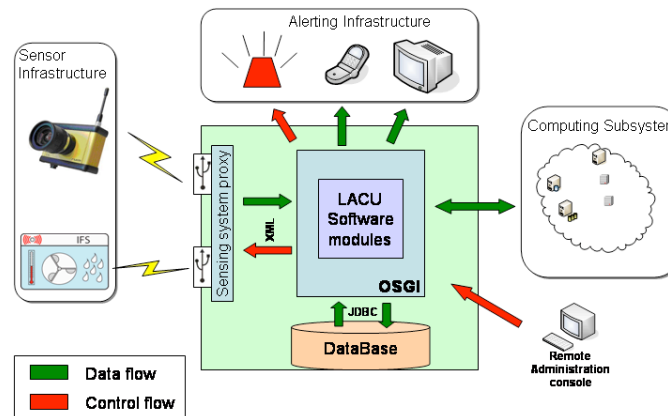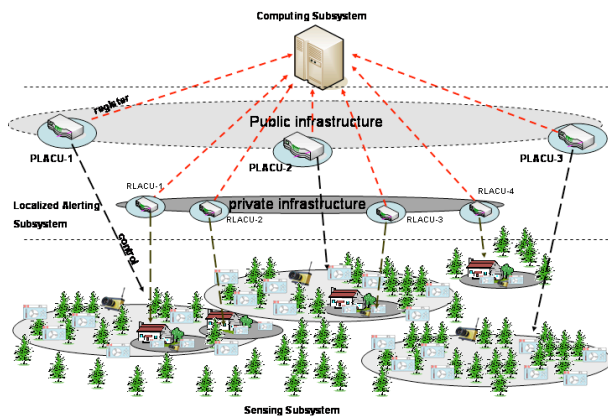
O. Sekkas, I. Manatakis, E. Manolakos and S. Hadjiefthymiades, Sensor and Computing Infrastructure for Environmental Risks – The SCIER System. In: E Asimakopoulou and N Bessis (eds.). Advanced ICTs for Disaster Management and Threat Detection: Collaborative and Distributed Frameworks, IGI (2010).

13

GIS Services for Disaster Planning

- GIS is critical for building disaster planning, crisis management and early-warning systems. Decision making in GIS increasingly relies on analyses of spatial data in map-based formats. Maps are complex structures composed of layers created from distributed heterogeneous data belonging to the separate organizations.

- Here a SOA for understanding and managing the production of knowledge from the distributed observation, simulation and analysis data is used through integrated data-views in the form of multi-layered map images.


A. Sayar, G. Fox and M. Pierce, Unified Data Access/Query over Integrated Data-views for Decision Making in Geographic Information Systems. In: N Bessis (ed.), Grid Technology for Maximizing Collaborative Decision Management and Support: Advancing Effective Virtual Organizations, IGI, 2009

14

Living Human Project (LHP) - MSV

- *The Living Human Project (LHP) aims to create an in silico model of the human musculo -skeletal apparatus which can predict how mechanical forces are exchanged internally and externally, at all scales, from the whole body down to the protein level (http://www.livinghuman.org/)*

- *Phenomena observed in living organisms cannot be explained within a single sub-system but reflect, rather, systemic outcomes that result from the interaction of multiple sub -systems.*

- *The Multiscale Spatiotemporal Visualisation (MSV) project will: i) define an interactive visualisation paradigm for biomedical multiscale data, ii) validate it on the large collections produced by the VPH projects, and iii) develop a concrete implementation as an open-source extension to the Visualisation Took Kit (VTK), ready to be incorporated by virtually any biomedical modelling software project.*

Exemplary problems
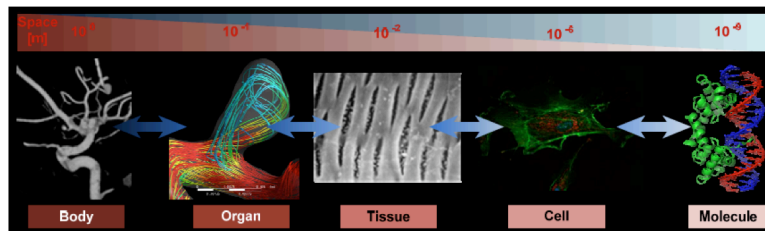
Cerebral aneurysms: an example of a multi-scale problem in space and time that requires tailored visualization tools for each scale. So far, there is no unified solution for such challenging task

http://www.biomedtown.org/biomed_town/MSV/reception/MSV_website/

What are we *(or should be)* trying to do?

- Enabling scientists to be (more) creative
- Enabling scientists to be scientists. And not programmers
- Enabling mediocre scientists to become better and thus have better science
- Enabling smart scientists to be smarter and propagate their smartness
- Accelerating dissemination
- Accelerating pooling
- Accelerating insight
- Encouraging plagiarism

Slide extracted from David De Roure, in 2006 Open Grid Forum

Is it better to say: where we are heading to?

Making the *Invisible* **Visible**

In fact, we are doing quite well but

most times, we fail to see the holon and its implications as a holon... can we break this boundary?

Trends – using Google insights...

Web Search Interest: grid computing

Worldwide, 2004 - present

Categories: Computers & Electronics (50-75%), Industries (0-10%), Reference (0-10%), more...

Interest over time   ☐ forecast ⑦   ☑ News headlines

How can I see numbers?

