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Presentation for CSE510B
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From Grid Cookbook :
Grid Case Studies
[Grid Applications, Grid Deployments]

Case Studies Summary

- Open Science Grid
  - CMS The compact Muon Solenoid
  - ATLAS – Search for supersymmetry
  - SDSS – Sloan Digital Sky Survey
- SURAgrid
  - SCOOP Storm Surge Model
  - Simulation – Optimization for Threat Management in Urban Water Systems
  - Multiple Genome Alignment
- Texas Tech TechGrid
- White Rose Grid
- Grid In New York State

Compact MUON Solenoid

- Part of the LHC – Large Hadron Collidor particle accelerator and collider
- Collaboration of
  - Various US universities
  - FNAL - Fermi National Accelerator Laboratory
  - (Working with) CERN - European Organization for Nuclear Research
  - 2600 people from 180 scientific institutes
- Funded By
  - DOE - Department of Energy
  - NSF – National Science Foundation

CMS Tiered computing model

- Tier 0 – CERN in Switzerland
  - Produces experimental raw data and initial reconstruction data
  - Main data stream of 100MBytes/sec
- Tier 1 – FNAL and six others
  - Replicates Experimental Data
  - Produces re-reconstruction data
  - Produces AOD – Analysis Object Data
- Tier 2 - Universities in the US and Brazil
  - Receive AOD
 - Produce Monte-Carlo simulation data for Tier1 sites

The CMS experiment will involve large data transfers. Significant work is required to prepare for :

- Data throughput (tests in progress)
- Data storage responsibilities
- High throughput computing

ATLAS : A Toroidal LHC ApparatuS
A search for super symmetry
(sparticles - super partner particles)

- Part of the LHC

- Collaboration of
  - CERN - European Organization for Nuclear Research
  - 1900 physicists from 164 institutions in 34 countries
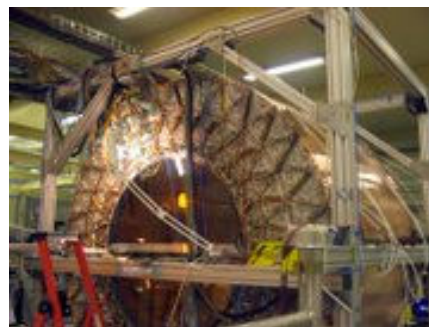
- Combines data from three different grid environments :
  - Open Science Grid
  - LHC Computing Grid
  - University of Wisconsin – Condor Pool
- Uses the Virtual Data Toolkit to create an interoperable grid of the 3
- Created a simulated environment to model the processing required when the experiment commences.

SDSS Sloan Digital Sky Survey
"The most ambitious astronomical survey ever undertaken"

- Collaboration of
  - 150 scientists at 25 Universities and Institutions
- Funded by
  - Alfred P. Sloan Foundation,
  - NSF
  - U.S. DOE
  - NASA
  - Japanese Monbukagakusho,
  - Max Planck Society,
  - Higher Education Funding Council for England.

SDSS technology

- Images from a 2.5 meter telescope with a 120 megapixel camera
- 1st phase completed 6/2005, Imaged over 8000 sq degrees – detecting nearly 200 million celectial objects
- 2nd phase targeted for completion by 6/2008 will combine 3 separate surveys

SCOOP Storm Surge Model

- Built on SCOOP framework (Southeastern coastal ocean observing and prediction)
- Utilizes Unidata's Local Data Manager for real time wind data
- Framework allows forecast mode based on current data or hindcast mode based on archives
- Sophisticated architecture for allocating resources based on loads, queue delays and network connectivity.

Simulation-Optimization for Threat Management in Urban Water Systems

- Funded by NSF
- Collaboration of
  - Sreepathi and Mahinthakumr, NCSU
  - Von Laszewski and Haetgen, University of Chicago
  - Uber and Feng, University of Cincinnati
  - Harrison, University of South Carolina

Technology
- Thousands to millions of simulation instances driven by optimization search algorithms
- Simulates realistic water distribution systems
- MPI c wrapper on EPANET
- Simulation / Optimization : JEC Java Evolutionary Computation toolkit

Multiple Genome Alignment

Collaborators :

* Georgia State University
* SURA

Implements a genome sequencing algorithm

Uses a memory efficient method for computation and is parallelized efficiently to be compatible with grid implementation.

Texas Tech TechGrid

Mission : integrate the numerous and diverse resources of Texas Tech University

Goal : enable significant advances in scientific discovery and to foster innovative educational programs.

600 Windows and Linux PC's Condor grid

Applications (Texas Tech)

- Proth : look for prime numbers from sieved candidates
- Partial Differential Equation : Dr. Sandro Manservisi
- Multivariate Minimization Project

White Rose Grid (Leeds)

- One of 4 core nodes of the National Grid Service
- Based on Sun and Intel/AMD systems
- Supports Fortran, c, c++ using MPI or OpenMP

White Rose Grid

Current and past projects

- CARMEN – For neurophysiologists to share datasets; enable neuronal signal detection; sorting, analysis, visualisation, modeling.
- COLAB – investigate the provision of topologically aware fault and intrusion tolerance in grid systems, with GRIDFIT – Grid Fault Injection Technology
- Integrative Biology – Addresses causes of cardiac failure and cancer tumors.
- MoSeS Modeling and Simulation for eSocial Sciences – Develop representation of the entire UK population as individuals and households
- SeCA Scientific e-Communities Architecture – Design of a novel collaborative e-science architecture based on peer 2 peer technologies. Initially applied to combustion chemistry
- DAME Distributed Aircraft Maintenance Environment
- GEMSS Grid Enabled Medical Simulation Services
- GOSPEL – grid based workbench for the computational modeling of lubricants.
- ESRC demonstrator and HYDRA2 - support for the decision making process in health care planning.

Grid in New York State

- Columbia U., HWI, Marist College, Niagara U., SUNY Buffalo, SUNY Geneseo, U. Rochester, Syracuse U.
- Precursor to NY statewide grid
- Integrates a computational grid and a datagrid
- Grid Enabling Application Templates – Eases porting and development of grid enabled applications

Grid in New York State Applications

- Shake-and-Bake(SnB) — Molecular Structure Determination Application
- Buffalo-and-Pittsburgh (BnP) — SnB and PHASES Complete Protein Phasing
- Ostrich — Optimization and Parameter Estimation Tool for Groundwater Modeling
- Aseismic Design & Retrofit (EADR) — Passive Energy Dissipation System for Designing Earthquake Resilient Structures
- Princeton Ocean Model Great Lakes (POMGL) — Great Lakes Hydrodynamic Circulation Model
- Titan — Computational Modeling of Hazardous Geophysical Mass Flows
- Chem — Commercial Quantum Chemistry Software Package
- NWChem — Computational Chemistry Software Package developed and maintained by DOE
- Split — Modeling Groundwater Flow with the Analytic Element Method