SPRUCE
Special PRiority and Urgent Computing Environment
http://spruce.teragrid.org/

Pete Beckman
Argonne National Laboratory
University of Chicago
Computer Modeling and Simulation is a Critical Part of Decision Making
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

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
How can we get cycles?

• Build supercomputers for the app
  - Pros: Resource is ALWAYS available
  - Cons: Incredibly costly (99% idle)
  - Example: Coast Guard rescue boats

• Share 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
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? When? What?
  - How will emergency use impact regular use?
  - Decision-making, workflow, and interpretation
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:
AT&T: 1010 + 288
MCI: 1010 + 222 +1-710-627-4387
Sprint: 1010 + 333 -or- 1-800-288-4387
- 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 Architecture Overview (1/3)
Right-of-Way Tokens

Event

1. Automated Trigger
2. First Responder

SPRUCE Gateway / Web Services

Right-of-Way Token

Human Trigger
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

Supercomputer Resource

Conventional Job Submission Parameters

Urgent Computing Parameters

SPRUCE Job Manager

Local Site Policies
SPRUCE Architecture Overview (3/3)  
Analyzing Urgent Jobs
SPRUCE Services

• Web Services:
  ✷ ‘Plug-n-Go’ model for dynamic workflows
  ✷ All portal functions running as WS
  ✷ Apache AXIS 2

• User Portal:
  ✷ For users who prefer manual operations
  ✷ AJAX interfaces for ease of use

• Admin Portal:
  ✷ Site admins have logins
  ✷ Can manage tokens and monitor usage
  ✷ Hierarchical access model
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)

Urgent Computation Request

Deadline
Urgency Level

Live Job/Queue Data

<table>
<thead>
<tr>
<th>Platform</th>
<th>Next Available Job (Policy Based)</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCSA::Cluster1</td>
<td>Immediate</td>
<td>...</td>
</tr>
<tr>
<td>SDSC::Cluster1</td>
<td>(5.3 hrs, 1024 nodes)</td>
<td></td>
</tr>
<tr>
<td>PSC::Cluster1</td>
<td>Immediate</td>
<td></td>
</tr>
</tbody>
</table>

Site Policies

<table>
<thead>
<tr>
<th>Platform</th>
<th>Policy</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCSA::Cluster1</td>
<td>Human-in-the-loop, immediate access, kill existing jobs, 15 min turn</td>
<td></td>
</tr>
<tr>
<td>SDSC::Cluster2</td>
<td>Automated, next job</td>
<td></td>
</tr>
<tr>
<td>SDSC::Cluster1</td>
<td>Normal priority, no SPRUCE support</td>
<td></td>
</tr>
<tr>
<td>PSC::Cluster1</td>
<td>Automated, immediate access, kill existing jobs, 10 min turnaround</td>
<td></td>
</tr>
</tbody>
</table>

Warm Standby Validation History

<table>
<thead>
<tr>
<th>Platform</th>
<th>App.</th>
<th>Validated</th>
<th>Reliability</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCSA::Cluster1</td>
<td>Tornado</td>
<td>8 days ago</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>NCSA::Cluster1</td>
<td>Airflow</td>
<td>14 days ago</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>SDSC::Cluster2</td>
<td>Airflow</td>
<td>45 days ago</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>SDSC::Cluster2</td>
<td>Influenza</td>
<td>30 days ago</td>
<td>59%</td>
<td></td>
</tr>
</tbody>
</table>
Deployment Status

• Deployed and Available on TeraGrid –
  ▶ UC/ANL
  ▶ NCSA
  ▶ Purdue
  ▶ SDSC
  ▶ TACC

• Ongoing work –
  ▶ Indiana
  ▶ LSU

• Integration into LEAD Portal –
  ▶ First user–customer
The Future

- Extended submission schema
- Flexible tokens – aggregation, extension
- Encode local site policies
- Automated ‘advisor’
- Warm standby integration
- Data movement
- Redundancy to avoid portal downtime
Questions? Ready to Join?

spruce@ci.uchicago.edu
snadella@mcs.anl.gov

http://spruce.teragrid.org/
Screen Shots

LEAD Demo Shots
Experiment Builder Portlet

Experiment Wizard

User: Marcus Christie  Project: SC2008 Tests

Specify a name, description, and select workflow

Name: spruce_demo

Description:

My Workflows (0)

Sample Workflows (4)

Case Study WRF Forecast with ADAS Initialized Data

Description

WRF Forecast with ADAS Initialization and using canned case study data

Terrain_Preprocessor_Service

ADASDataFiles

Config

ADAS_Interpolator_Service

ARPS2WRF_Interpolator_Service
Experiment Builder Portlet

Experiment Wizard

User: Marcus Christie
Project: SC2006 Tests
Name: spruce_demo
Description:
Workflow: Case Study WRF Forecast with ADAS Initialized Data

Start Options

You may choose when you would like your experiment to start.