💡 See worldwide top rising searches by clearing the search terms

A Maple Grid Computing Toolbox – распределенные вычисления для инженеров
B Grid Computing, The New Commodity
C 'Grid Computing' o solidaridad tecnológica
D One-stop Shop For Grid Computing
E 'Grid computing Red Hat' out-Amazons Amazon
F Oracle's Phillips Sees Grid Computing For The Masses
G Grid Computing

2004   2005   2006   2007   2008   2009   2010

* The last value on the graph is based on partial data and may change. Learn more

Google   Embed this chart

Regional interest   ⑦ Region Town/City

1. India
2. Pakistan
3. Singapore
4. South Korea
5. Malaysia
6. Iran
7. Hong Kong
8. Taiwan
9. Greece
10. Indonesia

Search volume index
0 ▢▢▢▢▢ 100

➕ View change over time ⑦

Trends

Web Search Interest: p2p

Worldwide, 2004 - present

Categories: Internet (25-50%), Computers & Electronics (10-25%), Entertainment (0-10%) , more...

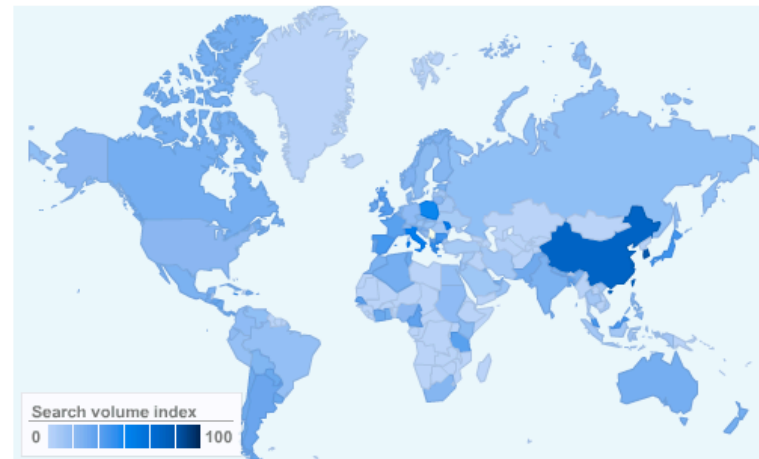**Interest over time**   ☑ forecast   ☑ News headlines

How can I see numbers?

💡 See worldwide top rising searches by clearing the search terms

A '아뿔사' 애플, P2P 방식 앱 뒤늦게 퇴출
B Cae una red de distribución de pornografía infantil a través de P2P
C Un juez de Barcelona reconoce la legalidad de las páginas de enlaces y de las redes P2P
D FTC warns 100 organizations about leaked data via P2P
E BT to throttle P2P for faster broadband
F Israeli ISPs Caught Interfering With P2P Traffic
G Opera delivers Unite beta, touts in-browser P2P

* The last value prior to the forecast is based on partial data and may change. Learn more
** Future values are based exclusively on the extrapolation of past values. Learn more

➕ Google Embed this chart

Regional interest   ⑦ Region Town/City

1. South Korea
2. China
3. Taiwan
4. Moldova
5. Hong Kong
6. Italy
7. Trinidad and Tobago
8. Poland
9. Jamaica
10. Greece

Search volume index
0 ▭▭▭▭▭ 100

➕ View change over time ⑦

19

Trends

Web Search Interest: web 2.0

Worldwide, 2004 - present

Categories: News & Current Events (25-50%), Computers & Electronics (10-25%), Internet (10-25%) , more...

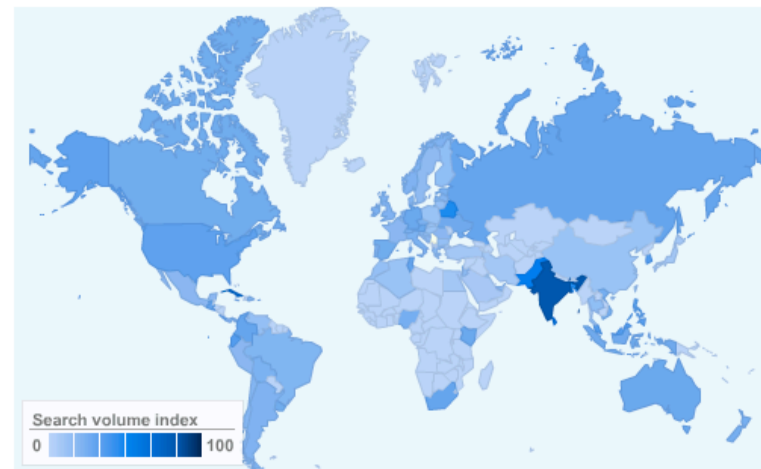| Interest over time | ☐ forecast ⓘ | ☑ News headlines |

How can I see numbers?

💡 See worldwide top rising searches by clearing the search terms

A Read all 'Web 2.0' posts in Security
B Journalisme et web 2.0: regards croisés
C Web 2.0, Social Media and the Dark Web - A Web Criminals Paradise?
D Web 2.0 Summit: PayPal's Platform Plans
E 5 projets serious gaming et Web 2.0
F Tr.im cuts air supply, says no money in tiny Web 2.0 pot
G Web 2.0 allows more open government

2004   2005   2006   2007   2008   2009   2010

* The last value on the graph is based on partial data and may change. Learn more

➕ Google   Embed this chart

Regional interest   ⓘ Region Town/City

1. India
2. Cuba
3. Sri Lanka
4. Pakistan
5. Singapore
6. Hong Kong
7. Belarus
8. Bangladesh
9. Taiwan
10. Mauritius

Search volume index
0 ▬▬▬▬ 100

➕ View change over time ⓘ

20

Trends

Web Search Interest: cloud computing

Worldwide, 2004 - present

Categories: Computers & Electronics (10-25%), Reference (0-10%), Local (0-10%), Society (0-10%) , more...

