SPRUCE
Special PRiority and Urgent Computing Environment
http://spruce.uchicago.edu

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Computer Modeling and Simulation is a Critical Part of Decision Making

- Global climate change
- Earthquake modeling
- Flood prediction
- Influenza modeling
- Urban traffic modeling
Urgent Computing: I Need it Now!

• Applications with dynamic data and result deadlines are being deployed

• Late results are useless
  - Wildfire path prediction
  - Storm/Flood prediction
  - Influenza modeling

• Some jobs need priority access “Right-of-Way Token”
Example #1

Severe Weather: Predictive Simulation from Real-Time Sensor Input

Source: Kelvin Droegemeier, Center for Analysis and Prediction of Storms (CAPS), University of Oklahoma. Collaboration with LEAD Science Gateway project.

Copyright 2000 Star-Telegram

Map showing the tornado path from 6:18 p.m. to 6:28 p.m.
Example #2

Disaster Incident Response: Urban Airflow Modeling

Source: Alan Huber, National Exposure Research laboratory, Environmental Protection Agency.
Example #3

SURA Coastal Ocean Observing Program (SCOOP)

Source: Center for Computation and Technology, Louisiana State University

University of Alabama at Huntsville, University of Florida, GoMOOS, Louisiana State University, University of Miami, University of Maryland, University of North Carolina, Texas A&M, Virginia Inst of Marine Sciences

CENTER FOR COMPUTATION & TECHNOLOGY AT LOUISIANA STATE UNIVERSITY
How can we get cycles?

- Build supercomputers specifically for the app
  - **Pros**: Resource is ALWAYS available
  - **Cons**: Incredibly costly (99% idle)
  - **Example**: Coast Guard rescue boats
- Share existing resources (public infrastructure)
  - **Pros**: low cost
  - **Cons**: Requires complex system for authorization, resource mgmt, and control
  - **Examples**: school buses for evacuation, cruise ships for temporary housing, SPRUCE
Introducing SPRUCE

• The Vision:
  ◦ Build cohesive infrastructure that can provide urgent computing cycles for emergencies

• Technical Challenges:
  ◦ Provide high degree of reliability
  ◦ Elevated priority mechanisms
  ◦ Resource selection, data movement

• Social Challenges:
  ◦ Who can use the system? When? What?
  ◦ How will emergency use impact regular use?
  ◦ Decision-making, workflow, and interpretation
Are there existing systems that we can use for a model?
Existing “Digital Right-of-Way” Emergency Phone System

GETS is a "ubiquitous" service in the Public Switched Telephone Network...if you can get a DIAL TONE, you can make a GETS call

**Government Emergency Telecommunications Service**

1234 5678 9012

**Name:** GETS USER

**Organization:** GETS USER ORGANIZATION

Calling cards are in widespread use and easily understood by the NS/EP User, simplifying GETS usage

GETS priority is invoked “call-by-call”

Dial 1-710-NCS-GETS (627-4387)

At the tone, enter your PIN.

When prompted, dial your destination number (area code + number).

If you cannot complete a call, use a different long distance carrier:

- **AT&T:** 1010 + 288
- **MCI:** 1010 + 222
- **Sprint:** 1010 + 333

- **-or-** 1-888-288-4387
- **-or-** 1-800-900-4387
- **-or-** 1-800-257-8373

From a Wireless Priority Service enabled device:

Dial *272 before any call, including a GETS call.

**Assistance:** For help or to report trouble, dial 1-800-818-GETS (4387) or 1-703-818-GETS (4387).

**Test Calls:** Make periodic GETS calls to 703-818-3924.

US GOVERNMENT PROPERTY. If found, return to:
NCS (N3), PO Box 4502, Arlington, VA 22204-4502

WARNING: For Official Use Only by Authorized Personnel.
SPRUCE “Right-of-Way” Tokens

- **Priority Levels**
  - yellow, orange, red
- **Life Time**

- **Resource Sets**
  - UC/ANL ia64, ia32 etc
- **Expiration Date**
SPRUCE Architecture Overview (1/3)
Right-of-Way Tokens

Event

1. Automated Trigger
2. Human Trigger

First Responder

SPRUCE
Science Gateway

SPRUCE: Urgent Computing
SPRUCE Architecture Overview (2/3)
Submitting Urgent Jobs

1. User Team
2. Urgent Computing Job Submission
3. Choose a Resource
4. Authentication
5. Priority Job Queue
6. Local Site Policies
7. Supercomputer Resource

Conventional Job Submission Parameters
Urgent Computing Parameters
SPRUCE Architecture Overview (3/3) Analyzing Urgent Jobs

1. Supercomputer Resource
2. Results
3. Domain Specialist Interpreter
4. Decision Maker
5. Analyzing Urgent Jobs

SPRUCE: Urgent Computing
Summary of Components

[portal]
- Token management
  - Admin, user, remote

[configuration & policy]
- Priority queue and local policies

[installed software]
- Authorization & management for job submission and queuing
Site–Local Response Policies: How will Urgent Computing be treated?

