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

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Argonne National Laboratory
Computer Modeling and Simulation is a Critical Part of Decision Making

- Global climate change
- Earthquake modeling
- Flood prediction
- 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.
Example #2

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
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
  ♦ Data movement, resource selection

• Social Challenges:
  ♦ Who? 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

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

GETS priority is invoked “call-by-call”

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

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Number</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;T</td>
<td>1010 + 288</td>
<td>-or- 1-888-288-4387</td>
</tr>
<tr>
<td>MCI</td>
<td>1010 + 222</td>
<td>-or- 1-800-900-4387</td>
</tr>
<tr>
<td>Sprint</td>
<td>1010 + 333</td>
<td>-or- 1-800-257-8373</td>
</tr>
</tbody>
</table>

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
Admin Portal
SPRUCE Architecture Overview (1/3)
Right-of-Way Tokens

Event

1. Automated Trigger

2. Human Trigger

First Responder

SPRUCE Science Gateway
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
   - Local Site Policies
   - Supercomputer Resource

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

- Token management
  - admin, user, remote

- Priority queue and local policies

- 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
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>
</tr>
</thead>
<tbody>
<tr>
<td>240552</td>
<td>Cylinder-1</td>
<td>gustav</td>
<td>Q</td>
<td>dque</td>
</tr>
<tr>
<td>240556</td>
<td>STDIN</td>
<td>lgrinb</td>
<td>Q</td>
<td>dque</td>
</tr>
<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

# 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

- Running on TG sites – UC/ANL, Purdue, TACC, SDSC
- In progress at NCSA, Indiana
- LSU is a non-TG site, adopting the software
- Torque, PBS Pro, LoadLeveler, LSF
- Web services interface to all portal functions
- Ready to integrate LEAD and SCOOP into SPRUCE
  - First user-customers
  - Warm standby apps
The Future

- Extended submission schema
- Flexible tokens – aggregation, extension
- Encode local site policies
- Warm standby integration
- Automated ‘advisor’
- Data movement
Questions?

spruce@ci.uchicago.edu

http://spruce.uchicago.edu
SPRUCE: Urgent Computing for Supercomputers

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
SPRUCE: Urgent Computing for Supercomputers

Token Info

Token 9UBS-MTHR-WU7E-NAGV

Get Info

xxxx-xxxx-xxxx-xxxx
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
SPRUCE: Urgent Computing for Supercomputers

Activate Token

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

Log In
SPRUCE: Urgent Computing for Supercomputers

Activate Token

User Count: 0
Issued to: suman-lead-ppt-shots
Time remaining: 72:00:00

Current Users

DN *
/C=US/O=SDSC/OU=SDSC/CN=Peter Beckman/UID=ux454139

real name *
Pete Beckman

email *
beckman@mcs.anl.gov

Reset | Activate | Deactivate | Log Out
**Spruce: Urgent Computing for Supercomputers**

**Activate Token**

Activated user successfully

<table>
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<th>Value</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>Issued to</td>
<td>suman-lead-ppt-shots</td>
</tr>
<tr>
<td>Time remaining</td>
<td>71:58:19</td>
</tr>
</tbody>
</table>

**Current Users**

<table>
<thead>
<tr>
<th>DN</th>
<th>Real Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pete Beckman</td>
</tr>
</tbody>
</table>

**Options**

- Reset
- Activate
- Deactivate
- Log Out
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
<table>
<thead>
<tr>
<th>Token ID</th>
<th>Token</th>
<th>Activation Time 1</th>
<th>Activation Time 2</th>
<th>Activation Time 3</th>
<th>IP Address</th>
<th>Username</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7X6T-PEQN-Z7K4-4Y95</td>
<td>11:19:57</td>
<td>12:00:00</td>
<td>11:50:26</td>
<td>128.135.219.122</td>
<td>ivan_testing</td>
</tr>
<tr>
<td>3</td>
<td>R5CE-7DBB-C8PC-5285</td>
<td>12:12:41</td>
<td>13:00:00</td>
<td></td>
<td></td>
<td>ivan_testing</td>
</tr>
<tr>
<td>4</td>
<td>697C-TG7N-E3BP-6G57</td>
<td>12:14:52</td>
<td>12:00:00</td>
<td></td>
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<tr>
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<td>12:15:21</td>
<td>12:00:00</td>
<td></td>
<td></td>
<td>ivan_testing</td>
</tr>
<tr>
<td>6</td>
<td>BZWB-BPWB-PPQD-E758</td>
<td>09:37:28</td>
<td>23:00:00</td>
<td></td>
<td></td>
<td>suman</td>
</tr>
<tr>
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<td>UQ56-WRBP-CSHY-KJFN</td>
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<td>12:00:00</td>
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<tr>
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<tr>
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<td></td>
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<tr>
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<td>23:00:00</td>
<td>10:50:09</td>
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## Activated Table

