SPRUCE

A Special PRiority and Urgent Computing Environment for supporting Urgent High-Performance Computing

Ivan Beschastnikh
Computation Institute
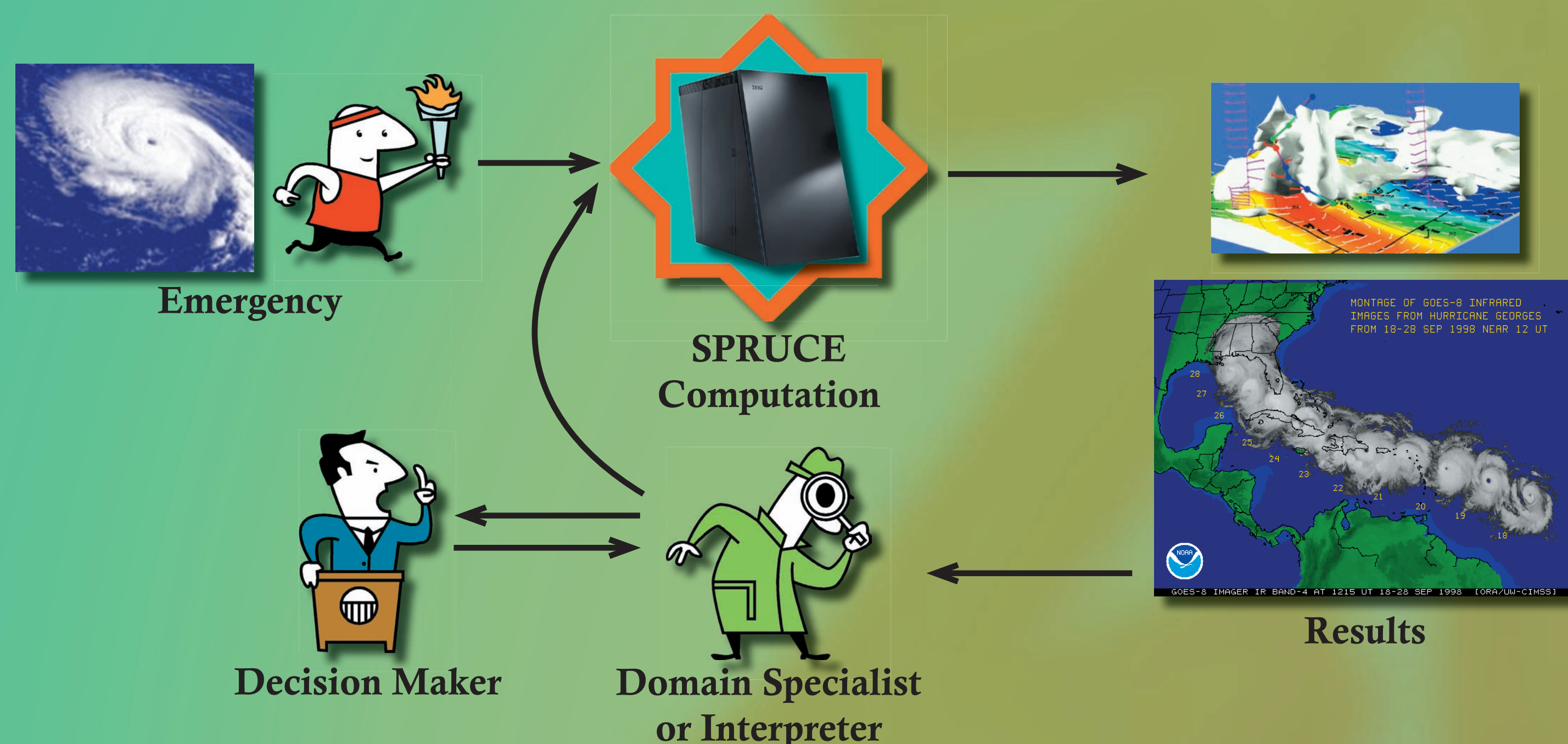The University of Chicago

TeraGrid

Motivation

Modeling and simulation using high-performance computing are playing an increasingly important role in decision-making and prediction. For time-critical emergency decision support applications, such as severe weather prediction, flood and influenza modeling, late results may be useless. A specialized infrastructure is needed to provide computational resources quickly, automatically and reliably. SPRUCE is a system for supporting urgent computing on both traditional supercomputers and distributed Grids.

