Resource Sharing at the Tera-FLOP Scale

For the BioMedical Research & Care Sectors

Erasmus Computing Grid
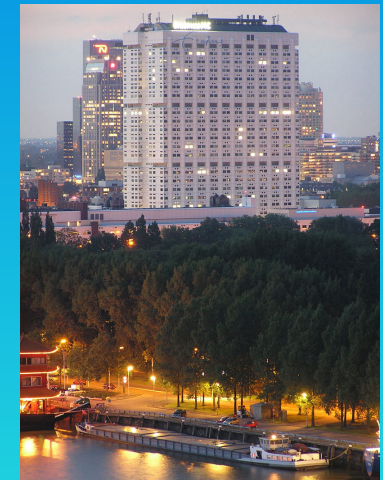
The Erasmus Computing Grid & MediGRID

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The Erasmus Computing Grid

The largest Desktop GRID for the BioMedical Research and Care Sectors with now ~10 Tera FLOPS and a potential 30 Tera FLOPS with ~15,000 employees, at two city wide institutions: the Hogeschool Rotterdam and the Erasmus Medical Center.

Erasmus Computing Grid

~ 10 BioMedical User Groups

ECG - Centralized Office

Two donor organizations

HOGESCHOOL ROTTERDAM

Erasmus MC
University Medical Center Rotterdam

~15,000 PC "owners", i.e. local PC donors.

Research:

- ❖ **genomic and proteomic analysis**
- ❖ **epidemiology**
- ❖ **image analysis, e.g. Applied Molecular Imaging (AMI)**

Education:

- ❖ **training of the coming grid generation of IT specialists**
- ❖ **developing new concepts for grid computing**

Diagnostics:

- ❖ **clinical image and data analysis**
- ❖ **operation planning and operation support**

Industry:

- ❖ **brokerage of computing resources**

Dedicated and Secured!

MediGRID and Services@MediGRID

Erasmus Computing Grid

MediGRID and Services@MediGRID operate the national biomedial research and care cluster grid within the national German D-Grid initiative and integrates various disciplines, institutions, and states throughout Germany.

~ 20 BioMedical User Groups

Distributed - Office

~ 20 D-Grid Communities

~ 100 D-Grid donor organizations (~10 MediGRID)

~10,000 cluster nodes

~ 2,000 medical secured

Module Coordination:
❖ coordination of the distributed office

Module Resource Integration:
❖ sharing of the integrated resources

Module Middleware:
❖ grid technical virtualization

Module Ontology Tools:
❖ ontology development for grid user projects

Module BioMedical Informatics:
❖ user projects in biomedical research

Module Clinical Imaging:
❖ user projects in clinical imaging

Module Clinical Research:
❖ user projects in general clinical research

Module e-Science:
❖ general research on e-grid science

Services@MediGRID:
❖ services towards MediGRID

Dedicated and Secured!

Large-Scale Resource Sharing in IT:
The *Inverse* Tragedy of the Commons

Erasmus Computing Grid

Erasmus MC
HOGESCHOOL ROTTERDAM

The grid phenomenon and its implications are similar complicated to the ecology/climate/environmental challenge!

The Tragedy of the Commons:

=> A resource belonging to all and being on limited demand is overexploited / destroyed by the users due to responsibility diffusion!

Transforms into =>

:The *Inverse* Tragedy of the Commons

A Resource belonging to all and being in affluent availability on limited demand is <= _underexploited_ by potential users due to responsibility diffusion !!!!!

Similarity: Renewable Energy Resource!

The grid challenge lies in the e-Social embedding of grid phenomenons:

- **Micro-Sociality: the sharing attitude and socialization of the individual.**

- **Macro-Sociality: the organization culture of the embedding institution.**

Autopoietic Social Sub-Systems:
The Grid Challenge of Integration

The social systems theory by Niklas Luhmann (1927-1998) based on the autopoietic concept of Humberto Maturana and Francisco Varela (1946-2001) is so far the most advanced social systems theory existing to describe the complexity of grid implementation.

The Social Social Sub-Systems Involved:

❖ **Religion**

❖ **Education**

❖ **Science**   => **Currently Grid Involves Only Considerably => Science**

❖ **Art**

❖ **Economy**

❖ **Jurisdiction**

❖ **Policy**

:The Autopeitic Tragedy of Social Sub-Systems

The subsystems have their own code of communication and are separated from each other in a way blocking in principle a consistent integration although they form a society with all their contradictions !!!!!

The e-Social challenge lies in the integration sub-systems to a working grid society:

• **Micro-Sub-Systems: the sub-system stickiness of individuals.**

• **Macro-Sub-Systems: the integration of institutionalized sub-systems via soft interfaces.**

Grid Psychology

From Individual to Cultural Risk Management

Grid implementation and social spread is carried first by individuals as with any meme introduced into society: in the focus of the transformation of society to e-Society stands - as always - the balance between potential risk and opportunity.