- “Next-to-run” status for priority queue; wait for running jobs to complete
- Force checkpoint of existing jobs; run urgent job
- Suspend current job in memory (kill –STOP); run urgent job
- Kill all jobs immediately; run urgent job

- Provide differentiated CPU accounting
  - “jobs that can be killed because they maintain their own checkpoints will be charged 20% less”
- Other incentives
Emergency Preparedness Testing: “Warm Standby” (future work)

- In urgent computing situation, there is no time to port applications
  - Applications must be in “warm standby”
  - Verification and validation runs test readiness periodically
  - Only verified apps participate in urgent computing

- Grid-wide Information Catalog
  - Application was last tested & validated on <date>
  - Also provides key success/failure history logs
Choosing a Resource (future work)

**Deadlines and Urgency Levels**

- **Urgency Level**
  - 59%
  - 78%
  - 98%
  - 95%

**Platform**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Next Available Job (Policy Based)</th>
<th>…</th>
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</thead>
<tbody>
<tr>
<td>NCSA::Cobalt</td>
<td>Immediate</td>
<td>…</td>
</tr>
<tr>
<td>SDSC::Datastar</td>
<td>(5.3 hrs, 1024 nodes)</td>
<td>…</td>
</tr>
<tr>
<td>PSC::Rachel</td>
<td>Immediate</td>
<td>…</td>
</tr>
</tbody>
</table>

**Live Job/Queue Data**

- **30 days ago**
  - Tornado
  - Influenza

- **14 days ago**
  - City Airflow

**Validated Apps.**

- Normal priority, no SPRUCE support [SDSC::Elimidata]

**Policy**

- **Tornado**
  - Immediate

**Site Policies**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Policy</th>
<th>…</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCSA::Cobalt</td>
<td>Human-in-the-loop, immediate access, kill existing jobs, 15 min. turnaround</td>
<td>…</td>
</tr>
<tr>
<td>SDSC::Datastar</td>
<td>Automated, next job</td>
<td>…</td>
</tr>
<tr>
<td>SDSC::Elimidata</td>
<td>Normal priority, no SPRUCE support</td>
<td>…</td>
</tr>
<tr>
<td>PSC::Rachel</td>
<td>Automated, immediate access, kill existing jobs, 10 min turnaround</td>
<td>…</td>
</tr>
</tbody>
</table>

**Live Job/Queue Data**

- **5.3 hrs, 1024 nodes**

**Warm Standby Validation History**

<table>
<thead>
<tr>
<th>Platform</th>
<th>App.</th>
<th>Validated</th>
<th>Reliability</th>
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</thead>
<tbody>
<tr>
<td>NCSA::Cobalt</td>
<td>Tornado</td>
<td>8 days ago</td>
<td>95%</td>
</tr>
<tr>
<td>NCSA::Cobalt</td>
<td>City Airflow</td>
<td>14 days ago</td>
<td>98%</td>
</tr>
<tr>
<td>SDSC::Elimidata</td>
<td>City Airflow</td>
<td>45 days ago</td>
<td>78%</td>
</tr>
<tr>
<td>SDSC::Elimidata</td>
<td>Influenza</td>
<td>30 days ago</td>
<td>59%</td>
</tr>
</tbody>
</table>

**Best HPC Resource**

**Advisor**

**User Team**

**MDS4 Service**

**SPRUCE Data**

**Choosing a Resource**

- Immediate
  - 8 days ago
  - NCSA::Cobalt
  - City Airflow
  - validated
  - 98%

- Immediate
  - 30 days ago
  - SDSC::Elimidata
  - Influenza
  - validated
  - 59%
Direct SPRUCE Job Submission (No Grid Middleware)

# spruce_sub urgency=red spruce_test.pbs

No Valid Token found for user = snadella, aborting job submission

<validate token at SPRUCE gateway>

# spruce_sub urgency=red spruce_test.pbs

240559

# qstat

<table>
<thead>
<tr>
<th>JobId</th>
<th>Name</th>
<th>User</th>
<th>S</th>
<th>Queue</th>
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<tbody>
<tr>
<td>240552</td>
<td>Cylinder-1</td>
<td>gustav</td>
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<td>dque</td>
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<td>240556</td>
<td>STDIN</td>
<td>lgrinb</td>
<td>Q</td>
<td>dque</td>
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<tr>
<td>240559</td>
<td>spruce-job</td>
<td>snadella</td>
<td>R</td>
<td>spruce</td>
</tr>
</tbody>
</table>
SPRUCE Job Submission via Globus

```bash
# grid-proxy-init
Enter GRID pass phrase for this identity: *****************
Your proxy is valid until: Sat May 29 03:21:30 2006

# cat globus_test.rsl
<...>
(resourceManagerContact =
    tg-grid1.uc.teragrid.org:2120/jobmanager-spruce)
(executable = /home/snadella/spruce/mpihello)
<...>
(urgency = red)
<...>

# globusrun -o -f globus_test.rsl
```
Deployment Status

