Grid Computing with Debian, Globus and ARC

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Grid Computing

- Seamless integration of distributed computing and storage resources from the user’s point of view

- Computing grid vs. power grid analogy
  - Power grid: users plug in their electrical devices and don’t need to care which power plant provides the electricity (unless they want to)
  - Computing grid: the user prepares a computing task and sends it to the “grid” and doesn’t need to care which cluster performs the calculation (unless it wants to)
Volunteer vs. Grid Computing

- Volunteer Computing: BOINC
  - “single regular users fetch prepared workunits”
  - regular Debian client package
  - unofficial server packages

- Computational Grids
  - “big compute clusters wait for arbitrary jobs”
  - no previous packages for any Linux distributions
  - common IT backbone for High Energy Physics
Mutual Trust

Network of trust
- Users trust sites
  - Data security, validity of installations
- Sites trust users
  - All usage can be traced back to the user

X.509 certificates
- Certificate Authorities (CAs) guarantee identities
- User creates time-limited variants of these certificates (proxies) to delegate their rights to jobs
Mutual Trust (cont’d)

- International Grid Trust Federation (IGTF)
  - CAs that trust each other’s policies
  - Users with a user certificate issued by a member CA can authenticate to resources that have host certificates issued by any other member CA

- Virtual organisations
  - Clusters in the grid delegate decision over admissions to virtual organisations
  - Easiest: a website collecting the individuals’ certificates descriptive names
Typical Grid Usage

- Submission of Job
  - Task should be described in a job description – executable, input data, output data, software and hardware requirements, ...

- Status information
  - Query the state of clusters and jobs

- Retrieval of results
  - Download to client or (if specified in the job description) automatically upload to storage

- Data management
  - Keep track of large sets of input and output files
Remaining Challenges

- Make grid access easier
  - Local vs. grid accounts

- Increase flexibility
  - Migration of jobs
  - Preparation of runtime environments

- Increase public awareness
  - Universities and research groups
  - Industry
  - Computer clubs
  - Presentations like this one ;-)
Current Technologies / Projects

- **Globus**
  - can be used as a complete grid middleware
  - is a library of core functionalities for many

- **Unicore**
  - both Grid and Grid Infrastructure

- **EGEE**
  - uses the gLite grid middleware and Globus

- **NorduGrid**
  - with or without Globus
  - compatible with the others
A set of libraries and tools for grid computing used by many grid projects

- **Globus security infrastructure (GSI)**
  - Authentication and authorization based on short lived proxy certificates
  - Standardized as RFC 3820

- **GridFTP**
  - Extensions to the FTP protocol to support GSI authentication, third-party transfers, multiple data channels for parallel transfers, partial file transfers
  - “Proposed recommendation” document in the Global Grid Forum (GFD-R-P.020)
Packaging Globus

Source
- Distributed as >100 MB tarball
- Contains ~300 inter-dependent packages within

Split into individual packages to become manageable
- Strong consistency between Globus and Debian packages

Build uses the Grid Packaging Toolkit (GPT)

Patches communicated back to upstream
Packaging Globus

- Redundancies with system libraries are all eliminated from the source tree
  - e.g. openssl, openldap, libltdl
- Glue packages are provided instead
  - providing GPT metadata information for system packages to satisfy build dependencies
- Status
  - First packages uploaded to Debian new queue, also uploaded to Fedora
Packaging Globus

- Regular package for Grid Package Toolkit
- Use GPT packaging metadata information to autogenerate Debian folders in source code management system
- Manual curation of these folders
  - preparation of patches
  - provisioning of better descriptions
NorduGrid – ARC

- Advanced Resource Connector
- Grid middleware built on top of the Globus libraries, with higher level services
- Used by the Nordic Data Grid Facility (NDGF) to provide computing resources for
  - High Energy Physics researchers at the CERN Large Hadron Collider
  - Bioinformatics
  - Quantum chemistry
  - ...

2009-02-07  www.knowarc.eu
## Monitor of clusters contributing

**ARC Grid Monitor**

### 2009-02-06 CET 17:41:17

<table>
<thead>
<tr>
<th>Land</th>
<th>Site</th>
<th>CPUs</th>
<th>Last (Prozesse: Grid+Lokal)</th>
<th>In einer Queue</th>
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<tr>
<td><strong>Australien</strong></td>
<td>Alfred (UniMelb)</td>
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<td><strong>Dänemark</strong></td>
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Packaging NorduGrid – ARC

- Available today from www.nordugrid.org
- version 0.6.x
  - “Production” release
  - full Globus dependency
  - Globus packages should be accepted first
- version 1.x
  - ongoing development
  - optional Globus dependency
  - Debian packages will offer the more compatible Globus-dependent version
Implications for Debian

- Increased connectivity
  - between users of Debian
  - in between clusters of Linux distributions
- Promotion as an extended concept of the Debian society
  - the sharing of packaging may be extended towards a sharing of resources
- Debian Technologies
  - packages are perfect descriptions for runtime environments
  - availability on many heterogeneous platforms
Acknowledgments

- KnowARC – www.knowarc.eu
  - European Commission 5th framework programme project
- NDGF – www.ndgf.org
- The developers of Globus – www.globus.org
  - Charles Bacon in particular, for his integration of patches
- The developers of NorduGrid ARC – www.nordugrid.org