The Risk Psycholgy Matrix:

❖ **Individual Security Perception & Risk Acceptance**

❖ **Knowledge-Based Security & Risk Acceptance**

❖ **Incidental Security Reaction Behaviour**

❖ **Legal and Political Security Scenarios**

❖ **Religious & Cultural Security Archetypi**

Linking Grid Psychology with Autopeitic Social Sub-Systems

:The Autopeitic Link

Genetics & Deep Psychology (C.G. Jung)

Education & Science

Economics & Realities

Jurisdiction& Politics

Religion, Art & Culture

The grid challenge lies in a unified concept addressing the psychology of grid:

• **Micro-Risk-Management: the micro-risk in the perception the individual and its emotional well-being.**

• **Macro-Risk-Management: the macro-risks in the procedural and institutionalization in organizations.**

e-Human *"Grid"* Ecology

Overcoming of the "Dare-To-Share" Attitude

The success of grid is based on a sustainable grid ecology within the e-Society, i.e. the e-Human Ecology of Grid reaches a equilibrated space within the integration of grid psychology with autopoietic e-Social sub-subsystems. Human Ecology first evolved in Chicago in the 1920's concerning city development by Robert Park (1864-1944) and Ernest Burgess (1886-1966).

The Definition of e-Human "Grid" Ecology:

"Under e-Human "Grid" Ecology we understand the complete science of the relationships of grid to the surrounding environment to which we can count all conditions of existence in the widest sense."[1]

[1] Haeckel, E., Generelle Morphology der Organismen, Berlin, Band 2, Allgemeine Entwicklungsgeschichte, p. 286, 1866.

[2] Haeckel, E., Natürliche Schöpfungsgeschichte, 9. Auflage, Berlin, p. 793, 1898

(e-Human "Grid" Ecology "is) …the relationship between grid and all other e-Social systems." [2]

=> Solution to the Inverse Tragedy of the Commons!

The solution of the grid challenge on the operational layer are addressed:

• **Micro-Operationality:** the participative integration of fundamental IT applications of major individual users complying with the psychology of grid in an e-Human Ecology manner.

• **Macro-Operationality:** the set-up of an open and sustainable management structure complying to all the autopoietic e-Social sub-systems in an e-Human Ecology manner.

The Happy End - Profits Sharing the Commons

Both the Erasmus Computing Grid and the MediGRID/Services@MediGRID examples show that the IT challenges mankind faces in the biomedical research and care sectors can be successfully approached by exploitation of the commons by e-Human "grid" Ecology means.