Interest over time ☑ forecast ☑ News headlines

How can I see numbers?

* The last value prior to the forecast is based on partial data and may change. Learn more
** Future values are based exclusively on the extrapolation of past values. Learn more

Google | Embed this chart

See worldwide top rising searches by clearing the search terms

A Microsoft's Top Software Architect, a Cloud Computing Advocate, Quits
B Globalisation, cloud computing spark change in "future of work"
C Oracle unveils new hardware for managing cloud computing
D Le « cloud computing » : une opportunité pour les pays émergents
E NTT and Mitsubishi Electric Develop Advanced Encryption Scheme to Increase Cloud Computing Security
F Dell, HP, Fujitsu to offer Windows Azure cloud computing services to customers
G ERCOM launches a plug & play key for secure acces to Cloud Computing and Collaborative Platforms

Regional interest ⑦ Region Town/City

1. India
2. Singapore
3. Sri Lanka
4. Hong Kong
5. Kenya
6. South Korea
7. Taiwan
8. United States
9. Pakistan
10. Ireland

Search volume index
0 —————— 100
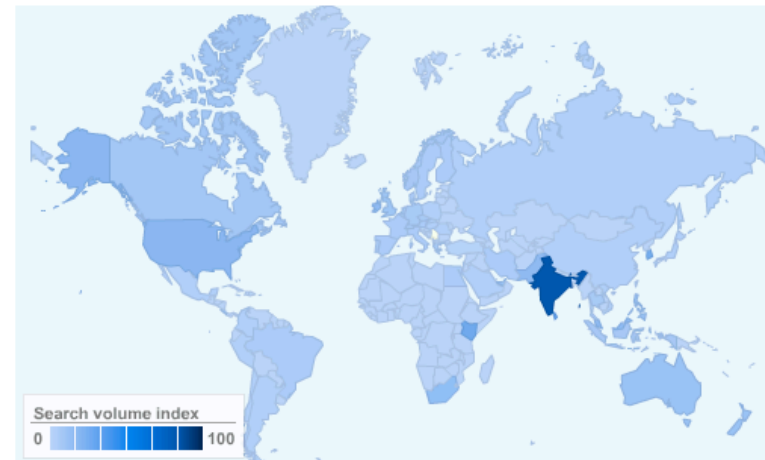
View change over time ⑦

Trends

Web Search Interest: computational intelligence

Worldwide, 2004 - present

Categories: Society (25-50%), Computers & Electronics (0-10%), Science (0-10%) , more...

Interest over time   ☑ forecast   ☑ News headlines

How can I see numbers?

💡 See worldwide top rising searches by clearing the search terms

Ⓐ Research and Markets: Gain a Detailed Insight into Computational Intelligence and Feature Selection with This Analysis of Rough and Fuzzy Approaches

2004   2005   2006   2007   2008   2009   2010   2011

* The last value prior to the forecast is based on partial data and may change. Learn more
** Future values are based exclusively on the extrapolation of past values. Learn more

➕ Google Embed this chart

Regional interest   ⓘ Region Town/City

#		
1.	Taiwan	
2.	India	
3.	China	
4.	Australia	
5.	Canada	
6.	United Kingdom	
7.	Germany	
8.	Japan	
9.	United States	
10.	Spain	

Search volume index
0 ▮▮▮▮▮▮ 100

➕ View change over time ⓘ

22
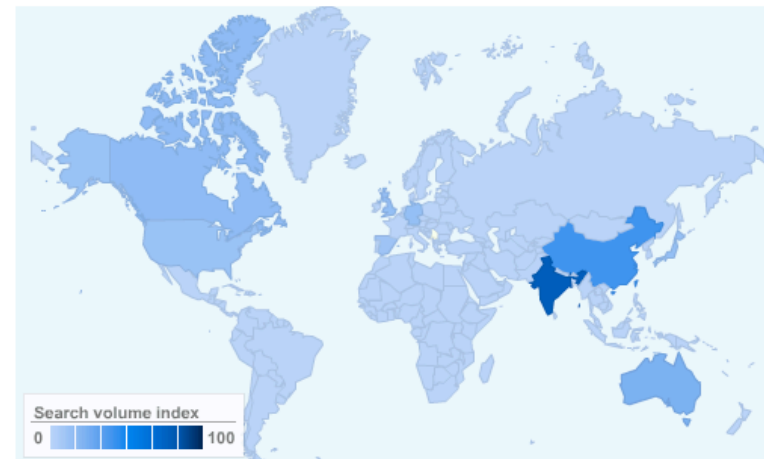
Trends

Web Search Interest: collective intelligence

Worldwide, 2004 - present

Categories: Computers & Electronics (10-25%), Industries (0-10%), Society (0-10%) , more...

Interest over time   forecast ? ☑ News headlines

How can I see numbers?

💡 See worldwide top rising searches by clearing the search terms

A MIT Sloan launches Climate CoLab contest to harness collective intelligence about climate change
B Forecast for 2020: 'Collective intelligence' in IT
C Panda Security Celebrates Three Years of Collective Intelligence
D Collective Intelligence Outsmarts Genius
E Can Collective Intelligence Save the Planet?
F Collective Intelligence in Action
G Collective intelligence pioneer hailed

2004   2005   2006   2007   2008   2009   2010

* The last value on the graph is based on partial data and may change. Learn more

Google Embed this chart

Regional interest   ? Region Town/City

1. France
2. India
3. Australia
4. United States
5. Canada
6. China
7. United Kingdom
8. Germany
9. United Arab Emirates
10. Afghanistan

Search volume index

0 [   ] 100

➕ View change over time ?

