Corral: A Glide-in Based Service for Resource Provisioning

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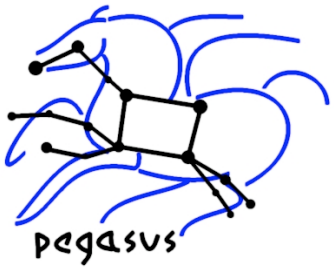


Outline

- Throughput Applications
- Grid Computing
- Multi-level scheduling and Glideins
- Corral
- Example: SCEC CyberShake
- Future Work

Throughput Applications

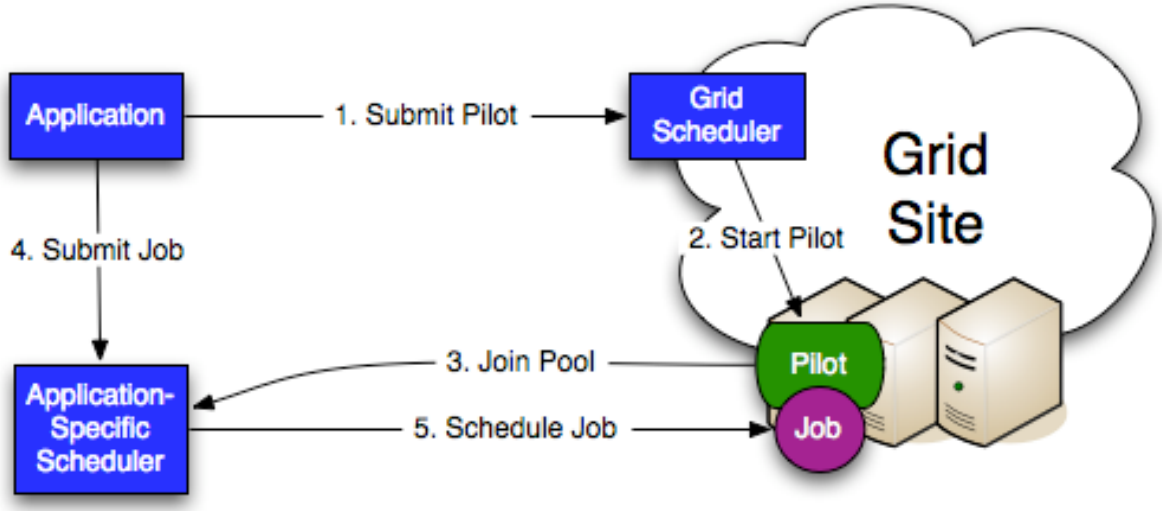
- Characterized by
  - Many tasks: Thousands to millions
  - Short task runtimes: May be less than 60s
  - Tasks are commonly serial
- Key performance metric: **time-to-solution**
- Examples:
  - scientific workflows
  - parameter sweep
  - master-worker
  - “pleasantly parallel”

Grid Computing

- Grids
  - Benefit: Provide plenty of computing resources
  - Challenge: Using those resources effectively
- Grid Overheads
  - Queuing Delays
  - Software Overheads
  - Scheduling Delays
  - Scheduling Policies
  - => Bad performance for throughput applications!
- Some solutions
  - Task clustering (workflows)
  - Advance reservations

Multi-level Scheduling

- Way for an application to use grid without the overheads
- Overlay a **personal cluster** on top of grid resources
- **Pilot jobs** install and run a **user-level resource manager**, which contacts an **application-specific scheduler** to be matched with application jobs
- **Glidein**: How to do MLS using Condor



Benefits of MLS and Glideins

- Running short jobs on the grid
  - Condor dispatches jobs faster than, e.g. Globus
- Bypass site scheduling policies
  - Use application-specific policies
  - e.g. prioritize jobs based on application needs
- Avoid competition for resources
  - Glideins reserve resources for multiple jobs
  - Minimizes queuing delays
- Better application scalability
  - Compared to GT2 GRAM, for example
  - Fewer jobmanagers => reduced load on gateway

Corral

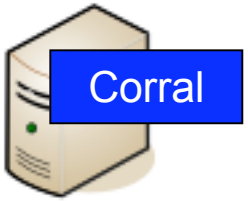
- Resource provisioning system
  - Uses multi-level scheduling model
  - Allocate resources explicitly rather than implicitly
  - Pay to allocate resources once and reuse them
  - Effectively minimizes grid overheads
  - Requires resource specification
- Corral web service
  - Automates the installation and configuration of Condor on grid sites
  - Submits **glideins** to provision resources