Deployment Status

SPRUCE is a TeraGrid Science Gateway, currently deployed at the UC/ANL, Purdue and TACC resource providers. Work is in progress to extend the system to include the NCSA, Indiana and SDSC resources. As of now, we support Torque and LSF, and are working on adding support for LoadLeveler and PBS Pro. This poster presents requirements for a system supporting urgent computing and illustrates how the SPRUCE architecture meets these requirements.
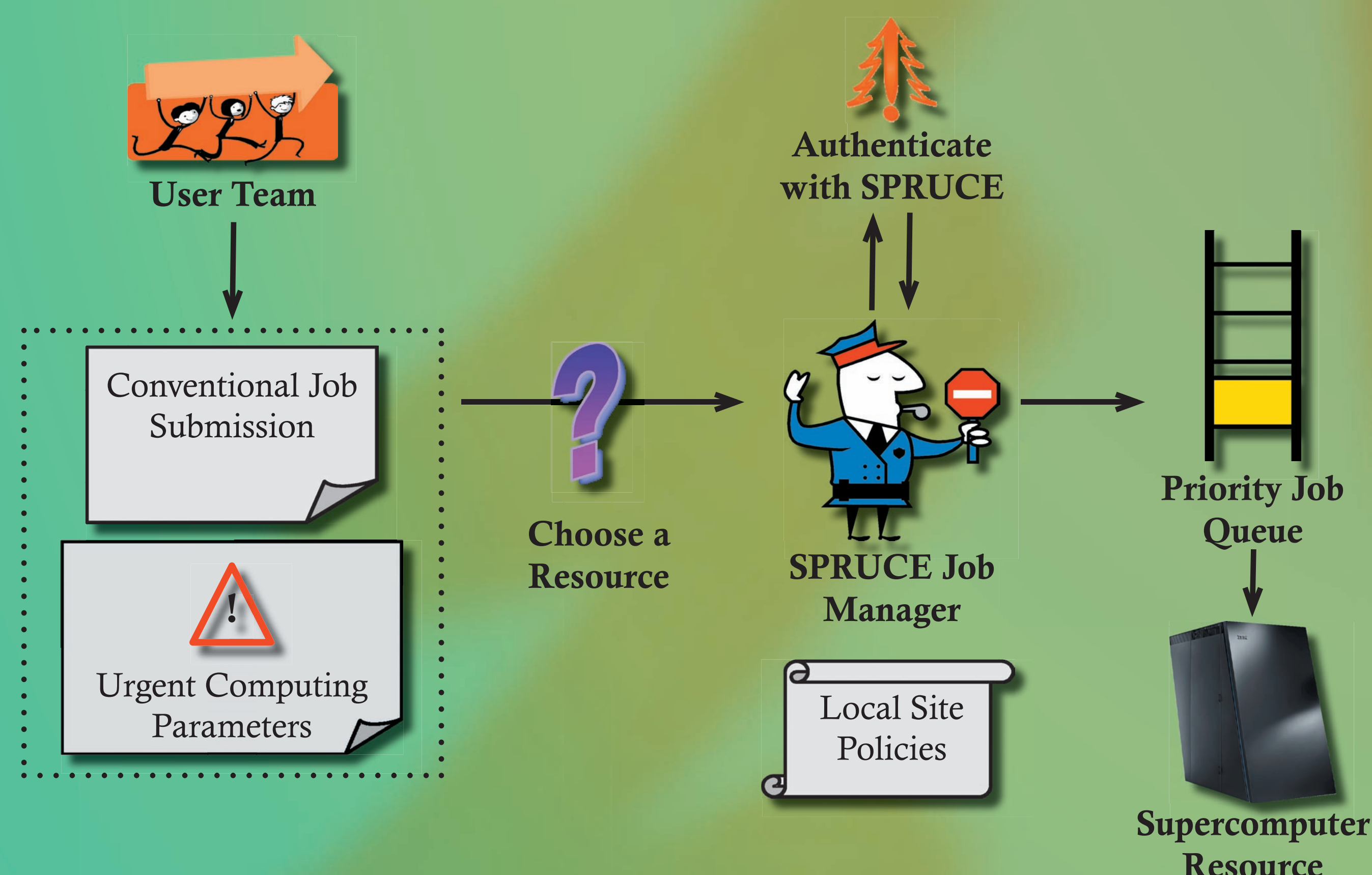
1
- Should leverage existing resources with minimal dependency
- Must integrate into existing dynamic and automated workflows

SPRUCE uses existing resources to provide high priority for emergency applications, and requires minimal changes to existing workflows. Both Grid based (e.g. Globus) as well as direct submission environments are supported. Work is in progress to provide a web services interface to the SPRUCE gateway.