23
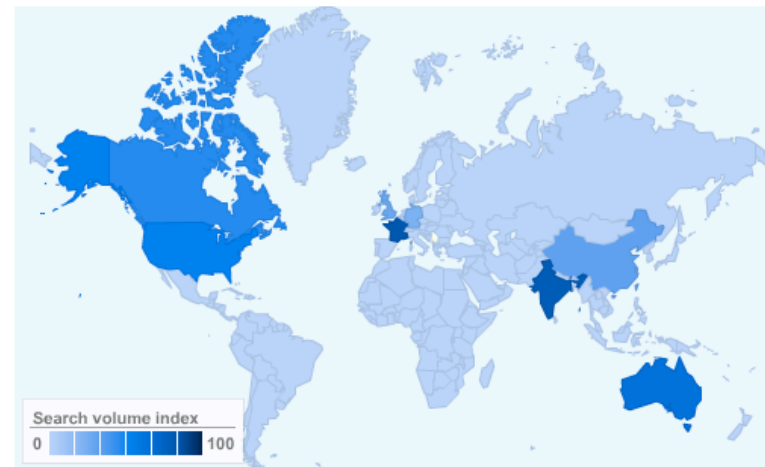
Trends

Web Search Interest: social networking

Worldwide, 2004 - present

Categories: Social Networks & Online Communities (25-50%), Computers & Electronics (0-10%) , more...

Interest over time   ☑ forecast   ☑ News headlines

How can I see numbers?

* The last value prior to the forecast is based on partial data and may change. Learn more
** Future values are based exclusively on the extrapolation of past values. Learn more

Google   Embed this chart

💡 See worldwide top rising searches by clearing the search terms

A One day without social networking - for a good cause
B Woman spread child porn using social networking: cops
C Text me UR ... equations? SAfrican social networking site offers math tutoring via cellphone
D Google to launch social networking feature
E Facebook No.1 social networking site in India
F A blogging experiment: A weekend of wine and "social networking"
G NewBay Enables Integrated Social Networking on Android-Powered LG Handsets

Regional interest   ⓘ Region Town/City

1. India
2. Bangladesh
3. Philippines
4. Nigeria
5. Jamaica
6. Kenya
7. Singapore
8. Pakistan
9. South Africa
10. United States

Search volume index
0 ▭▭▭▭▭▭ 100
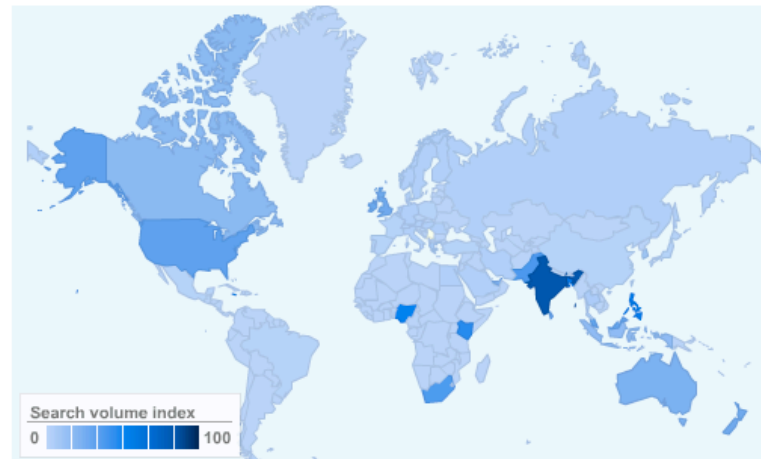
⊞ View change over time ?

Cloud Computing

The idea of cloud computing certainly isn't new.

Oracle's Larry Ellison launched the New Internet Computer (NIC) company in 2000 to lead the industry forward to that goal. The concept was very simple: On your desk, you would have a very low-cost computer with just a processor, a keyboard and a monitor. There would be no hard drive or CD /DVD drive. It would be hooked up to the Internet and would link to a central supercomputer, which would host all of your programs and files. The idea, however, was ahead of its time.

http://computer.howstuffworks.com/google-apple-cloud-computer.htm

Cloud computing is about utilizing computing resources and services…

Amazon Elastic Compute Cloud (also known as "EC2") allows users to rent computers on which to run their own computer applications.

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers.

http://aws.amazon.com/ec2/

25

Cloud Architecture

Buyya's definition, Keynote in ICCT 2008
- *"A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers."*