How Corral works

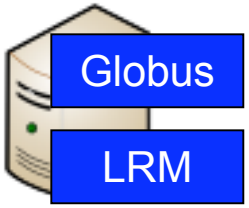
LOCAL SITE

GRID SITE

User

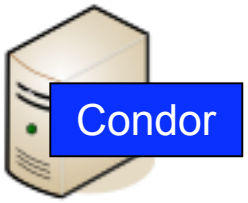


Corral Server



Head Node

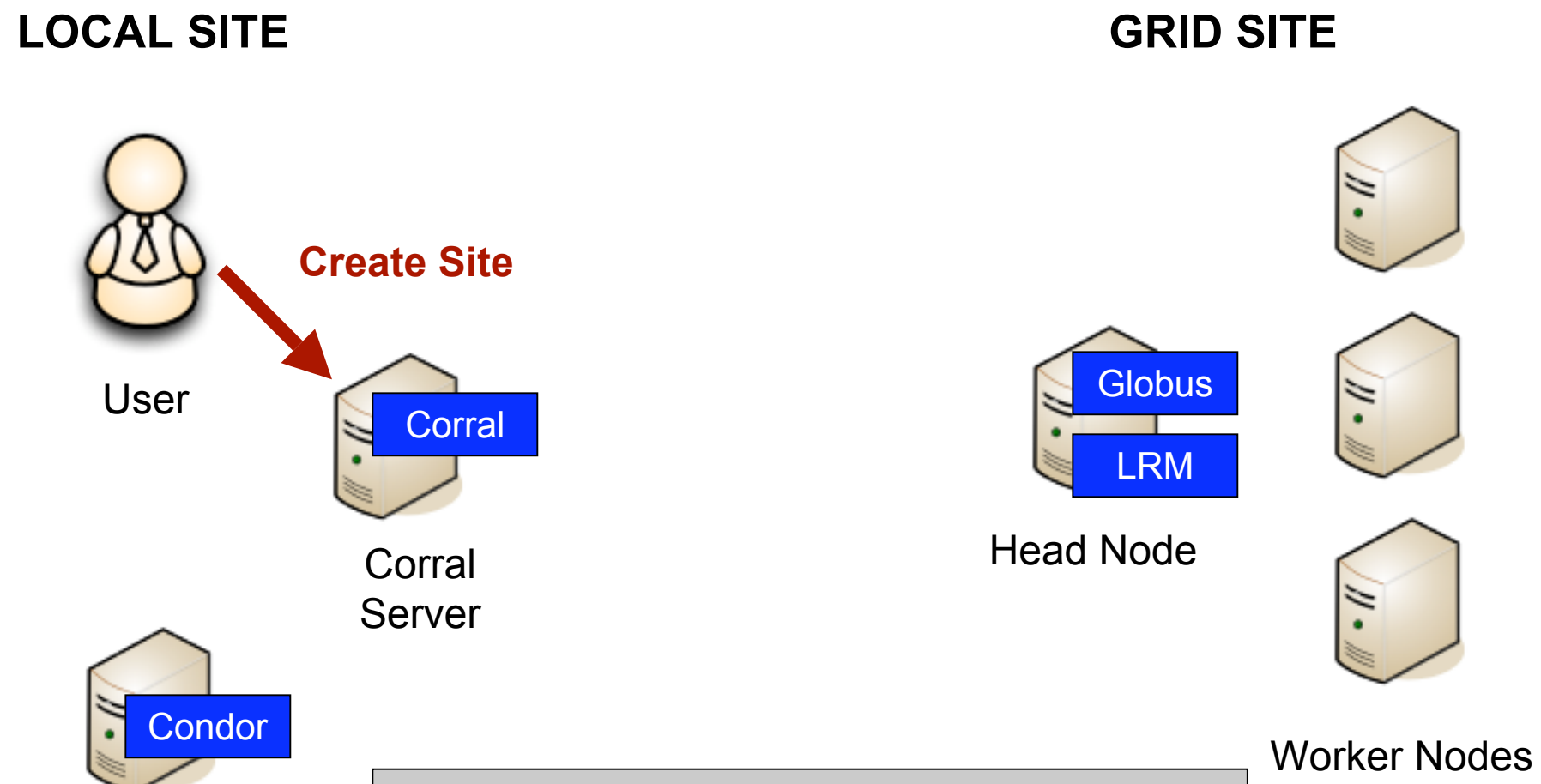
Worker Nodes



Condor Central Manager

In addition to the Condor central manager, the user runs a service container that hosts the Corral web service.

How Corral works



The user creates a new site by sending a request to Corral. The request specifies details about the grid site including: job submission information, file system paths, etc.

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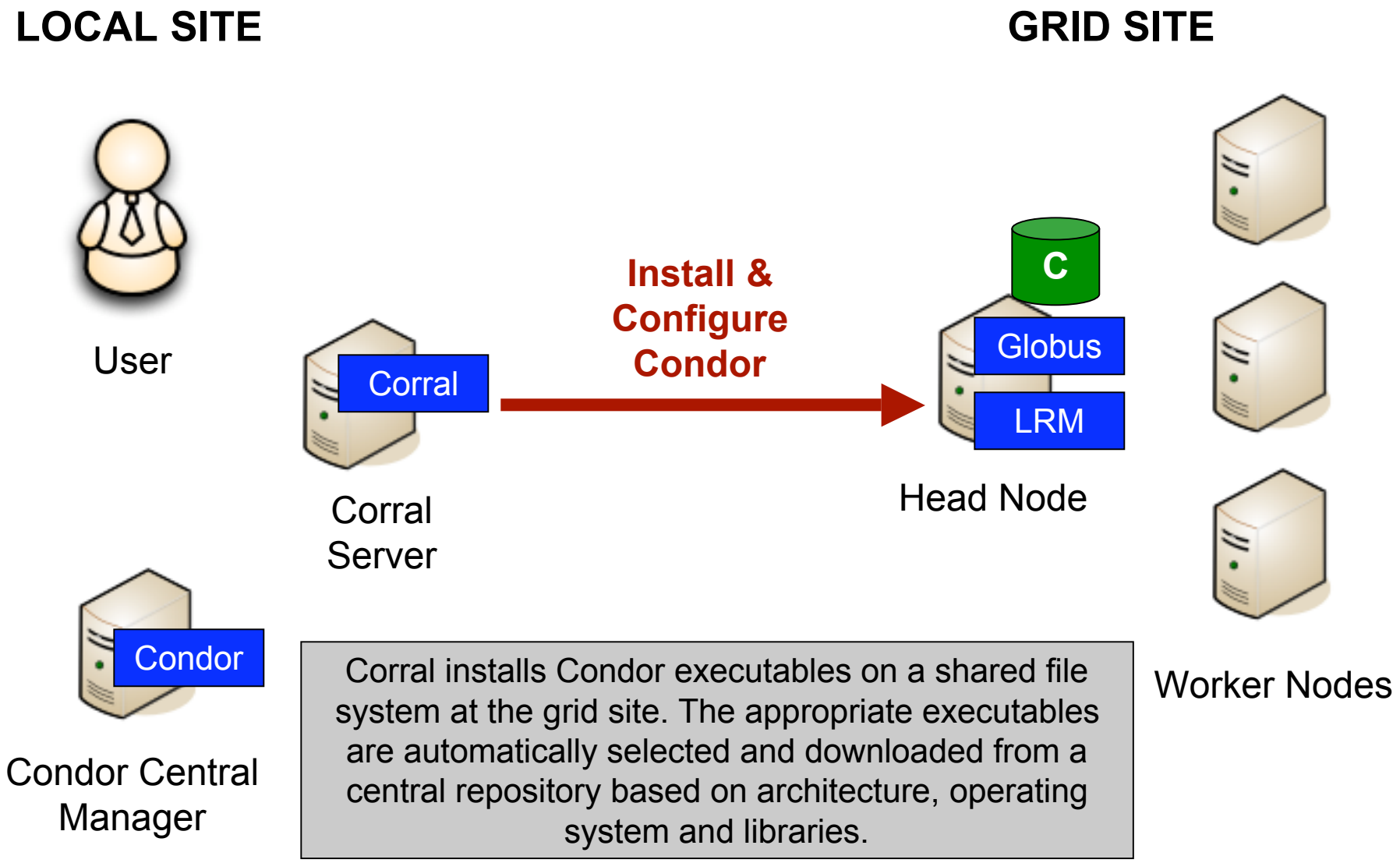

