

# CANARIE

*Cyberinfrastructure - are we ready ?*

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**Intelligent Infrastructure**

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# *What are the elements?*

**Highly Qualified Researchers:** The scientists who can make a difference

**Networking Infrastructure:** The lambda-network

**Instrumentation:** Everything that is of interest to science: computers for computational research, telescopes, satellites, special physics equipment, weather balloons, lasers, spectrometers, visualization means, large sensor networks, large data collections, artificial intelligence agents

**Compute and Data Resources:** A variety of HPC and data storage and management resources for all manner of research

**Middleware:** Connects the distributed resources, data and storage facilities in a seamless way and facilitates a deep integration of components.

**Support Resources:** E-science is about cultural transformation of the research enterprise; funding of operating expenses for professional support expertise is essential to effecting this transformation





# *A Disruptive Technology*

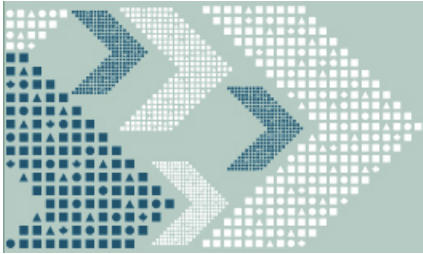
- Team rather than individual
- Lateral rather than vertical
- Iterative rather than finished
- Network based rather than locational
- Intangible rather than tangible
- Managed complexity rather than imposed simplicity
- Access rather than ownership
- Trust rather than control
- Operating costs rather than capital costs



# *A Disruptive Technology*

- Team rather than individual
- Iterative rather than linear
- Network based rather than hierarchical
- Intangible rather than physical
- Market driven rather than imposed
- Shared ownership rather than control
- Low marginal costs rather than capital costs

**Note: None of these are technical issues!**



# *A Disruptive Technology*

- That is, of course, why cyberinfrastructure is so disruptive
- That is why investing in people is so critical



# *A Disruptive Technology*

## **Towards 2020 Science**

[http://research.microsoft.com/towards2020science/background\\_overview.htm](http://research.microsoft.com/towards2020science/background_overview.htm)

## **Ubiquitous Cyberinfrastructure**

<http://lagrid07.lncc.br/docs/UbiquitousCyberinfrastructure>

Jim Myers Associate Director for Cyberenvironments and Technologies, NCSA



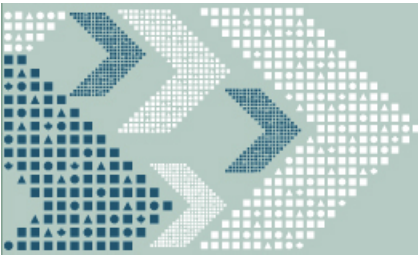


# *An International Perspective*

*The key issues identified by the committee to fully enable e-Research in Australia are:*

- Human Capabilities*
- Access to Data*
- Need for Linkage of e-Research Resources*
- Structural and Cultural Change*
- Lack of Awareness and Support*
- Need for a focus*
- More collaboration in Research*

*Australian e-Research Co-ordinating Committee –  
September 2005*



# *An International Perspective*

*Cyberinfrastructure is now essential for advancing scientific discovery and the state-of-the-art in engineering. It doesn't matter whether it's the inner workings of the universe, or the inner workings of the economy, the design of a new chemical process or the design of a new material, new insights into how cells function or the delivery of personalized medicine, the spawning of a tornado or planning urban development. The basic fact remains the same – cyberinfrastructure is now a driver of science and engineering. Without it science and engineering will not reach their full potential.*

*CTWatch Quarterly February 2006*





# *An International Perspective*

*Cyberinfrastructure integrates hardware for computing, data and networks, digitally-enabled sensors, observatories and experimental facilities, and an interoperable suite of software and middleware services and tools. Investments in interdisciplinary teams and cyberinfrastructure professionals with expertise in algorithm development, system operations, and applications development are also essential to exploit the full power of cyberinfrastructure to create, disseminate, and preserve scientific data, information, and knowledge. NSF – January 20, 2006*