http://www.salesforce.com/
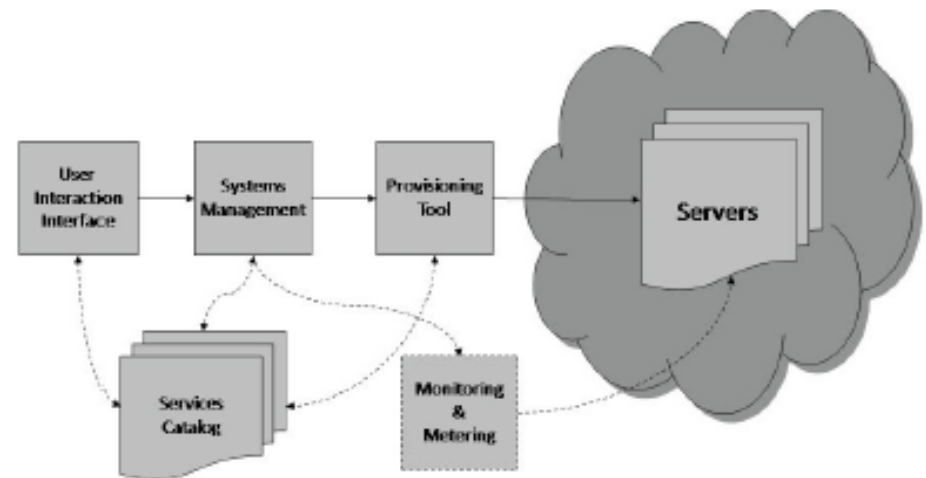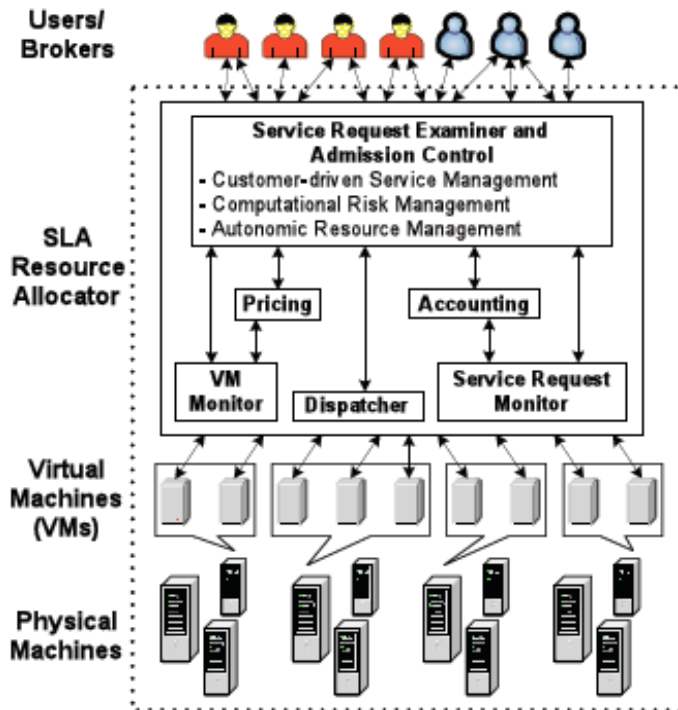
Do Clouds differ from Grids?

- *hmmmm..... Yes and No!*

- **Clouds are still Grids but have been purposefully developed for:**

  1. *WCs and/or Commercial purposes (<u>not for solving well-known scientific problems</u> as opposed to Grids)...*

     Serve solving problems of SMEs (trust, security), smaller scale web communities up to individuals.

     Can they become successful?

  2. <u>*Re-factored business oriented grid model:*</u> *Companies offering Clouds could exploit user using some sort of <u>intelligence</u> for better e-services...*

Grids   **1. Clouds**   **2. Customized/Personalized Clouds**

P2P/Situated/Ad-hoc networks

- **_Peer-to-peer (P2P)_** is a distributed architecture that partitions tasks or work loads between nodes (peers). Peers make a portion of their resources and operate as both suppliers and consumers.

  - *Challenge: Resource discovery*

- **_Pervasive computing_** embeds computing and information technologies into our environments by integrating them seamlessly into our everyday lives.

  - *Challenge: Context Awareness*

- *Lately,* **_Situated Computing_** *as an emerging paradigm deals with computing devices having the autonomous ability of adapting, detecting, interpreting and responding to the user's environment.*

  - *Challenge: Adaptation Strategy and Interfaces.*

Social Networking

A social network service focuses on the building and verifying of online social networks for communities of people who share interests and activities, or who are interested in exploring the interests and activities of others, and which necessitates the use of software.

Web 2.0

Social Networking

Start Pages

Social Bookmarking

Peer Production News

Social Media Sharing

Online Storage
   (Computing)

Collective Intelligence

- *The idea of the collective intelligence creates a free-flowing system of knowledge with no bureaucratic controller, it also creates an informational free-for-all where no one decides what knowledge is worthy of contribution and what should be left out (Pierre Lévy)*

- *The expression "collective intelligence" designates the cognitive powers of a group (Pierre Lévy)*

- *"Collective intelligence" has now 1,940,000 web-pages referring to it. 6 years ago there was only about 10,000.*

- *Collective Computational Intelligence versus Computational Collective Intelligence:*
hmmmm… are they the same or NOT?

Web 2.0: Data Mashups

http://hisz.rsoe.hu/alertmap/index2.php?area=eu&lang=eng   http://www.emsc-csem.org/index.php?page=home&sub=gmap

…contd

LAPD crime maps — LOS ANGELES POLICE DEPARTMENT

Drag large map to move. > Sign Up for LAPD e-Policing

200 N Spring St
Los Angeles, CA 90012
Central Division

Date Range Shown:
01/28/2010 to 01/31/2010
Radius: 1 mile(s)

CRIME INFO SEARCH

200 North Spring Street

Enter an address or double click the map for regional crime statistics.