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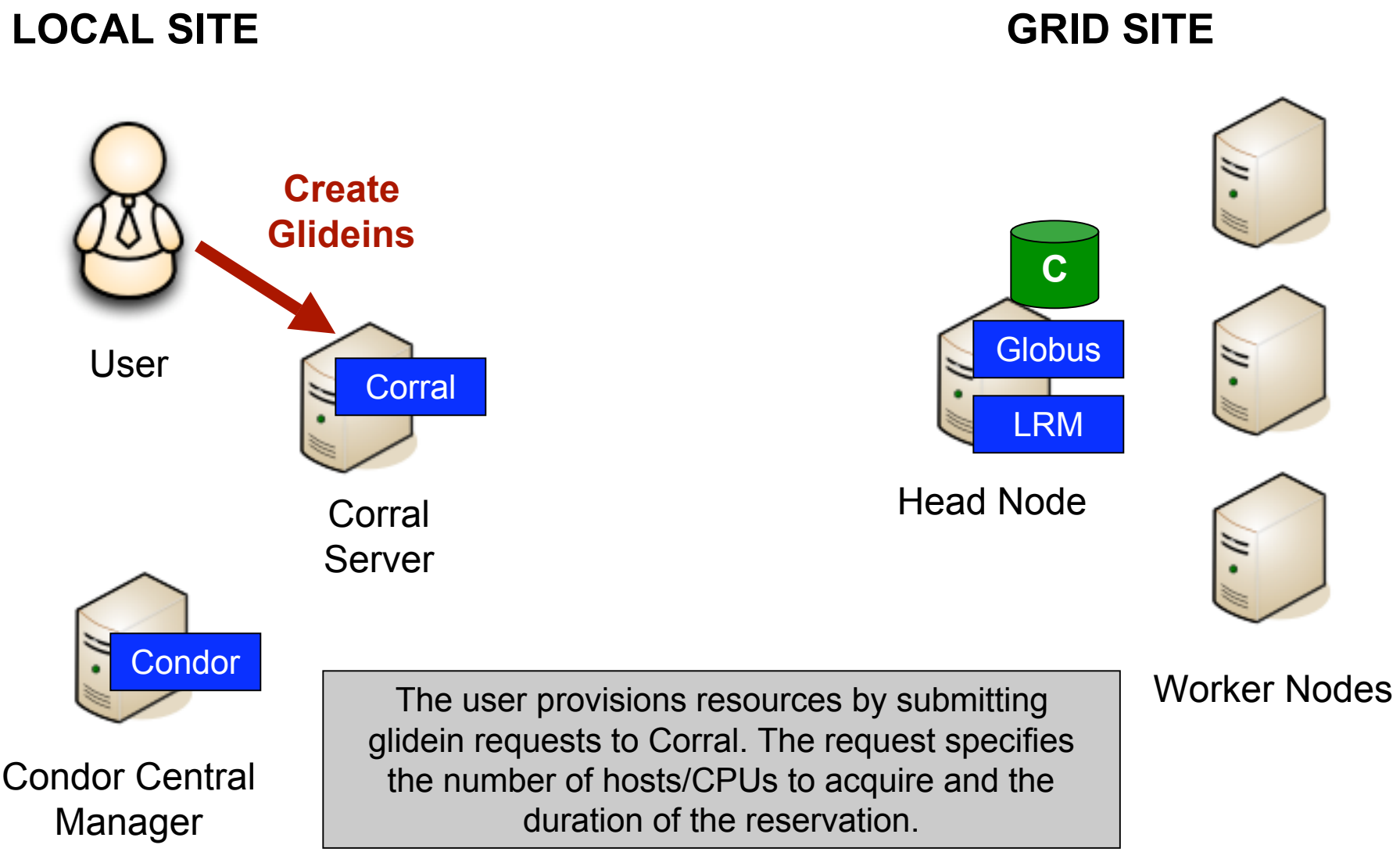

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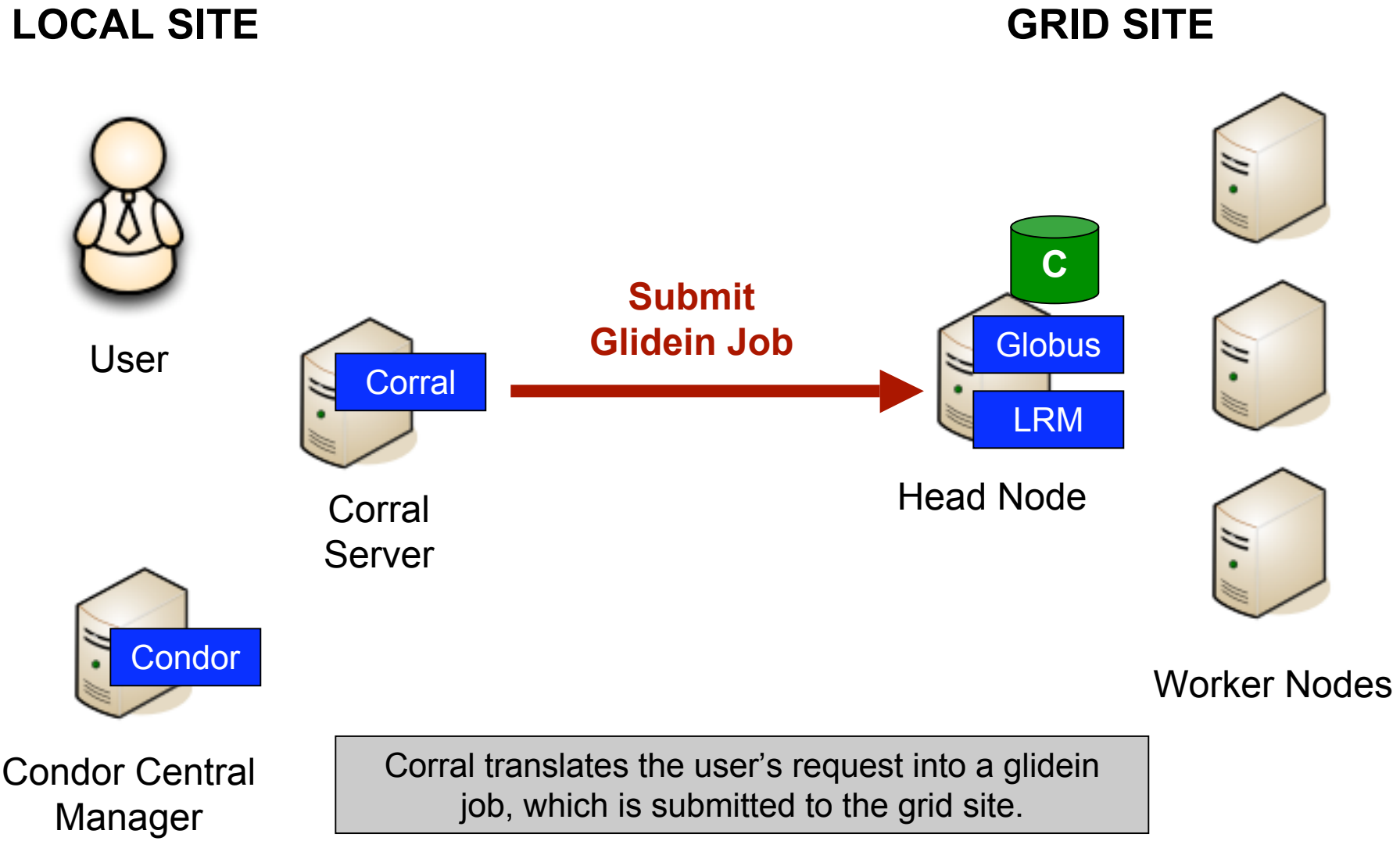

Corral translates the user's request into a glidein job, which is submitted to the grid site.