# *An International Perspective*

*NSF will play a leadership role in the development and support of a comprehensive cyberinfrastructure essential to 21<sup>st</sup> century advances in science and engineering research and education.*

*NSF – January 20, 2006*



# *An International Perspective*

*With the access to enabling tools and services, self-organizing communities can create VOs to facilitate scientific workflows; collaborate on experiments; share information and knowledge; remotely operate instrumentation; run numerical simulations using shared computing resources; dynamically acquire, archive, e-publish, access, mine, analyze, and visualize data; develop new computational models; and deliver unique learning, workforce-development, and innovation tools. Most importantly, each VO design can originate within a community and be explicitly tailored to meet the needs of that specific community.*

*Engineering Virtual Organization Grants (EVO)  
Program Solicitation NSF 07-558*



# *An International Perspective*

*Grids need to be treated as research infrastructure in their own right comparable in scope and focus to other big undertakings such as high intensity X-ray sources, large optical and radio telescopes, and genomic databases. As a critical research tool, Grids should be assigned the resources for assuring robustness, accessibility and reliability that are typical of advanced research infrastructures. Grids can serve many users and communities and are not just add-ons to individual science projects. Accordingly governments should consider whether they need to modify or create institutional or organisational arrangements to ensure that Grids benefit from the correct prioritisation, planning, funding, and oversight mechanisms. Governments should also consider taking steps to strengthen the international mechanisms for co-operation and co-ordination at the scientific, commercial and intergovernmental levels. - OECD Report on Grids*





# *An International Perspective*

- *EGEE*
- *UK e-Science*
- *EU Frameworks 6 & 7*
- *D Grid*
- *TeraGrid*
- *LNCC & SINAPAD – Brazil*
- *Naregi – Japan*
- *K\*Grid – South Korea*
- *Mareka and the CHPC – South Africa*
- *Garuda India*



# D GRID

- > **The e-Science Initiative and D-Grid finally started on September 1, 2005. BMBF is funding over 100 German research organizations with 100 Million Euro, over the next 5 years. For the first 3-year phase of D-Grid, the support is almost 20 Million Euro. Goal is to design, build and operate a network of distributed, integrated and virtualized high-performance resources and related services which allow processing of large amounts of scientific data and information. D-Grid currently consists of a grid infrastructure project and 6 community projects in the areas of high-energy physics, astrophysics, medicine and life sciences, earth sciences (e.g. climate), engineering sciences, and libraries.**



# *An International Perspective*

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# ***GARUDA***

Garuda, the Vahana of  
Lord Vishnu





# *An International Perspective*

*Garuda, India - <http://www.garudaindia.in>*

*GARUDA is a collaboration of science researchers and experimenters on a nation wide grid of computational nodes, mass storage and scientific instruments that aims to provide the technological advances required to enable data and compute intensive science for the 21st century. One of GARUDA's most important challenges is to strike the right balance between research and the daunting task of deploying that innovation into some of the most complex scientific and engineering endeavors being undertaken today.*





*Where are we in Canada?*

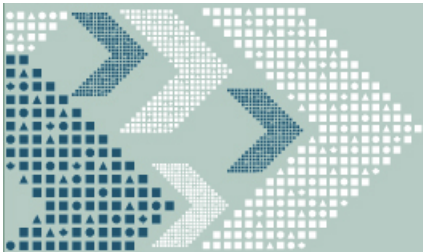
# Missing in Action!

A quote reported from the meeting of the Grid Forum Advisory Committee  
Athens, February 2006



*Where are we in Canada?*

*Not entirely fair. We have  
elements of cyberinfrastructure.*



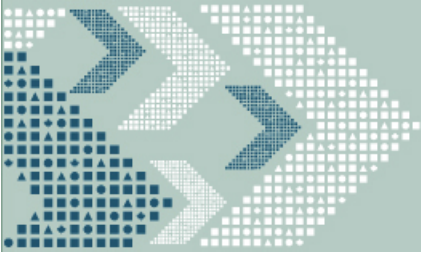
## *What do we have?*

- *Regional and pan-Canadian networks to enable all the connectivity required*
- *Well provisioned regional compute centres*
- *Some Serious instrumentation – CLS, Neptune*
- *Triumph/ATLAS*
- *MFA Grant*
- *Some level of grants for indirect costs*



