Users and Applications

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Metacomputing is a decades old idea

- Previous attempt, including Condor, failed to appeal to users
  - Progress in commercial hardware has always been faster than in Open Source-like middleware, hence it was practical to buy a bigger supercomputer/cluster
- Globus Toolkit 1 was heading into oblivion in early 2000

Physicists in Europe and USA realized that the time (Y2K) for metacomputing is ripe

- MONARC project (consisting of CERN researchers) developed a multi-tiered model for distributed analysis of data
- Particle Physics Data Grid (PPDG) and GriPhyN projects by US physicists started using Grid technologies
- Globus was picked up by the CERN-lead EU DataGrid (EDG) project
- CERN collaborators in the Nordic countries initiated the NorduGrid as an EDG deployment branch
- EDG failed to deliver in time, hence user demands made NorduGrid switching from deployment to development of own Grid solution
High Energy Physics challenges

- Data-intensive tasks
  - Large datasets, large files
  - Lengthy processing times
  - Large memory consumption
  - High throughput is necessary

- Very distributed user base
  - Distributed computing resources of modest size
  - Produced and processed data are hence distributed, too
  - Issues of coordination, synchronization and authorization are outstanding

- HEP is by no means unique in its demands
  - Cost-effectiveness is very important, too
Getting users onto Grid

- EDG project: of 11 Work Packages, 3 were dedicated to applications
  - HEP (CERN experiments), biomedical applications, Earth Observation (ESA)
  - Users outside those areas are not permitted
- NorduGrid: was launched by HEP community, but always been open for others
  - Aimed at “inheriting” at least some of EDG users
  - Created an own cross-disciplinary user base
  - Still, most users are physicists…
    - … and even all the developers are physicists…
- Thanks to their testbed status, all these Grids have one big appeal: they are for free
  - There are no serious accounting solutions (how much is a Gridbuck?)
Usage

- Testbed conditions: free but unwelcoming
  - Experimental status of middleware
  - Of advertised 1000+ CPUs, not more than 200 are made available for a Grid user at any given time
  - Best-effort based support
  - No GUI; some portals of limited functionality
  - Only batch jobs can be executed, no interactivity – users have to learn a new job description language

- Still, the load is high
  - Some users have no other resources
  - Some large resource owners force users into the Grid environment

- Some facts
  - There are 32 different runtime environments in the NorduGrid universe (for ca 6 research areas)
  - NorduGrid sites authorize in total ca. 500 users worldwide
  - During the past month, at least 50 of them executed at least one job
  - In one year, few ATLAS users processed more than 5 TB in more than 7000 jobs on NorduGrid
  - At least 4 research papers acknowledged NorduGrid project for providing resources for relevant analysis (no other Grid solution enjoyed this)
  - Jobs in the NorduGrid universe are running 24/7
Job Description example:
extended Globus RSL

(&executable="recon.gen.v5.NG")
(arguments="dc1.002000.lumi02.01101.hlt.pythia_jet_17.zebra" "dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.ntuple"
  "eg7.602.job" "999")
(stdout="dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.log")
(stdlog="gridlog.txt")
(join="yes")

|((cluster="farm.hep.lu.se")|((cluster="lscf.nbi.dk")|((cluster="seth.hpc2n.umu.se")|((cluster="login-3.monolith.ncsu.edu"))
(inputfiles="("dc1.002000.lumi02.01101.hlt.pythia_jet_17.zebra"
  "rc://grid.uio.no/lc=dc1.lumi02.002000.rc=NorduGrid,dc=nordugrid,dc=org/zebra/dc1.002000.lumi02.01101.hlt.pythia_jet_17.zebra")
  ("recon_gen.v5.NG" "http://www.nordugrid.org/applications/dc1/recon/recon_gen.v5.NG.db")
  ("eg7.602.job" "http://www.nordugrid.org/applications/dc1/recon/eg7.602.job.db")
  ("noisedb.tgz" "http://www.nordugrid.org/applications/dc1/recon/noisedb.tgz")
)
(inputfiles="("dc1.002000.lumi02.01101.hlt.pythia_jet_17.zebra"
  "rc://grid.uio.no/lc=dc1.lumi02.002000.rc=NorduGrid,dc=nordugrid,dc=org/zebra/dc1.002000.lumi02.01101.hlt.pythia_jet_17.zebra")
  ("recon_gen.v5.NG" "http://www.nordugrid.org/applications/dc1/recon/recon_gen.v5.NG.db")
  ("eg7.602.job" "http://www.nordugrid.org/applications/dc1/recon/eg7.602.job")
)
(outputFiles="("dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.log"
  "rc://grid.uio.no/lc=dc1.lumi02.recon.002000.rc=NorduGrid,dc=nordugrid,dc=org/log/dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.log")
  ("histo.hbook"
  "rc://grid.uio.no/lc=dc1.lumi02.recon.002000,rc=NorduGrid,dc=nordugrid,dc=org/histo/dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.hist")
  ("dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.ntuple"
  "rc://grid.uio.no/lc=dc1.lumi02.recon.002000,rc=NorduGrid,dc=nordugrid,dc=org/ntuple/dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602.ntuple")
)"
(jobname="dc1.002000.lumi02.recon.007.01101.hlt.pythia_jet_17.eg7.602")
(runTimeEnvironment="ATLAS-6.0.2")
(CpuTime=1440)(Disk=3000)(ftpThreads=10))
Applications on NorduGrid

- **HEP**
  - Theoretical HEP studies: first serious users
  - ATLAS: most demanding tasks
    - Data Challenges
    - Higgs studies
    - B physics studies
    - Other MonteCarlo generation
  - Combined LEP analysis: first real data processing on the Grid
  - HERA-B
    - Quantum Lattice models
    - Genomics
    - Software development

RESOURCES ARE ALREADY OVERSTRETCHED!
Users vs providers

- NorduGrid middleware is application-ignorant
  - It is not tailored for any specific application
  - It does not impose users onto providers

- Resource owners decide themselves whom to let use the facilities, typically:
  - National facilities serve taxpayers
  - Research groups provide resources to co-workers
  - Individuals do not provide services

- Issue: how to share the resources with some and yet keep away others?
  - Can national resources be put up on an international Grid?
  - Can research groups share facilities with competitors?
  - Who pays and how?
VO or not VO?

- Original idea: let’s group researchers in Virtual Organizations (VO) and authorize them in bunch
  - Pro: ease of management, possibility of internal structure, similarity of applications
  - Contra: lone researchers, multinational organizations, geopolitical groups

- Reality: VOs do not help much in user management, number of VOs approaches that of single users

- New life for VO: maintain user’s roles and privileges
  - E.g., ATLAS member should not be able to launch CMS jobs, students should not be able to modify major databases etc

- Would geopolitical VOs like NorduGrid survive? Should they?
Summary

- Production Grid development is driven by user demands
  - Fundamental Grid development is driven by less practical IT research interests however

- As soon as resources become available, there are users
  - Grid technology as such does not create new CPUs, although Grid buzz-word does
  - Still, most researchers are either satisfied with existing local resources, or are afraid of the steep Grid learning curve

- Grid adds extra dimension to resource owner’s troubles
  - Many existing user access, authorization and registration rules will have to be changed in the Grid era
  - Will adequate global Grid accounting ever be possible?

- Most appealing thing about Grid both for users and resource owners is effectiveness of resource usage
  - Users will always get simpler access to hopefully more resources
  - Resource providers will never have vacant CPUs

- NorduGrid middleware and policies allow the unique balance between diversity of the resources and variety of users and applications
  - NorduGrid is the only Grid solution known to support production-scale load reliably and on round-the-clock basis