Resource Sharing at the Tera-FLOP Scale

For the BioMedical Research & Care Sectors

Erasmus Computing Grid

Erasmus MC
University Medical Center Rotterdam   HOGESCHOOL ROTTERDAM

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 and ~15,000 desktops, at two city wide institutions: the Hogeschool Rotterdam and the Erasmus Medical Center.

~ 10 BioMedical User Groups

ECG - Centralized Office

Two Donor Organizations
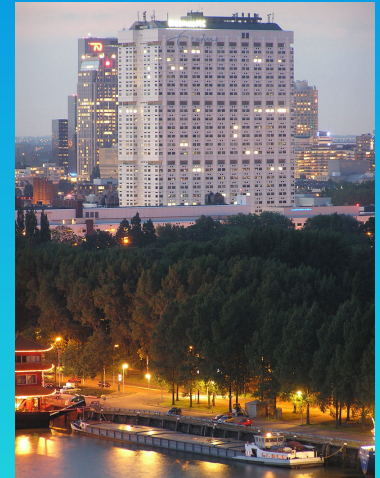
HOGESCHOOL ROTTERDAM

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

MediGRID and Services@MediGRID operate the national biomedial research and care cluster-grid within the national German D-Grid initiative and integrate 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

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 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 of sub-systems towards 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

Erasmus Computing Grid

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 autopoietic social sub-systems

:The Autopoietic 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-systems. Human Ecology first evolved in Chicago in the 1920's in the area of 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 solutions of the grid challenge on the operational layer are addressed by:

• **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
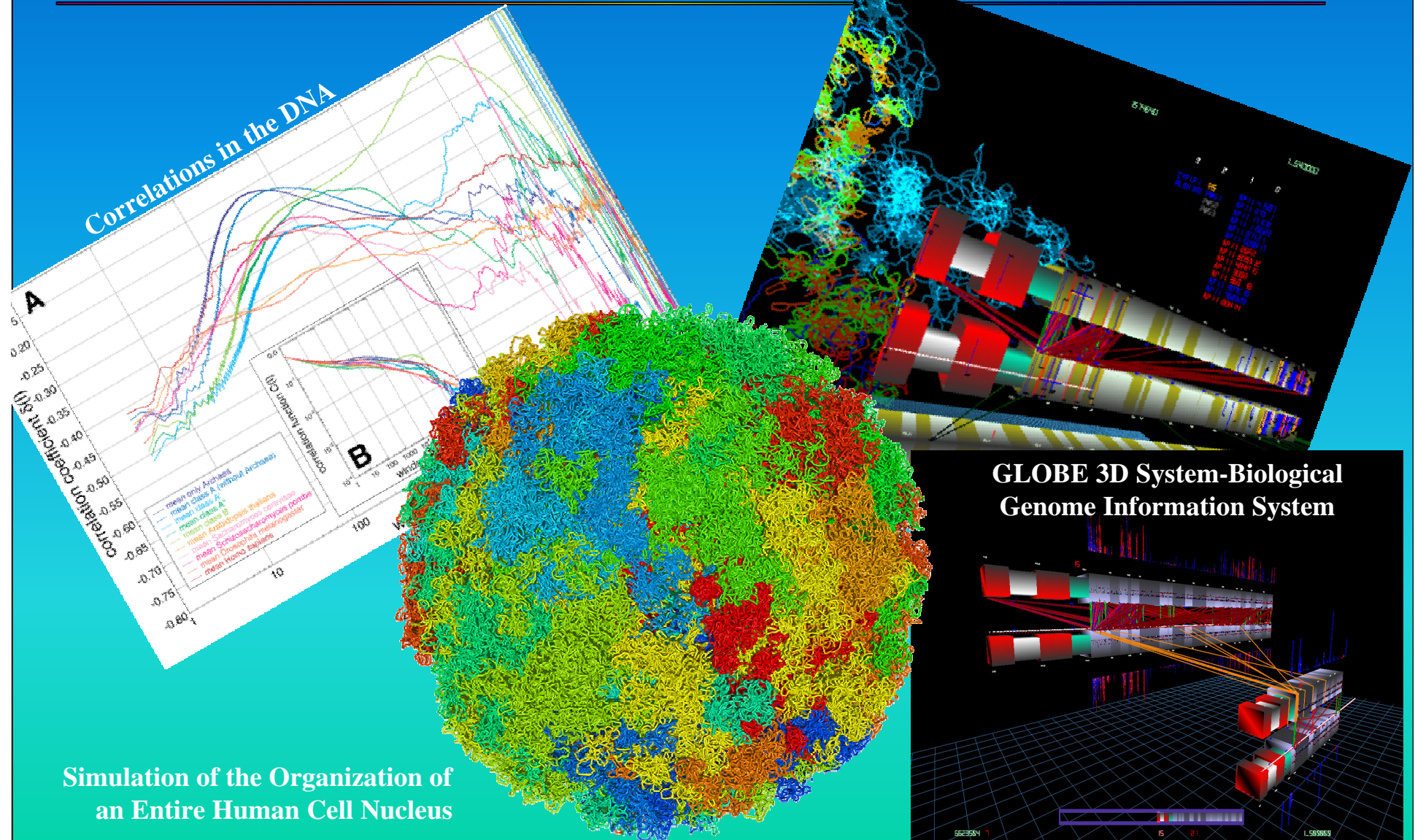
Simulation of the Organization of
an Entire Human Cell Nucleus

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