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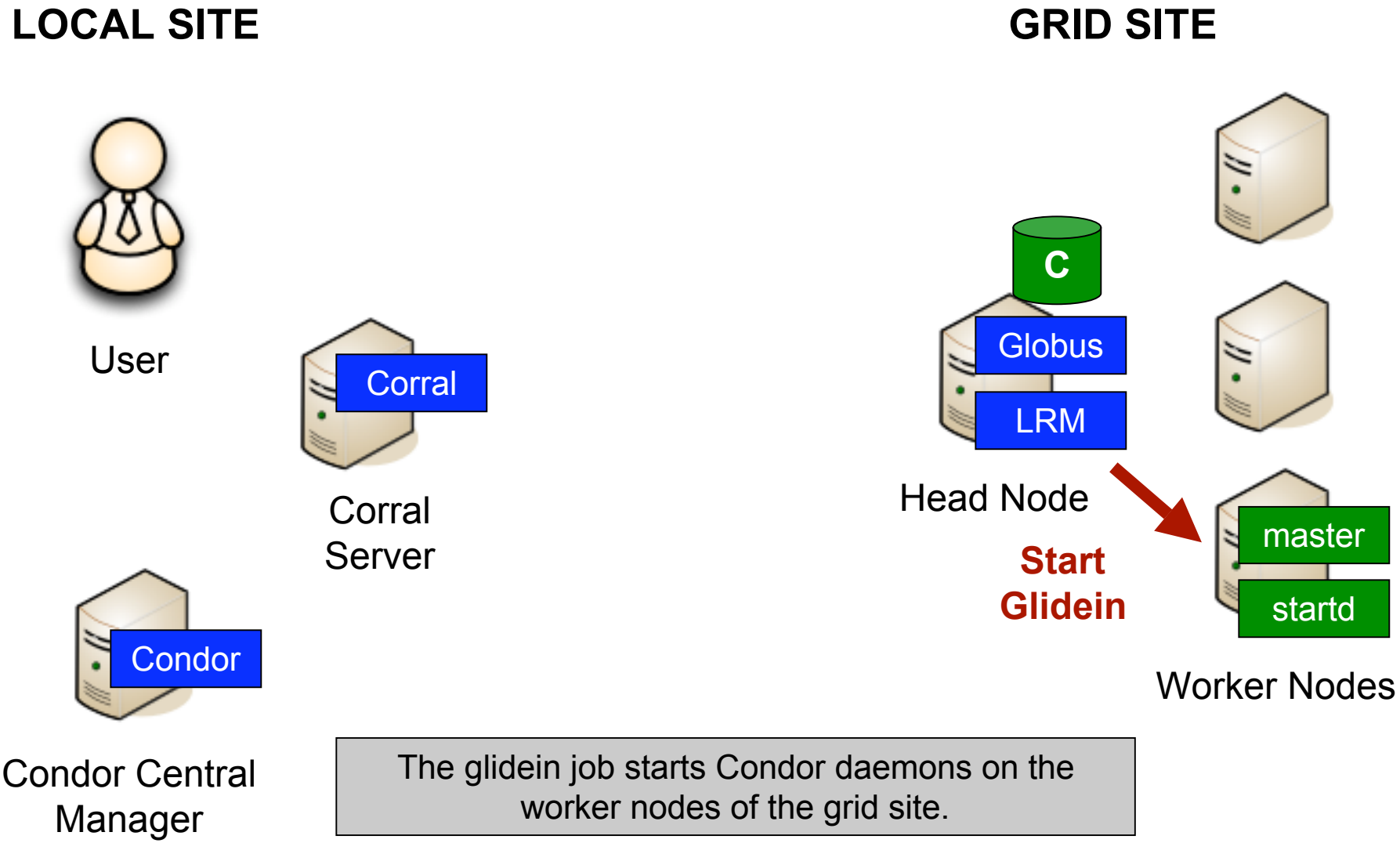

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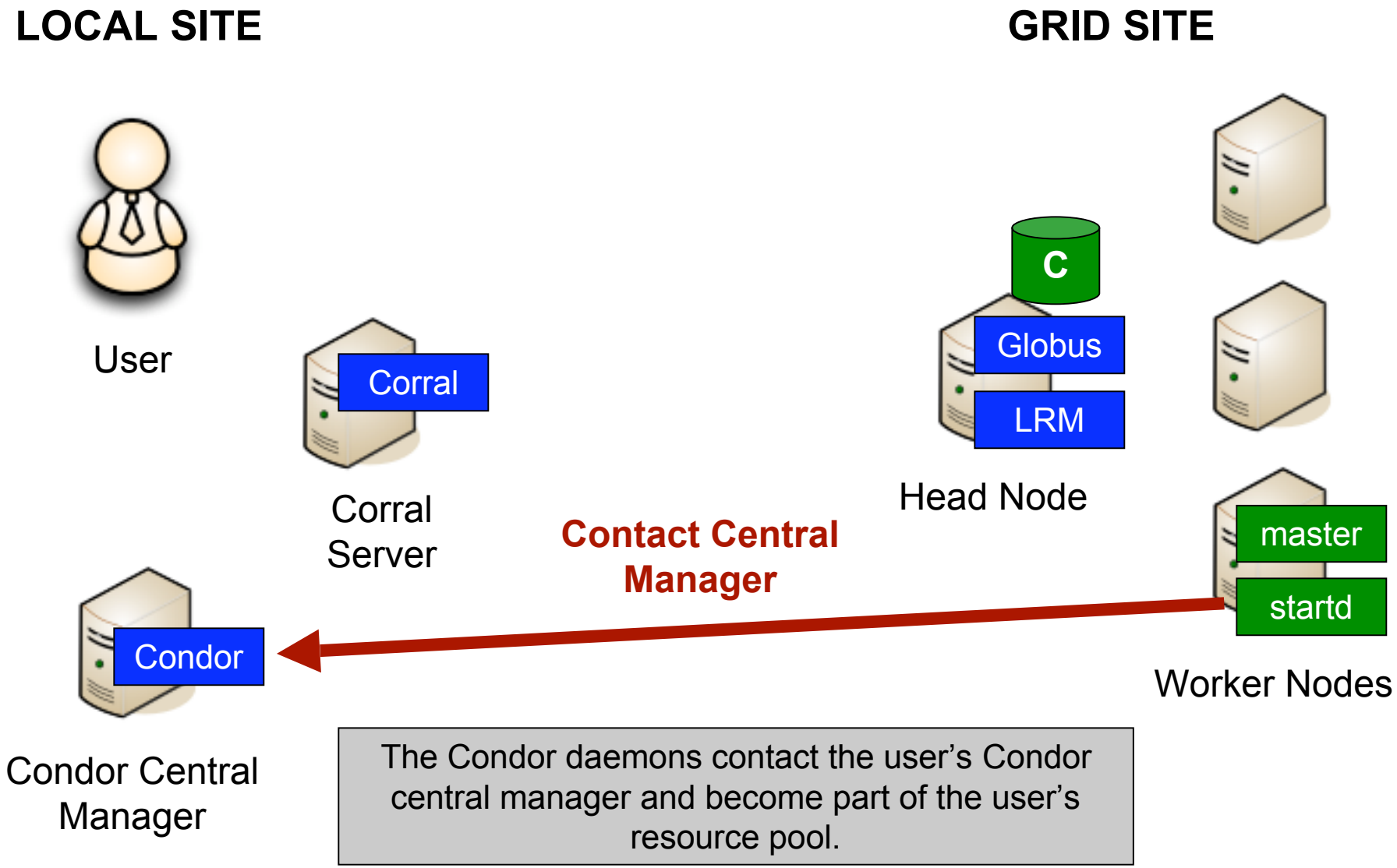