Emergency → SPRUCE Computation → Results

Decision Maker ← Domain Specialist or Interpreter

2
- Allow for a flexible, portable, and secure urgent access method
- Expose functionality through a Gateway for ubiquitous access

SPRUCE provides users with transferable "Right-of-Way" tokens restricted to specific resources and priorities. In case of emergency, tokens can be activated by the first responder at a Web-based SPRUCE gateway. The token holder associates the response team's user identities with the activated token, giving them permission to run urgent jobs. Tokens carry an expiration date and a lifetime during which computations requesting priority access can run.
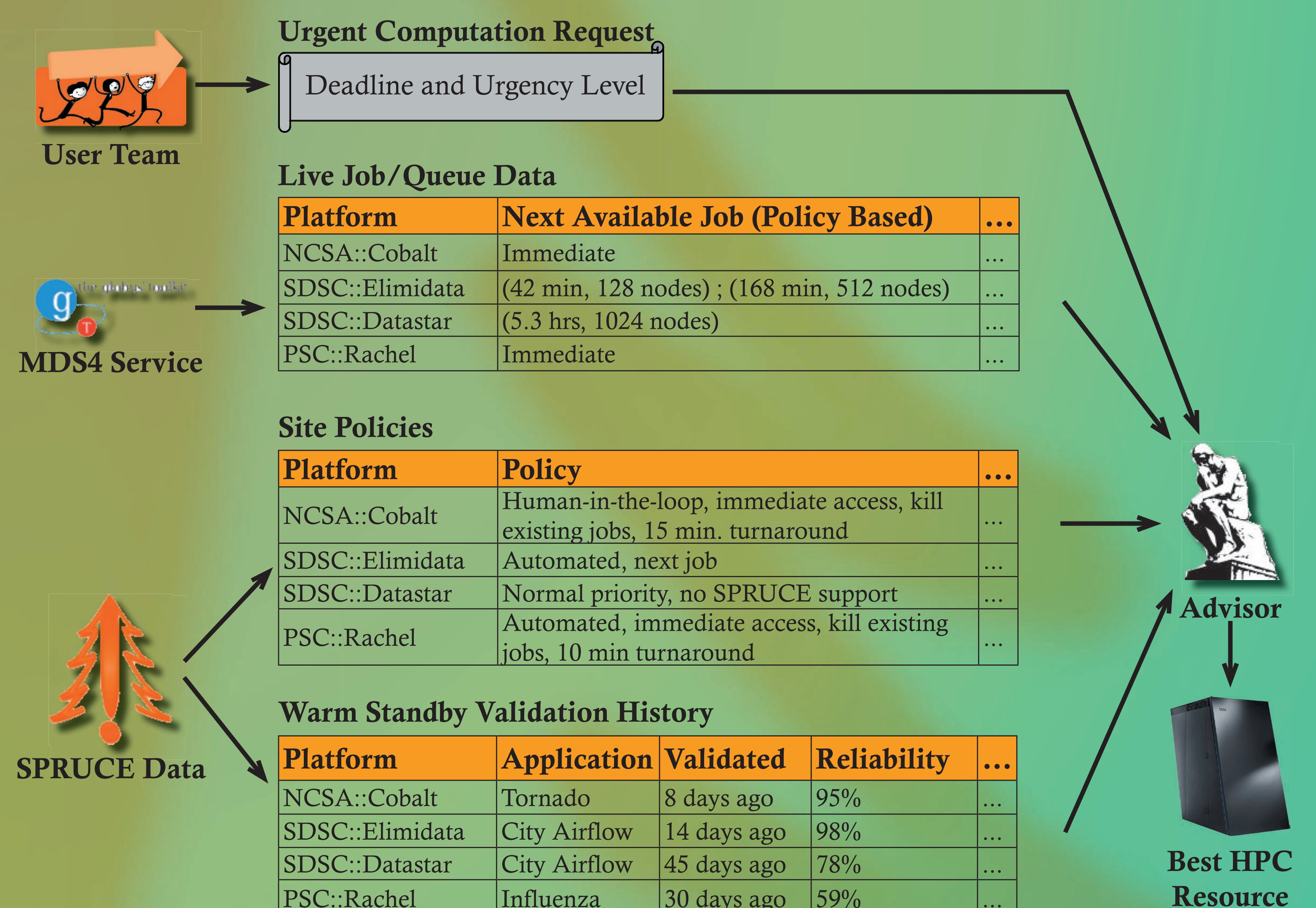
EVENT