CHOOSE A DATE RANGE:
end date: (click icon below)
01/31/2010
3 days
1 mile
(7 day range may load slowly)

CHOOSE CRIMES
☑ Burglary (Property)
☑ Grand Theft Auto
☑ Theft from Vehicle
☑ Personal/Other Theft
☑ Robbery (Violent)
☑ Aggravated Assault
☑ Rape
☑ Homicide

GO

View crime definitions >

Get Crime Tips >

©LAPD 2006-2009 | This application is compatible with Internet Explorer and Firefox Browsers | powered by ePolicing

- **LAPD (17:50pm February 2nd 2010)**
  http://www.lapdcrimemaps.org

- *http://www.programmableweb.com/tag/*
- *http://www.programmableweb.com/tag/crime*

- **Chicago Police Department (17:50pm February 2nd 2010)**
  http://chicago.everyblock.com/crime/

EveryBlock Chicago

Crimes overview
Search crimes

Crimes › Street

33

...contd

- Now you can track any flight in real time as its journey progresses, or indeed track what's heading into and out of any airport. Other site include: *www.flightradar24.com*

Map 1: http://flightaware.com/live/

http://www.radarvirtuel.com/

Collective Computational Intelligence

VISION:

*Can we collectively and purposefully utilize [**bring all-in-one**] next generation emerging technologies (Grids, Clouds, P2P, mobile ad-hoc networks, situated computing, crowd sourcing, Web 2.0 and social networking tools, etc...) to:*

- *compute intelligently (identify relationships, trends, etc...) what is known collectively – not just individually – by capturing, integrating, analyzing, mining annotated and visualized distributed resource – made available from various VO and WC users – in a meaningful manner?*

- *and feed back them to the users in a personalized manner?*

Collective Intelligence

Extracting "hidden" knowledge from vast amounts of content. Various techniques, most are inherited from Computational Intelligence. Emerging techniques most likely referring to the Social Networking developments:

- Ant Colony Optimization/Swarm Intelligence

- Data Mining: Classification and Clustering

- Social Networking Analysis/Tags/Temporal Tag Analysis

- Semantic relationships/Normalization/Formal Concept Analysis (semantics: incorporating DRF/OWL/XML)

Twitter Social Network, 20K nodes 250K edges

Image Copyright UMBC eBiquity Research Group

CAMEO*

CAMEO: Continuous Analytics for Massively Multiplayer Online Games

Massively Multiplayer Online Games (MMOGs) are popular:
- 25,000,000 active players (est. 60,000,000 by 2012)
- Over 150 MMOGsin operation
- Market size 7,500,000,000$/year

- Continuous raw data about the virtual world/continuous analytics:
  - Understand play patterns (decide future investments)
  - Prevent/detect cheating or disastrous game exploits (think MMOG economy reset)
  - Support player communities
  - Broadcasting of gaming events
  - Data for advertisement companies (new revenue stream for MMOGs)

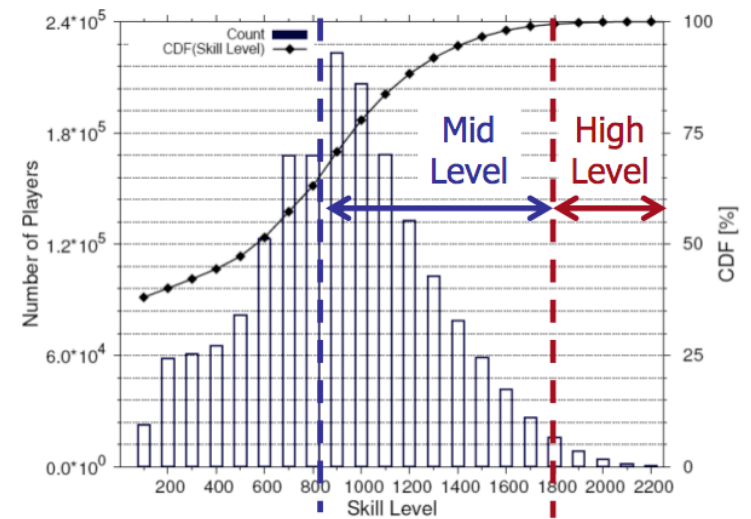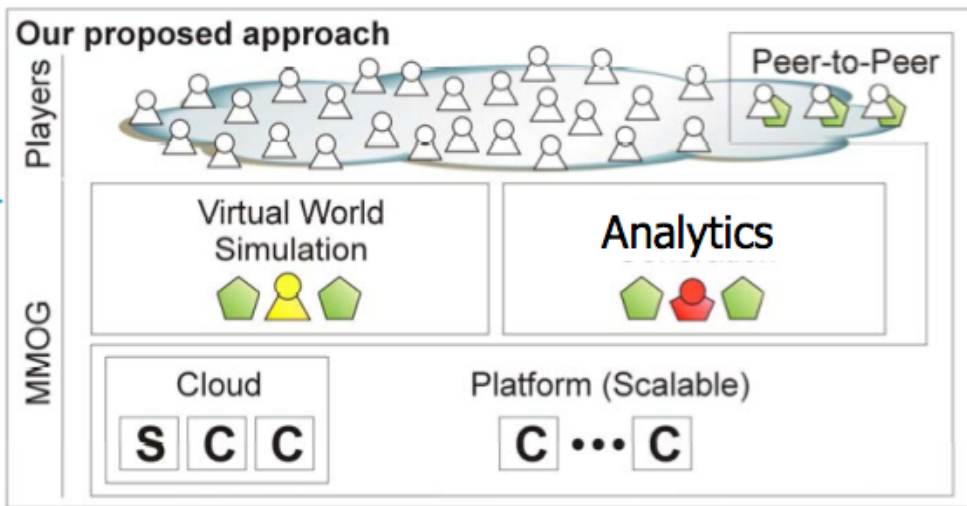http://www.st.ewi.tudelft.nl/~iosup/Presentations/2009/2009-08-25_aiosup_roia09cameo.pdf
IOSUP, A and LASCATEU, A. (2011): Clouds and Continuous Analytics Enabling Social Networks for Massively Multiplayer Online Games, accepted to appear: In Bessis, N and Xhafa, F (eds), Next Generation Data Technologies for Collective Computational Intelligence, to be published in the "Studies in Computational Intelligence" book series, Springer (2011).