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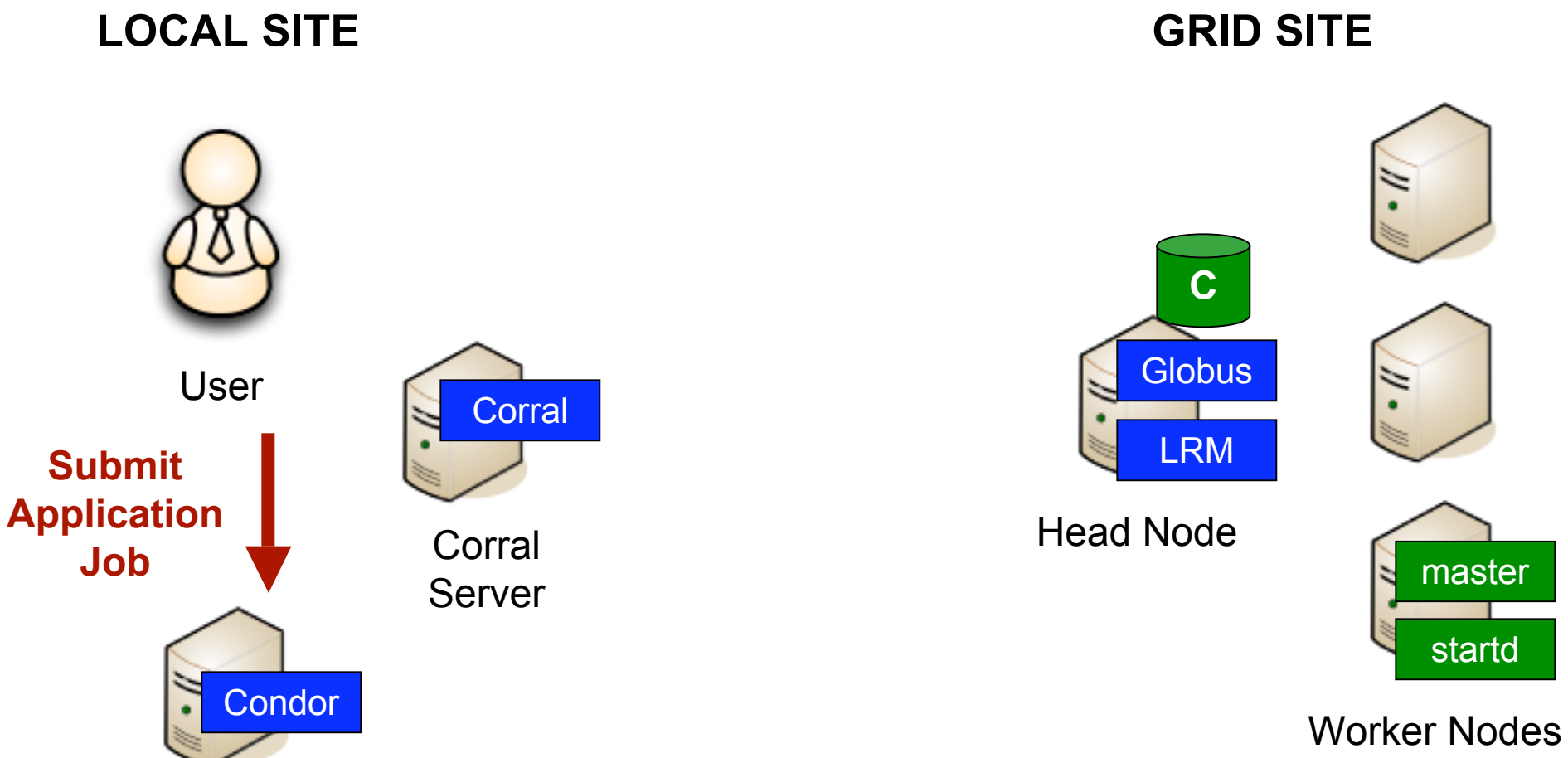

The user submits application jobs to their Condor pool. The jobs are matched with available glidein resources.

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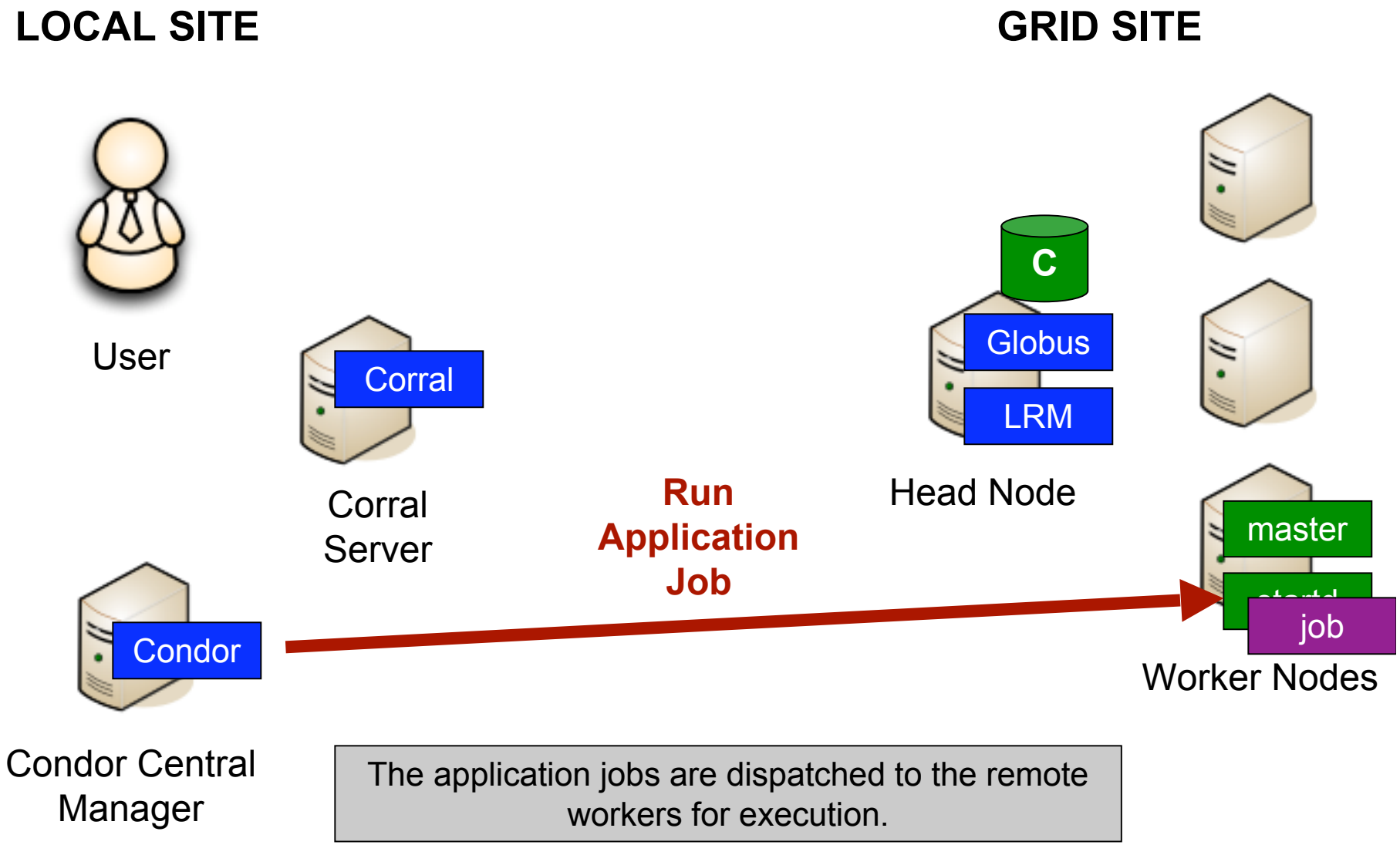