Automated Trigger → First Responder → SPRUCE Science Gateway

Human Trigger → SPRUCE Token
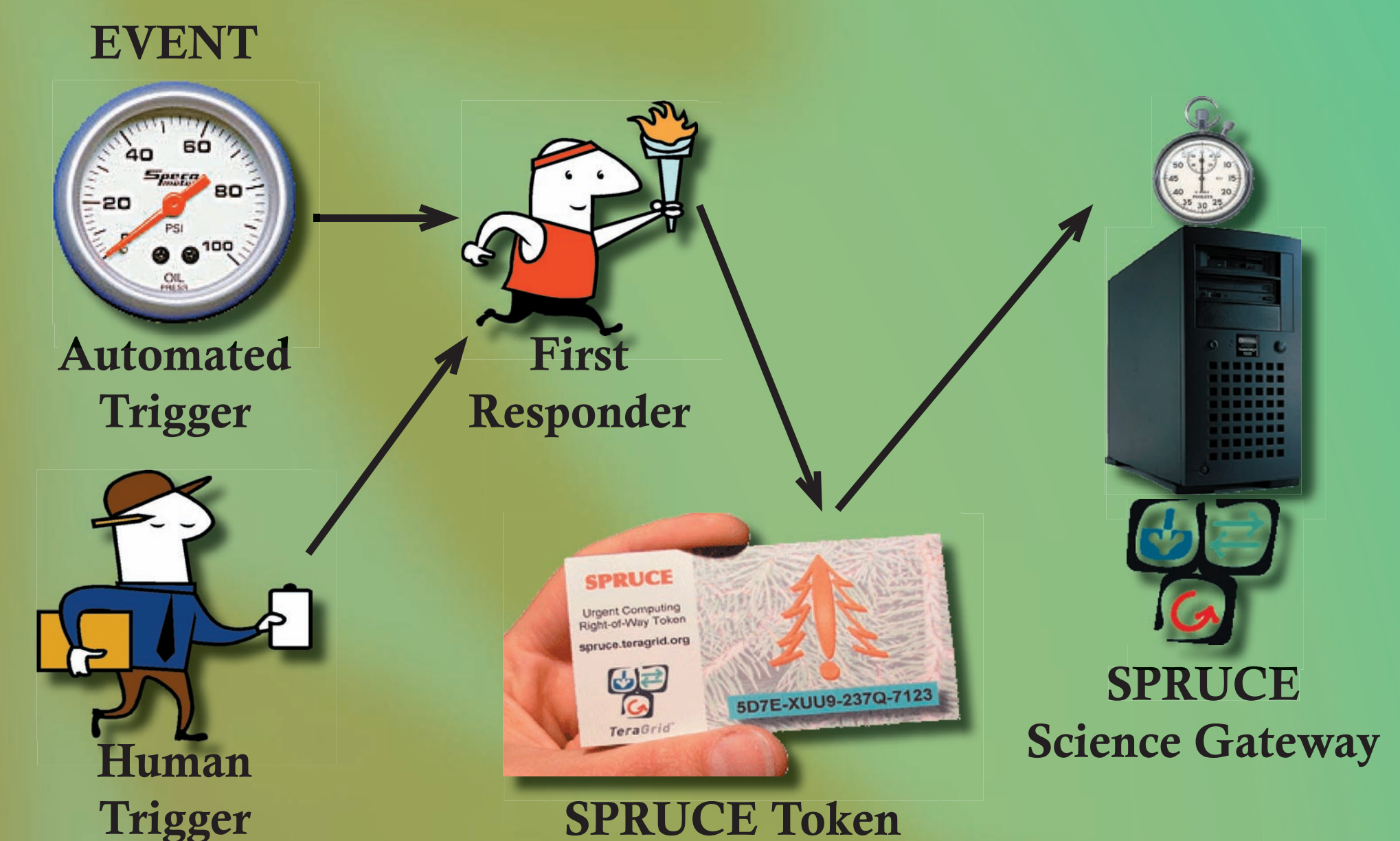
3
- Priority job submission must be simple
- Should support resource providers' policies for handling urgent jobs

