Supercomputing Center Management using AIRS
*(Albuquerque Integrated Reporting System)*

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http://www.hpc.unm.edu

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Leading academic site for high-performance computing

- Los Lobos (256-node) and Road Runner (64-node)
  - Early Linux Myrinet Clusters
  - Operated for National Computational Science Alliance (NCSA)

- Other Systems
  - Linux clusters
  - IBM SP3
  - Condor flock
  - Viz Lab
  - Lots of workstations, PC’s, and servers
Situation

- Multiple clusters, each with their own accounting systems
- Distinct naming domains (alliance.unm.edu and hpc.unm.edu) within one facility
- Dozens of users and projects, many administered remotely
- Usage structured by project
- Users able to bill to one or more projects
- Required daily usage reporting via electronic data transfer to sponsors
- Active and historical data scattered in multiple locations, including flat files, desktop databases, and on paper.
Design Goals

- Centralized SQL database
- Extensible system
- Web interfaces where appropriate
- Other interfaces where appropriate
- Non-disruptive integration into environment
- Data safety and correctness
Tools

- Perl
  - A host of modules!
- MySQL
- Apache
- HTML::Mason
  - Intermix HTML with Perl
  - Modular
- Linux, FreeBSD, AIX
- \LaTeX
- Java (recently)
First Breaths : 2000

- **Integrated Reporting System**
  
  Mail from **irs@hpc.unm.edu** gets read!

- Usage accounting, not process accounting!

- Scripts to populate database reading LoadLeveler, PBS, Manual formats

- Scripts to generate reports

- Daily usage reporting to NCSA

- Daily usage reporting to management via email

- Complete record of all jobs run since May, 1999
Key Relationships

- **PERSONS** can have multiple accounts affiliated with multiple **PROJECTS**

- Each **ACCOUNT** is specific to a **MACHINE**

- Each **PROJECT** has one or more **PROJECT ALLOCATIONS** of CPU-hours specific to given **MACHINES**

- Usage is debited against the **PROJECT ALLOCATION**

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\(^a\) An AIRS account is *not* the same as a line in the password file!
Domain Relationships

Diagram showing relationships between Person, Project, Project Allocation, Machine, Account, Account Allocation, and Login.
TableSpec

- Object-oriented access to database via Perl DBD

- Enforced consistency between SQL and data access objects

- Perl generating
  - Perl modules (classes)
  - SQL schema
  - \LaTeX, TexInfo, HTML, and DocBook documentation
Data Access Patterns

DB::SQLRecord
+ void fetch()
+ void update()
...

DB::SQLTable
+ insert_record(DB::SQLRecord)
+ delete_record(DB::SQLRecord)
...

DB::Records::Person
+ String first_name()
+ String first_name(String)
+ String last_name()
+ String last_name(String)
...

An instance connected to the Person table in the database

Generated - never edited!
Changes when DB table changes

DB::Person
+ String full_name()
...

Developer-maintained

AIRS/CWCE/June 2003 – p.12/33
Accounting Data

- Parse external log files
- Store original and standardized data
  - Reporting based on standardized data
- Support periodic charges (e.g. system maintenance or dedicated partitions)
- Reconciliation: Can you trace usage back to users?
- Configuration strategies
  - Data must reconcile during inhale
  - Data can be reconciled after inhale
Inhaling Data

- Data polled daily

- Robust polling — read any prior missing days

- Minimal changes to administrative nodes
  - Remote shell access
  - Authorization to read (/bin/cat) accounting files
Reporting

- Usage by PERSON
- Usage by PROJECT
- Usage by PROJECT category
- Usage by MACHINE
- ...
- Web-based forms use drill-down
Reporting Methods

Web Users with “audit” privileges may access any usage information via the Web.

Rushes Daily, weekly, and monthly reports are emailed to a known alias.
At HPC@UNM, the alias refers to a managed mailing list so that all of our administrators can see the usage data.

Project/Account Periodic (daily, weekly, bi-weekly, monthly, quarterly, yearly) reporting
- Users get reports on their own accounts.
- Principal investigators can report on their entire projects.

NCSA Daily reports to NCSA for specified users are transmitted via transaction mechanism.
Stage Two: 2001

- Account and User management (with manual updates of system files)
- Web interfaces for requesting Accounts and Projects
- Workflow processing for approvals
- Transaction subsystem
  - Required part of Alliance activities
  - Separable AIRS module
Web Activities

- Request a new PROJECT or ACCOUNT
- Approve a new PROJECT or ACCOUNT
- Create actual login accounts in NIS
- View usage information
- Modify PROJECT, ACCOUNT, or PERSON information, including reporting information
- Search for and view PROJECT, ACCOUNT, or PERSON information
- Search for and view MACHINE information
Configurable workflow process

Steps tracked

History maintained

Actions driven by transitions in state machine
Example: Accounts

- **Requested**: Account has been requested
- **Inprocess**: Awaiting account approvals
- **Approved**: Awaiting creation of account
- **Rejected**: Not approved, request may be resubmitted
- **Created**: Account creation complete; paperwork may need to be sent
- **Active**: Account is in production and may be used
- **Inactive**: Account is temporarily suspended
- **Frozen**: Account is longer in use; files are still available
- **Dead**: Files no longer maintained by site
Inventory management

Never underestimate the power of a wireless-equipped laptop with a barcode scanner!

Software license and vendor information

PI-management of projects
  • Add, approve, and remove participants accounts
  • View usage, including participants

Web-based security and view management

Automated login and password management
Privilege Levels

**Admin** level can modify any aspect of the database.

**Audit** level can *view* general accounting records for any project or machine or user.

**Project** level can view and modify aspects of their own projects.

**User** level allows a single user to view her own usage data, or to modify her own personal data.

**Open** level provides access to publicly available information.
- Additional strategies for inhaling records
- Trouble ticket system
- More powerful configuration mechanisms
- Account approval workflow (version 2)
- GPL’d
Authentication Interfaces

- Scripts are used to hide the site’s password/login handling from AIRS
  - Standard NIS scripts are provided for modifying password and group information
  - Alternately, AIRS can read password and group files
  - LDAP foreseen
- Basic interface
Trouble Tickets*

- Master’s project by Satish Sambasivan
- Data entry from Web, electronic mail, Java application
- Tickets annotated by text, voicemail, images
- AIRS database tables link to consultants, machines, etc.
- Range of management reporting

*Under development!
Ticket States
Ticket States (2)

**Quarantined** A ticket has been submitted electronically, but may be spam.

**Unassigned** A new ticket has arrived, but is not yet assigned.

**Assigned** Ticket has a consultant, but they may not have seen it yet.

**Actionable** Ticket is ready for next actions.

**Wait** Someone, usually the ticket creator, has been contacted, and the system is waiting a response.

**Resolved** No further action is necessary.

**Shelved** Problem has not been resolved.
User Interface

- Data manipulation based on Lotus Improv interface
  - Drag and drop view elements
  - Organize by row, column, page, and hidden

-Bookmarking of views

- Drill-down into ticket histories

- Examples next
<table>
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<tr>
<th>Consultant</th>
<th>State</th>
<th>Ticket Id</th>
<th>Opened</th>
<th>Description</th>
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What’s next?

- Business graphics
- More powerful workflow models
- Time tracking
- MySQL 4.0
- and all the usual stuff

Distribution tarballs are available!

http://airshq.hpc.unm.edu/