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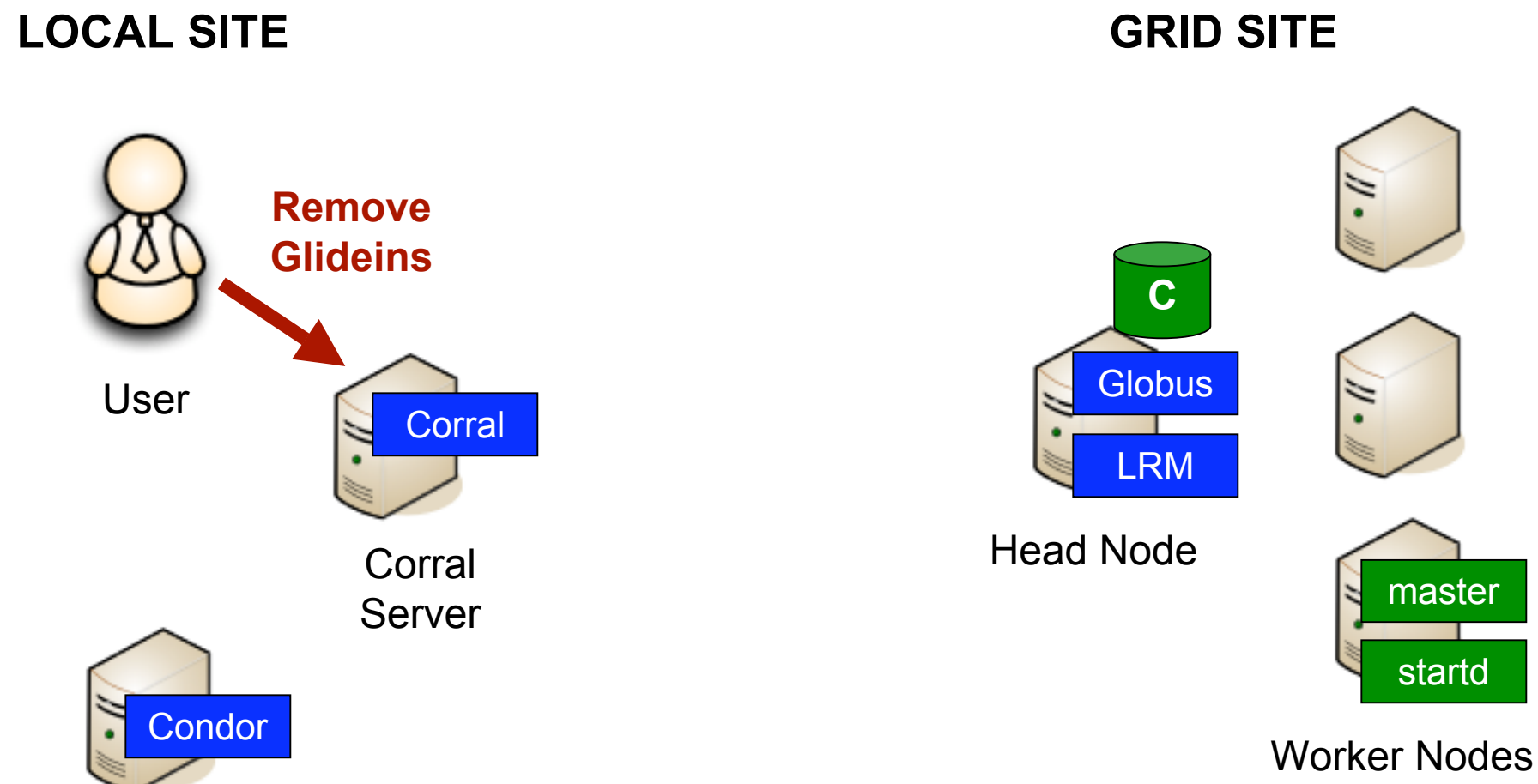
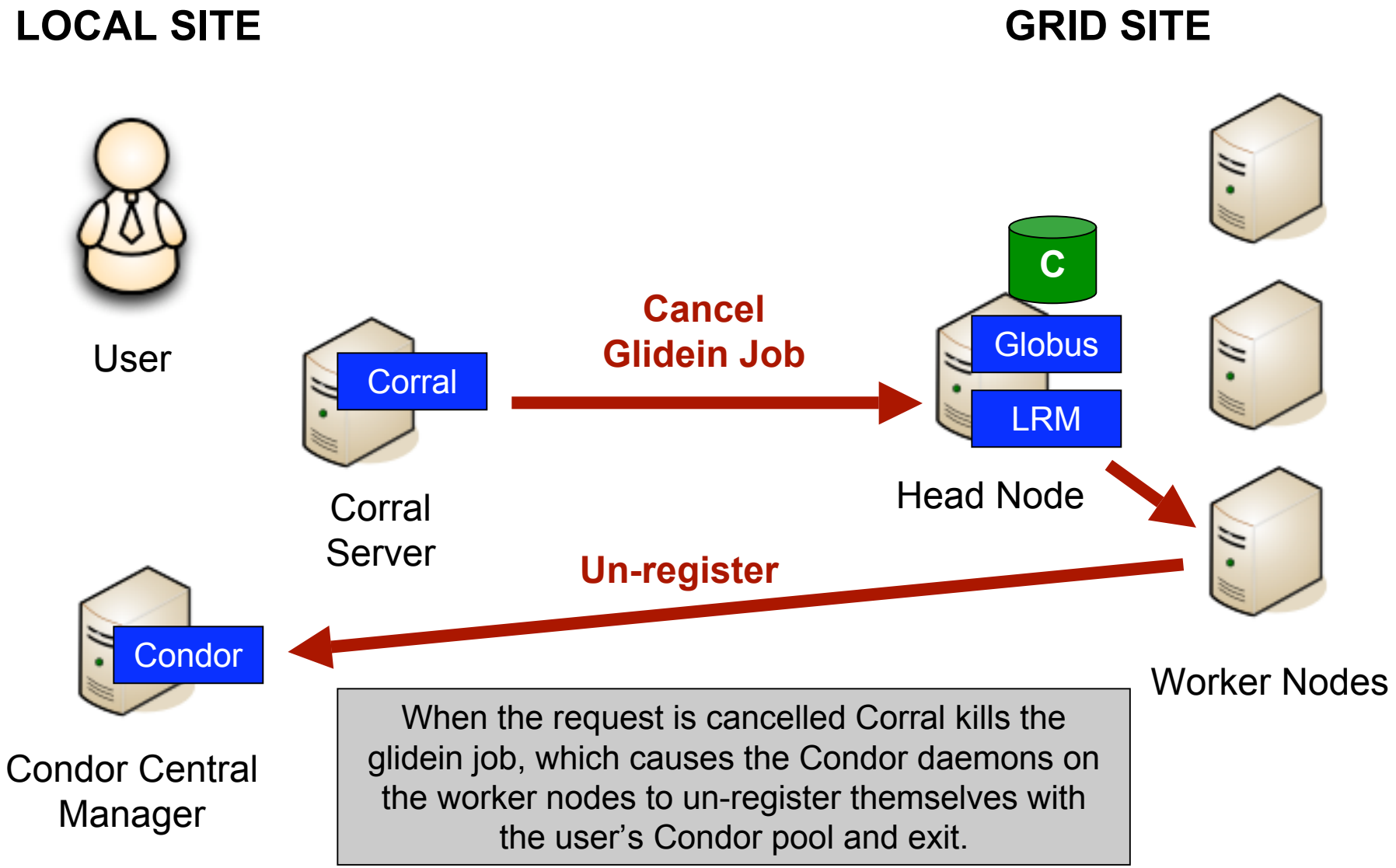


When the user is finished with their application they cancel their glidein request (or let it expire automatically).