CAMEO*

Use cloud (on-demand, paid, guaranteed) resources for excess load:

- *Goal: continuous analytics for RuneScape, the second-most popular MMOG on a random day (3M active players, over 100M accounts)*
- *Technical goal: use Amazon EC2, the largest commercial cloud provider and proponent of open cloud API*
- *Use of Data Crawling Analysis*

http://www.st.ewi.tudelft.nl/~iosup/Presentations/2009/2009-08-25_aiosup_roia09cameo.pdf
IOSUP, A and LASCATEU, A. (2011): Clouds and Continuous Analytics Enabling Social Networks for Massively Multiplayer Online Games, accepted to appear: In Bessis, N and Xhafa, F (eds), Next Generation Data Technologies for Collective Computational Intelligence, to be published in the "Studies in Computational Intelligence" book series, Springer (2011).

Crowd (Sourcing) Computing

Grids are about VO members utilizing resources to solve VO defined problems

Clouds are about users utilizing resources to help solve WC user -defined problem

and potentially, about companies that could utilize users -defined problems for forming some <u>collective intelligence</u> about their interests, problems and solutions

<u>Enabling the Citizen Science</u>

Everyone has a mobile phone

<u>that could upload a sensor API to receive readings about health state, noise levels, allergies, air pollution of the mobile's-holder environment</u>