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<th>user_id</th>
<th>deactivation_date</th>
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<tbody>
<tr>
<td>8</td>
<td>1</td>
<td>7</td>
<td>/C=US/O=SDSC/OU=SDSC/CN=Ivan Beschastnikh/USERID=bestchai 2006-03-10 18:36:28</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>9</td>
<td>ivan hello</td>
</tr>
<tr>
<td>17</td>
<td>9</td>
<td>13</td>
<td>/C=US/O=SDSC/OU=SDSC/CN=User One/UID=user1 2006-04-21 10:16:33</td>
</tr>
<tr>
<td>19</td>
<td>10</td>
<td>14</td>
<td>/C=US/O=SDSC/OU=SDSC/CN=Peter Beckman/UID=ux454139 2006-04-28 10:50:09</td>
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### Authentications Table

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<tbody>
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</tr>
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<tr>
<td>3</td>
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<td>192.5.198.198</td>
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<td>192.5.198.197</td>
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### Failed Authentications Table

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</tr>
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</tr>
</tbody>
</table>
Hierarchical Admin Portal (dev)
# Token Info Table

<table>
<thead>
<tr>
<th>ID</th>
<th>Token</th>
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<th>Created</th>
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<th>Activated</th>
<th>Activation IP</th>
<th>Issued To</th>
<th>Issued By</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>9ZDP-93K8-EG73-X63Y</td>
<td>72:00:00</td>
<td>2006-04-11</td>
<td>2006-04-30</td>
<td>2006-04-20</td>
<td>69.209.214.46</td>
<td>ivan orange testing</td>
<td>Ivan Beschastnikh</td>
</tr>
<tr>
<td>12</td>
<td>SAZF-Y8TL-GP5S-R2Y3</td>
<td>72:00:00</td>
<td>2006-04-11</td>
<td>2006-04-30</td>
<td>2006-04-20</td>
<td>128.135.219.155</td>
<td>ivan red testing</td>
<td>Ivan Beschastnikh</td>
</tr>
<tr>
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<td>2006-04-30</td>
<td>2006-04-20</td>
<td>128.135.219.155</td>
<td>ivan</td>
<td>Ivan Beschastnikh</td>
</tr>
<tr>
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<td>Ivan Beschastnikh</td>
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<tr>
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<td>72:00:00</td>
<td>2006-04-09</td>
<td>2006-04-30</td>
<td>2006-04-20</td>
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<td>Ivan Beschastnikh</td>
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<td>2006-12-12</td>
<td></td>
<td></td>
<td>suman_test</td>
<td>Suman Nadella</td>
</tr>
</tbody>
</table>
## Token Permissions Table

<table>
<thead>
<tr>
<th>Perm id</th>
<th>Token</th>
<th>Virtual Org</th>
<th>Site</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>LA</td>
<td>WOW</td>
<td>wow-cluster</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>TG</td>
<td>ANL</td>
<td>jazz</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>TG</td>
<td>Purdue</td>
<td>cerias-cluster</td>
</tr>
<tr>
<td>4</td>
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<td>TG</td>
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<tr>
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<td>wow-cluster</td>
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<tr>
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<td>wow-cluster</td>
</tr>
<tr>
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<tr>
<td>10</td>
<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
  TC

Site
  ANL
  Purdue

Resource
  jazz

server-1.crias-cluster

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>ANL</td>
<td>*</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>
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<tr>
<td>Nick Trebon</td>
<td><a href="mailto:ntrebon@mcs.anl.gov">ntrebon@mcs.anl.gov</a></td>
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<td>*</td>
<td>*</td>
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<tr>
<td>Pete Beckman</td>
<td><a href="mailto:beckran@mcs.anl.gov">beckran@mcs.anl.gov</a></td>
<td>beckran</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

### Buttons
- Create Admin
- Reset Passwd
- Delete Admin
Testing and Reporting Framework

Clients
- Web
- Application
- Monitor
- Java GUI

Harness
- Query Interface
- Engine
- Archive Depot

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