How Corral works



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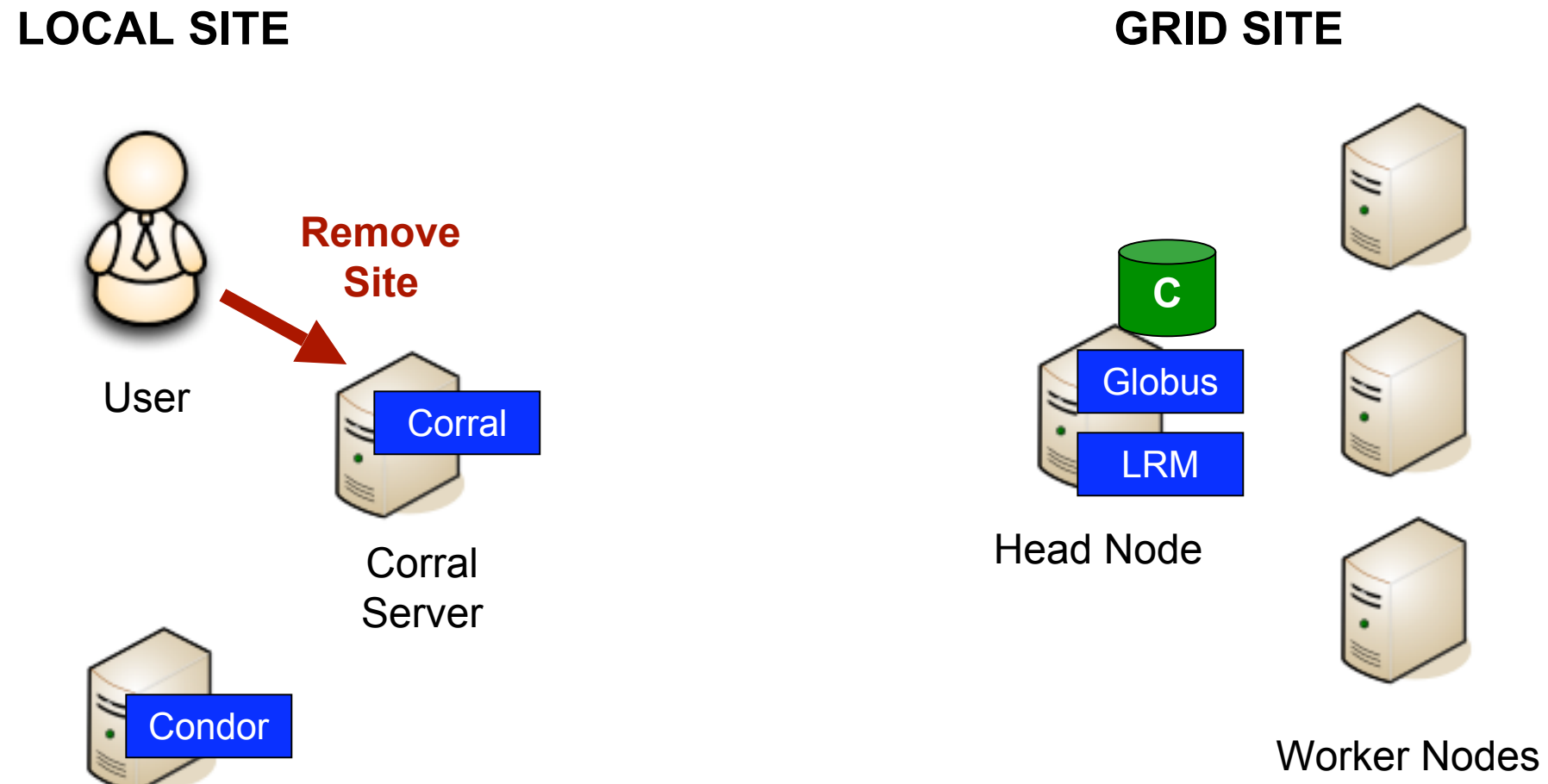
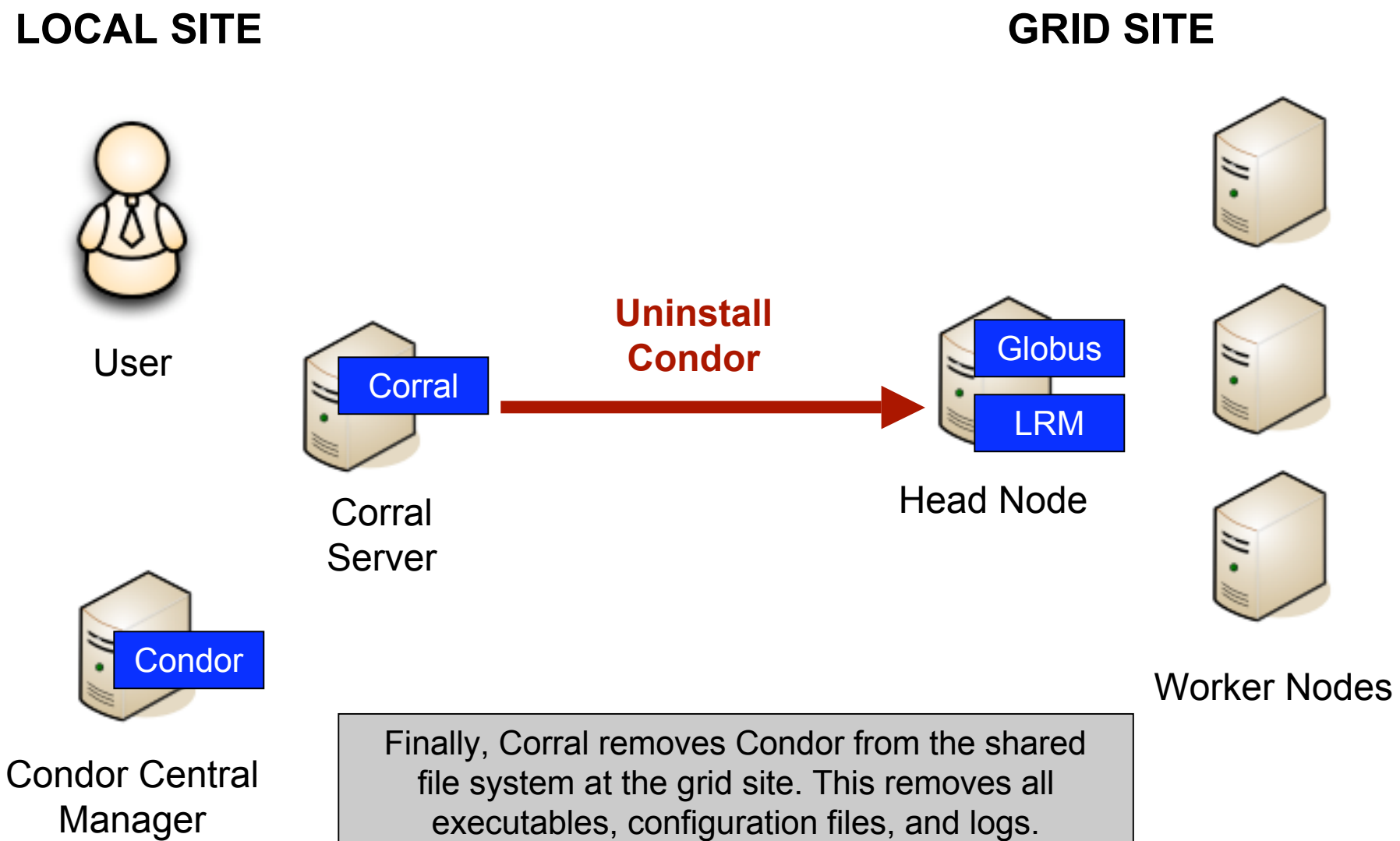


The user can submit multiple glidein requests for a single site. When the user is done with the site they ask Corral to remove the site.