- [ ] Immediately
- [ ] Based on data mining trigger

[Back] [Next] [Cancel] [Launch]
**Experiment Wizard**

User: Marcus Christie  
Project: SC2006 Tests  
Name: spruce_demo

Description:  
Workflow: Case Study WRF Forecast with ADAS Initialized Data

**Review and Submit**

You may use the "Back" button to change or review in greater detail your selections for this experiment. Optionally, you may start the workflow composer in monitoring mode prior to launching the workflow so that you can see a visualization of the workflow’s progress as well as the workflow’s notifications as they arrive. Once you are satisfied with the workflow’s configuration, click the "Launch" button to start its execution.

- Run this workflow with SPRUCE
  - WQ8U
  - FE6MV
  - AWP7
  - UZXK

< Back  Next >  Cancel  Launch
Screen Shots

Managing Tokens
Token: K8VT-F5FY-NSQD-D6ZS  look up

If you need to go back to the menu, press the User Portal link from the menu. Browser BACK button has no functionality.

Step 1:
Input the token number

Step 2:
Activate your token

Step 3:
Add users (can be done before activation as well)

Step 4:
Submit jobs with elevated priority!
SPRUCE: Special PRiority and Urgent Computing Environment

Token: K8VT-F5FY-NSQD-D6ZS
Fetching Token information...

Status: Activated
Lifetime: 72:00:00
Maximum Urgency: red
Creation date: 2006-09-08 10:57:33.0
Expiration date: 2006-12-12 12:00:00.0
Activation date: 2006-09-08 11:05:03.0
Deactivation date: 2006-09-11 11:05:03.0

Resources on TG:

- ia64 @ ANL
- ia32 @ ANL
- leer @ PUR
- Fast-I0 @ NCSA
- Fast-CPU @ NCSA
- Mer-ia64 @ NCSA

Users:

- Demo User

(Fresh info as of Fri Sep 08 2006 11:30:22 GMT-0500 (CDT))

If you need to go back to the menu, press the User Portal link from the menu. Browser BACK button has no functionality.
SPRUCE: Special PRiority and Urgent Computing Environment

URGENT COMPUTING FOR SUPERCOMPUTERS

Token: K8VT-F5FY-NSQD-D6ZS
Fetching User information...
refresh activate add user

Status: Not yet activated

Comment:
Activating token as a demo.

activate cancel

Lifetime: 72:00:00
Maximum Urgency: red
Creation date: 2006-09-08 10:57:33.0
Expiration date: 2006-12-12 12:00:00.0

Resources on TG:
- ia32 @ ANL
- ia64 @ ANL
- iear @ PUR
- Fast-CPU @ NCSA
- Mer-ia64 @ NCSA
- Fast-IO @ NCSA

Users: there are no users assigned to this token.
(Fresh info as of Fri Sep 08 2006 11:02:34 GMT-0500 (CDT))

If you need to go back to the menu, press the User Portal link from the menu. Browser BACK button has no functionality.
Token: K8VT-F5FY-NSQD-D6ZS
Fetching User information...

refresh check time add user

Status: Activated

Real name: __________________________

Demo User

E-mail: __________________________

user@domain.edu

Identity: /C=US/O=isser/OU=isser/CN=Demo User/UID=duser

add cancel

Lifetime: 72:00:00
Maximum Urgency: red
Creation date: 2006-09-08 10:57:33.0
Expiration date: 2006-12-12 12:00:00.0
Activation date: 2006-09-08 11:05:03.0
Deactivation date: 2006-09-11 11:05:03.0

Resources on TG:
- ia32 @ ANL
- ia64 @ ANL
- lera @ PUR
- Fast-CPU @ NCSA
- Mer-ia64 @ NCSA
- Fast-IO @ NCSA

Users: there are no users assigned to this token.