Erasmus Computing Grid

Correlations in the DNA
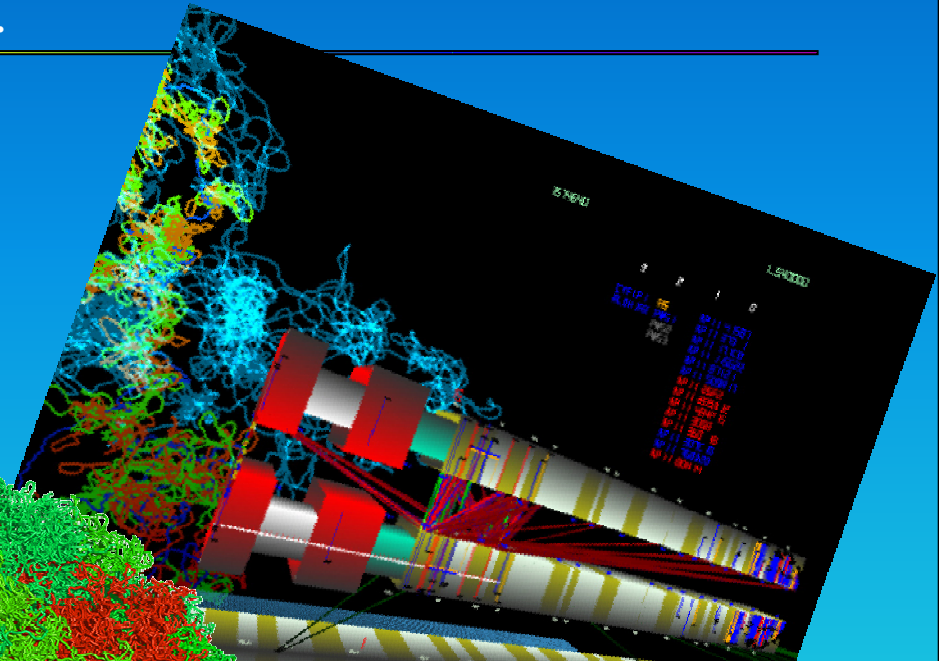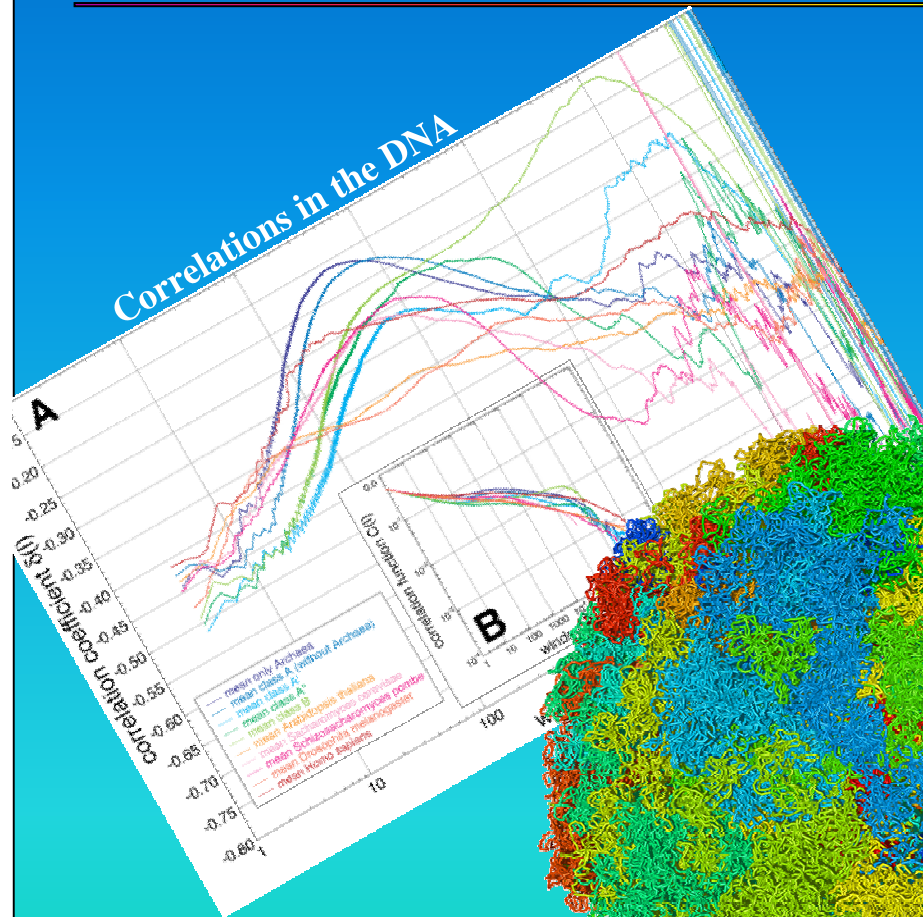
GLOBE 3D System-Biological Genome Information System
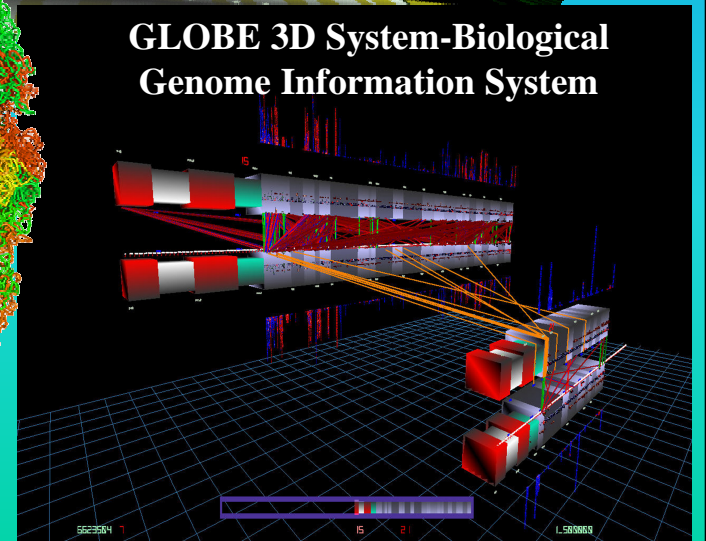
Simulation of the Organization of an Entire Human Cell Nucleus

Acknowledgements

Biggest thanks go to: resource donors and grid users!!!

Workforce ECG:

Rob de Graaf, ECG

Anis Abuseiris, ECG

Luc de Zeeuw, HR

Advisory Board:

Prof. Dr. Frank G. Grosveld, ErasmusMC

Prof. Dr. Hans van den Berg, HR

Braam van Laar, ErasmusMC

Rob Ketelaar, HR

Institutions:

Erasmus Medical Center

Hogeschool Rotterdam

Workforce MediGRID:

For the technical: Thomas Steinke & Annette Weisbecker

For the organization: Sebastian Semmler

For the management: Ulrich Sax and Otto Rienhoff

Institutions:

The Participating Institutions

The German MediGRID & Services@

The D-Grid Initiatives

The German Ministry for Science and Technology