How Corral works



Corral Features

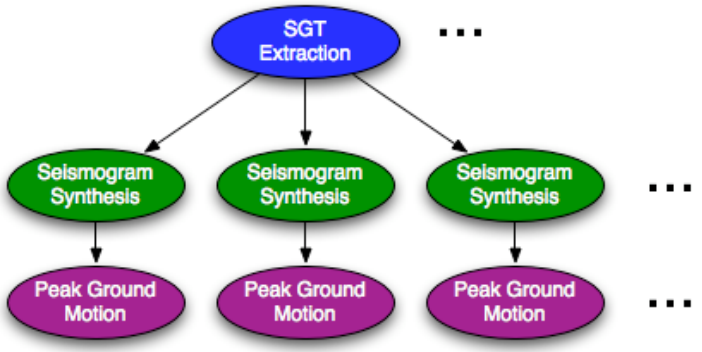
- Auto-configuration
  - Detect architecture, OS, glibc => Condor package
  - Determine public IP (if any)
  - Generates Condor configuration file
- Large requests
  - 1 glidein job = N slots
- Multiple interfaces
  - Command-line, SOAP, Java API
- Automatic resubmission
  - Indefinitely, N times, until date/time
- Notifications
  - Asynchronous API for integration with other tools

Networking Challenges

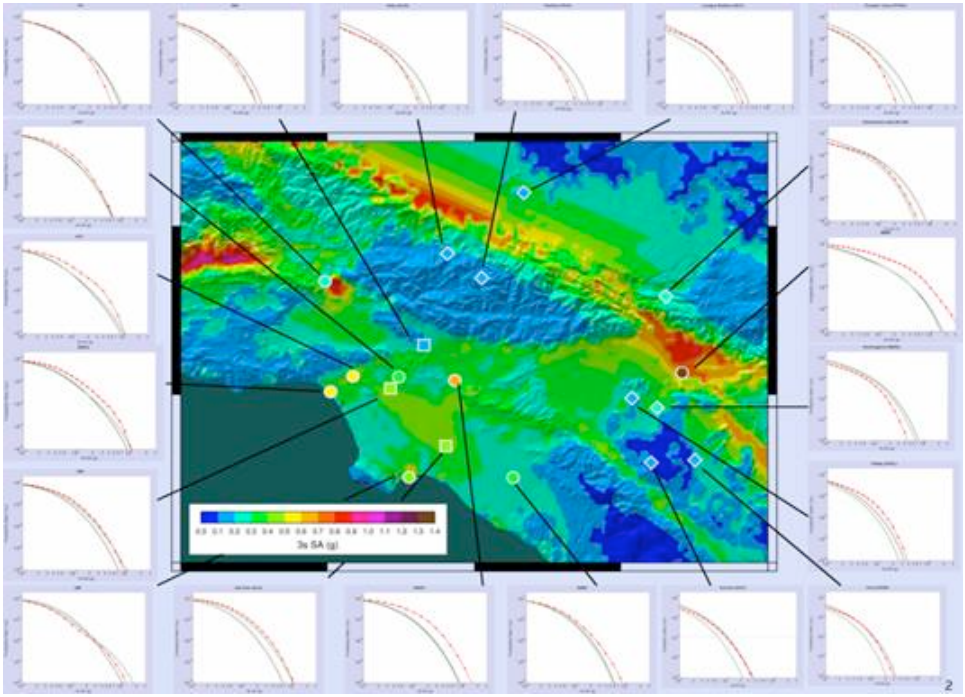
- Firewalls / Private IPs
  - Block communication between glideins and pool
  - Use: GCB/CCB, VPN, or CM on head node
  - Glideins can't be used on some sites
- Port Usage
  - Condor requires many ports
  - Issue for LOWPORT/HIGHPORT firewall holes
  - TCP TIME_WAIT can consume ports
- WAN issues
  - Large glidein pools look like DDoS attacks
  - Traffic gets blocked sometimes

SCEC CyberShake

- Probabilistic seismic hazard analysis workflow
  - How hard will the ground shake in the future?
- Uses Pegasus and DAGMan for workflow management



Transformation	Tasks	Runtime (s)
SGT Extraction	7,000	139
Seismogram Synthesis	420,000	48
Peak Ground Motion	420,000	1
Total Tasks:		847,000
Mean Runtime:		25.45



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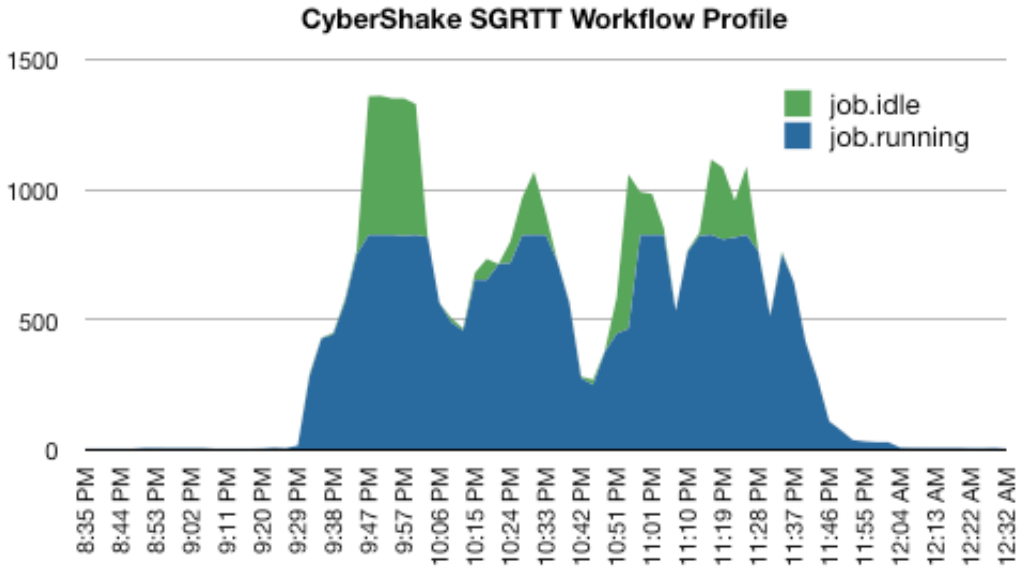
CyberShake Progress

- Using Corral since January
  - Provisioning resources from the TeraGrid
  - Requests: 185
  - Slots: 33,137
  - CPU Hours: 240,496
- Application Progress
  - Jan 2009-Apr 2009
    - Tasks: >11.3M
    - Jobs: >352K
  - May 2009 (planned)
    - Tasks: ~168M
    - Jobs: ~5M



- With glideins a site can be completed in ~3 hours on 800 cores (down from 18+ hours)

Future Work

- Dynamic Provisioning
  - Automatically grow/shrink pool according to application needs
- Support for other features
  - GSI security
  - CCB for firewall traversal (GCB already)
  - Grid matchmaking
  - Parallel universe
- Remote Pool?
  - Deploy Collector/Negotiator/Schedd as well

Try it out

- Website:
  - http://pegasus.isi.edu/corral
- Problems:
  - juve@usc.edu

Questions?