(Fresh info as of Fri Sep 08 2006 11:05:40 GMT-0500 (CDT))
Screen Shots

Running Urgent Jobs
Direct SPRUCE Job Submission (No Grid Middleware)

`# spruce_sub urgency=red spruce_test.pbs`

No Valid Token found for user = beckman, 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>beckman</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)
(executeable = /home/beckman/spruce/mpihello)
<...>
(urgency = red)
<...>

# globusrun -o -f globus_test.rsl
Screen Shots

Admin Interface
## Tokens Information

### Activated Tokens

<table>
<thead>
<tr>
<th>VO</th>
<th>Token</th>
<th>Lifetime</th>
<th>Created</th>
<th>Expiration</th>
<th>Activated</th>
<th>Activation IP</th>
<th>Issued To</th>
<th>Issued By</th>
<th>Admin Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>TG</td>
<td>9XSQ-UFCA-HFM4-3DWF</td>
<td>72:00:00</td>
<td>2006-11-03</td>
<td>2006-12-12</td>
<td>2006-11-03 14:30:32</td>
<td>128.135.125.142</td>
<td>sdsc_production test</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
<td>Deactivate</td>
</tr>
</tbody>
</table>

### Inactive Tokens

<table>
<thead>
<tr>
<th>VO</th>
<th>Token</th>
<th>Lifetime</th>
<th>Created</th>
<th>Expiration</th>
<th>Issued To</th>
<th>Issued By</th>
</tr>
</thead>
<tbody>
<tr>
<td>TG</td>
<td>TCHE-K3R4-Y74K-JQF7</td>
<td>72:00:00</td>
<td>2006-08-28</td>
<td>2006-12-12</td>
<td>ws_portal-edits</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
</tr>
<tr>
<td>TG</td>
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<td>72:00:00</td>
<td>2006-09-22</td>
<td>2006-12-12</td>
<td>SDSC-Mahichar</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
</tr>
<tr>
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<td>72:00:00</td>
<td>2006-09-22</td>
<td>2006-12-12</td>
<td>SDSC-Mahichar</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
</tr>
<tr>
<td>TG</td>
<td>8LSG-E3EM-UZFP-4EDE</td>
<td>72:00:00</td>
<td>2010-10-04</td>
<td>2010-12-12</td>
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<tr>
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<td>72:00:00</td>
<td>2010-12-12</td>
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<td>ivan-test-portal</td>
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</tr>
<tr>
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</tr>
<tr>
<td>TG</td>
<td>YE2S-FNB4-FW9-3CYK</td>
<td>72:00:00</td>
<td>2012-10-12</td>
<td>2012-12-12</td>
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</tr>
<tr>
<td>TG</td>
<td>WQ8U-P6MV-AWP7-UZKKK</td>
<td>72:00:00</td>
<td>2010-12-12</td>
<td>2012-12-12</td>
<td>marcus</td>
<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
</tr>
</tbody>
</table>

### Deactivated Tokens

<table>
<thead>
<tr>
<th>VO</th>
<th>Token</th>
<th>Lifetime</th>
<th>Created</th>
<th>Activated</th>
<th>Activation IP</th>
<th>Issued To</th>
<th>Issued By</th>
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<tbody>
<tr>
<td>TG</td>
<td>KVRU-Y27Z-E8L2-9VJ5</td>
<td>72:00:00</td>
<td>2006-08-15</td>
<td>2006-08-15 14:15:01</td>
<td>128.135.125.142</td>
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<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
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<tr>
<td>TG</td>
<td>64DC- JLVL-TRRG-YBPR</td>
<td>72:00:00</td>
<td>2006-08-15</td>
<td>2006-08-15 14:24:00</td>
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</tr>
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<td><a href="mailto:snadella@mcs.anl.gov">snadella@mcs.anl.gov</a></td>
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<td>72:00:00</td>
<td>2006-09-29</td>
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<tr>
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</tr>
</tbody>
</table>
# Tokens Information

## Activated Tokens

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<tbody>
<tr>
<td>TG</td>
<td>8SLG-E3EM-UZFP-4EDE</td>
<td>72:00:00</td>
<td>2006-10-04</td>
<td>2006-12-12</td>
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## Deactivated Tokens

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