# *What do we not have?*

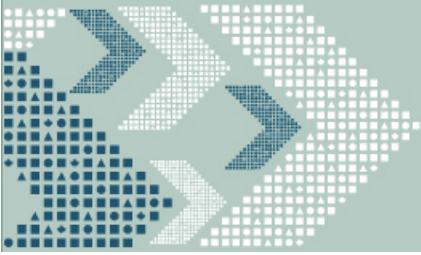
- *Focus*
- *Co-ordination*
- *Human Capacity Building*
- *Middleware Research*
- *Tera/Peta Scale Facility*
- *Data Strategy*
- *On-going realistic funding*



# *CAUTIOUS HOPE*

## **MOBILIZING SCIENCE AND TECHNOLOGY** *to Canada's Advantage*

**May 17, 2006**



## *CAUTIOUS HOPE*

*Ensuring that higher-education institutions have the leading-edge research equipment and facilities to compete with the best in the world.*

*\$510m to CFI, \$120m to CANARIE*



# *A step forward....*

- > Government of Canada has announced \$120m funding for CANARIE
- > A key aspect of new CANARIE funding will be deployment of “platforms” to support eScience and other applications
  - “**Network Enabled Platforms (NEP)**”
- > Next generation Internet architectures and cyber-infrastructure are converging on a similar architecture principles of “virtualization” of resources and services and creation of many concurrent facilities linking distributed computing, sensors, instruments, databases, etc
  - e.g. GENI is a platform to support network, computational and other types of research
- > Focus of NEP is on interconnection of “**production**” facilities of distributed computers, databases, instrument and sensor integrated with middleware technology such as grids, web services, Web 2.0, UCLP, Next Generation Internet, etc
- > **NEP is NOT a research program**





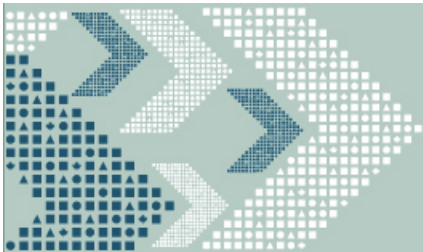
# Network Enabled Platforms

- > **Ideally proposal should be led by “community of interest” or “virtual organization” (VO) of domain scientists or users**
  - Single PI, single institution proposals will be discouraged
  - VO may designate management organization to manage VO, develop SOW with CANARIE, develop middleware etc
  - Example NSF – Cyber Infrastructure Management Organizations
  - JOI for Oceanography
  - BBN for GENI
  - etc
- > **Consortium or VO establishes governance and set resource sharing policies for users and defines common architectures, etc**
- > **Many such international consortia or VO already exist**
  - **Therefore participation in international platforms strongly encouraged**



# CANARIE's role

- > **CANARIE will fund middleware development to enable the seamless interconnection of resources such as databases, computational resources, instruments and sensors**
  - Of particular importance will be the middleware to support VO policies, authorization and access to these resources
  - Portal development
  - Middleware solutions can be built around SOA, Globus, AJAX, REST, UCLP, Web 2.0, NGI, etc
- > **CANARIE staff are also available to assist in design and deployment of middleware and portals**
  - Similar services and capabilities may be available from CRC/NRC
  - CRC/NRC may also be designated organization to manage VO
- > **CANARIE does NOT fund research as a final outcome**
  - But research necessary to build the platform may be an eligible expense
- > **Essential reading:**
  - <http://www.nsf.gov/pubs/2007/nsf07558/nsf07558.htm>



# The Challenge

- > How can the communities –HPC, Networking, Instrumentation, diverse disciplines address the need for coordination of policy, strategy, and programs to create real intelligent infrastructure?
- > What are the key elements of intelligent infrastructure that remain unaddressed?
- > What is our elevator pitch?
- > How can we remain in contact to ensure consistency of message?
- > How can we ensure that we keep the message clear and at a high level?