- Service running at UC/ANL and Purdue TG resources
- In progress at NCSA, TACC, IU TG sites
- Soon to begin at SDSC
- LSU is a non-TG site, adopting the software
- Currently Torque compatible
- Extending to LoadLeveler, LSF, PBS Pro
- Ready to integrate LEAD into SPRUCE
  - First user–customer
  - Warm standby apps
The Future

- Web services interfaces to all the portal functions
- Extended submission schema
- Flexible tokens – aggregation, extension
- Encode local site policies
- Warm standby integration
- Automated ‘advisor’
- Data movement
- Redundancy to avoid downtime of portal
Questions?
Using SPRUCE is simple

Step 1: Activate your token (use the link to the left)

Step 2: Add users to activated session

Step 3: Submit jobs with elevated priority!

For more information, see the User’s Guide
Token Info

Token: 9UBS-MTHR-WU7E-NAGV
      XXXX-XXXX-XXXX-XXXX

Get Info
Token Info

Token not activated

Lifetime 72:00:00
Expiration 2006-12-12 23:00:00
Created 2006-04-25 10:46:51
Issued to suman-lead-ppt-shots

OK
Activate Token

Token: 9UBS-MTHR-WU7E-NAGV

xxxx-xxxx-xxxx-xxxx

Log In
SPRUCE: Urgent Computing for Supercomputers

Activate Token

Activated user successfully

User Count: 1
Issued to: suman-lead-ppt-shots
Time remaining: 71:58:19

Current Users:
- Pete Beckman

DN *
real name *
email *

Reset  Activate  Deactivate  Log Out
SPRUCE: Urgent Computing for Supercomputers

Check Time

DN Beckman/UID=ux454139
OR
Token
xxxx-xxxx-xxxx-xxxx

Check Time
SPRUCE: Urgent Computing for Supercomputers

Check Time

Time remaining (hh:mm:ss) : 71:57:14

OK
## Tokens Table

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<th>Token ID</th>
<th>Token ID</th>
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## Activated Table

Refresh

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<td>9</td>
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Authentications Table

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Failed Authentications Table

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Hierarchical Admin Portal (dev)
# Token Info Table

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<tr>
<th>ID</th>
<th>Token</th>
<th>Lifetime</th>
<th>Created</th>
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### Token Permissions Table

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<th>Site</th>
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<td>TG</td>
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<td>4</td>
<td>8</td>
<td>TG</td>
<td>Purdue</td>
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<td>LA</td>
<td>WOW</td>
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<td>6</td>
<td>10</td>
<td>TG</td>
<td>ANL</td>
<td>jazz</td>
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<td>13</td>
<td>LA</td>
<td>WOW</td>
<td>wow-cluster</td>
</tr>
</tbody>
</table>
Add Token

* Token
[xxxx-xxxx-xxxx-xxxx]

* Lifetime
[hh:mm:ss]
min: 01:00:00
max: 72:00:00

* Expiration
[yyyy-mm-dd hh:mm:ss]
min: three days in the future

* Issued To
[max 255]

* Maximum Urgency
[yellow]

* Token Permissions

<table>
<thead>
<tr>
<th>Site</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANL</td>
<td>jazz</td>
</tr>
<tr>
<td>Purdue</td>
<td>cerias-cluster</td>
</tr>
</tbody>
</table>

Add Token
## Manage Admins

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Email</th>
<th>User Name</th>
<th>VO</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivan Beschastnikh</td>
<td><a href="mailto:ivan@uchicago.edu">ivan@uchicago.edu</a></td>
<td>ivan</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>TG Test Admin</td>
<td><a href="mailto:spruce_admin@teragrid.org">spruce_admin@teragrid.org</a></td>
<td>tg_admin</td>
<td>TG</td>
<td>*</td>
</tr>
<tr>
<td>ANL Test Admin</td>
<td><a href="mailto:spruce_admin@mcs.anl.gov">spruce_admin@mcs.anl.gov</a></td>
<td>anl_admin</td>
<td>TG</td>
<td>ANL</td>
</tr>
<tr>
<td>Suman Nadella</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
<td>suman</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nick Trebon</td>
<td><a href="mailto:ntrebon@mcs.anl.gov">ntrebon@mcs.anl.gov</a></td>
<td>nick</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Pete Beckman</td>
<td><a href="mailto:beckman@mcs.anl.gov">beckman@mcs.anl.gov</a></td>
<td>beckman</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

- **Create Admin**
- **Reset Passwd**
- **Delete Admin**
Misc
Testing and Reporting Framework

Clients
- Web
- Application
- Monitor
- Java GUI

Harness
- Query Interface
- Engine
- Archive Depo

Reporters
- version
- unit
- integrated
- self-sched

Distributed Resources
Technology issues

• Individual distributions
• Installation needs some admin effort
• Limited prototype functionality
• No co – scheduling
• Portal is a point of failure