<u>What can I make out of it? And how much useful are they?</u>

- Get evidence of my environment
- Environmental reports
- Policy strategy makers
- Monitor individual health and welfare
- Warning and disaster management systems
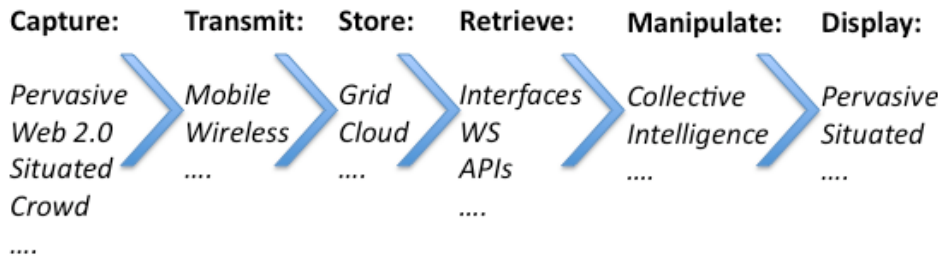- Trends (others' likes or dislikes)
- Etc…
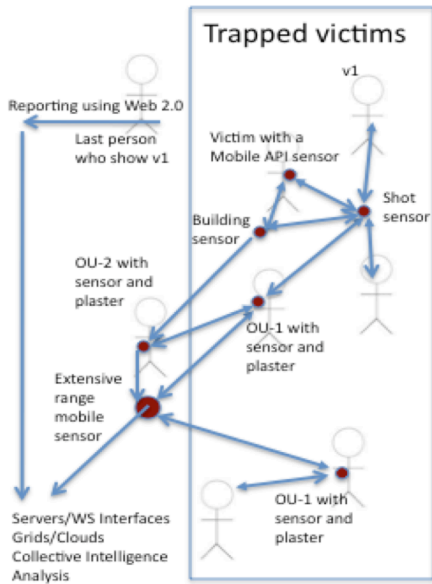
Their goal is to support c-cube and enable an approach relevant to collective resource utilization and thus, enhance multi-user participation in functioning as a coherent unit through the use of a Cyber Infrastructure (CI).
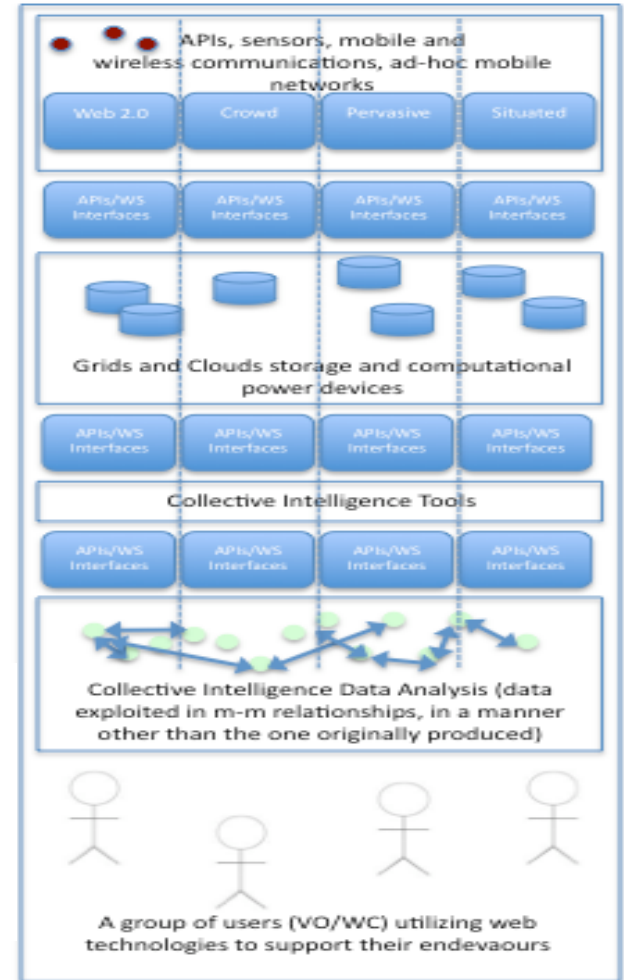
BESSIS, N., ASIMAKOPOULOU, E., FRENCH, T., NORRINGTON, P. and Xhafa F. (2010): The Big Picture, from Grids and Clouds to Crowds: A Data Collective Computational Intelligence Case Proposal in Managing Disasters, in Emerging Data Technologies for Collective Intelligence (EDTCI-2010) in conjunction with 5th 3PGCIC-2010 (4-6 November, Fukuoka, Japan).
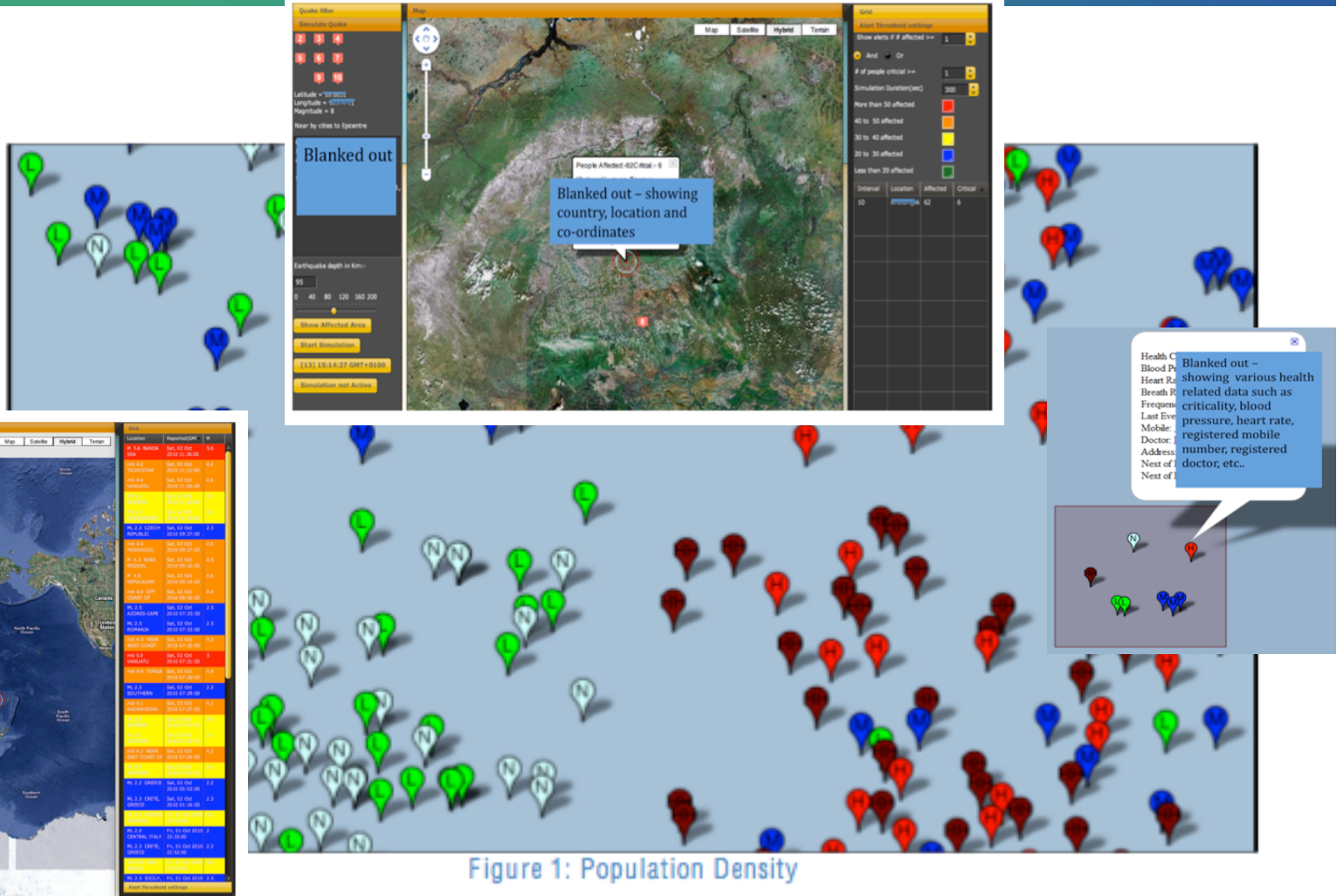
Crowd and Situated Computing

Figure 1: Population Density

BESSIS, N., ASIMAKOPOULOU, E., NORRINGTON, P., VARAGANTI, R. and. SURESH, T. (2010): A Next Generation Technology Victim Location and Low-Level Assessment Framework for Occupational Disasters Caused by Natural Hazards, International Journal of Distributed Systems and Technologies, V2, No1.

Discussion

- *Take home question:*

  How are we going to offer functionalities that enable the exploration and exploitation of combined collections in a meaningful manner or simulation results that are defined across a broad range of ad-hoc, spatial and/or temporal scales?

Thank you!