Once a user is associated with an active SPRUCE token, an exatr 'urgency' parameter in the job script is all that is necessary to initiate an urgent job run. On submission, the user's identity is authenticated against the SPRUCE Gateway and the SPRUCE job manager implements the policy to grant the necessary access. SPRUCE supports a variety of site-specific policies that dictate the resource response. These may include providing "next-to-run" status or preempting other jobs, and may differ for different priority levels.
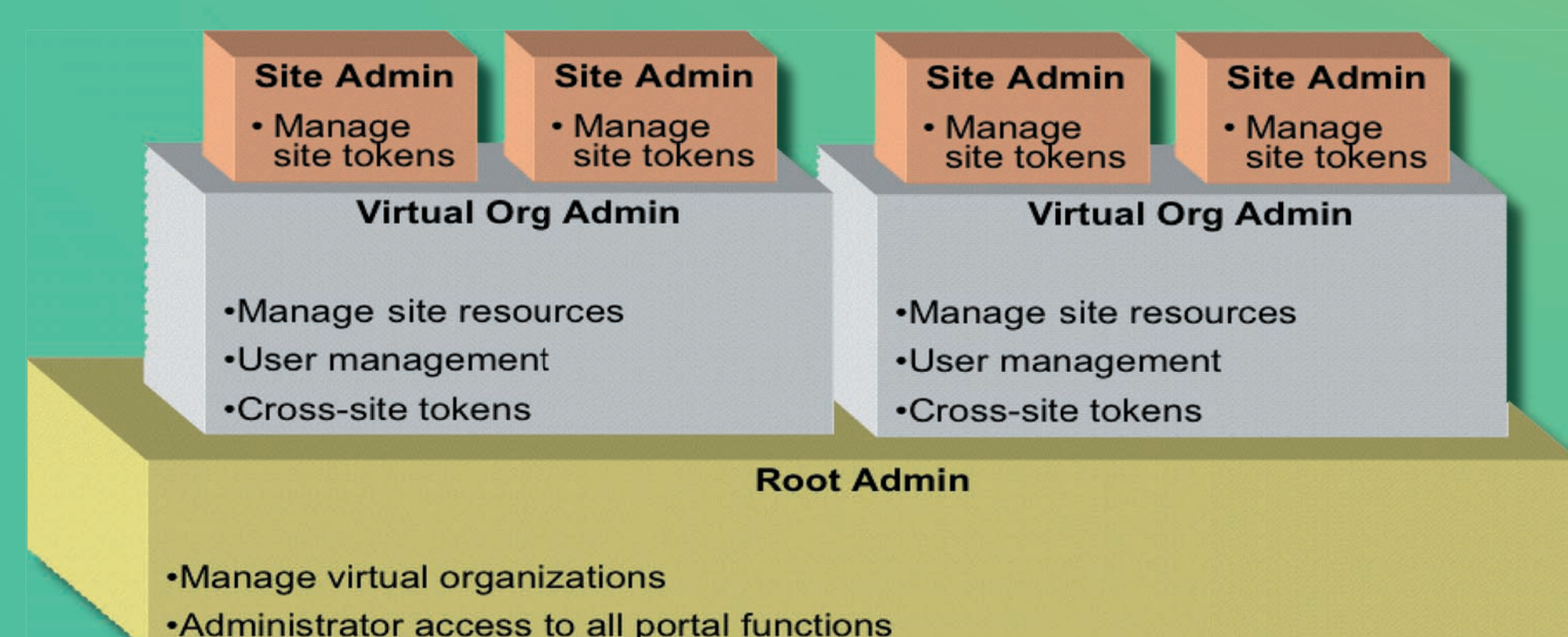
User Team → Conventional Job Submission / Urgent Computing Parameters → Choose a Resource → Authenticate with SPRUCE → SPRUCE Job Manager (Local Site Policies) → Priority Job Queue → Supercomputer Resource

4
- Provide best resource selection based on deadline, previous validation history, queue status, site policy, and other information.

An automated "advisor," currently in development, will help SPRUCE users to determine the best resource based on deadline, queue status, site policy and warm-standby validation history (see 6) at SPRUCE supporting sites.

Urgent Computation Request

User Team → | Deadline and Urgency Level |

Live Job/Queue Data

Platform	Next Available Job (Policy Based)	...
NCSA::Cobalt	Immediate	...
SDSC::Elimidata	(42 min, 128 nodes) ; (168 min, 512 nodes)	...
SDSC::Datastar	(5.3 hrs, 1024 nodes)	...
PSC::Rachel	Immediate	...

MDS4 Service

Site Policies

Platform	Policy	...
NCSA::Cobalt	Human-in-the-loop, immediate access, kill existing jobs, 15 min. turnaround	...
SDSC::Elimidata	Automated, next job	...
SDSC::Datastar	Normal priority, no SPRUCE support	...
PSC::Rachel	Automated, immediate access, kill existing jobs, 10 min turnaround	...

SPRUCE Data

Warm Standby Validation History

Platform	Application	Validated	Reliability	...
NCSA::Cobalt	Tornado	8 days ago	95%	...
SDSC::Elimidata	City Airflow	14 days ago	98%	...
SDSC::Datastar	City Airflow	45 days ago	78%	...
PSC::Rachel	Influenza	30 days ago	59%	...

Advisor → Best HPC Resource

5
- Allow for flexible resource, token, and user management by resource administrators
- Expose complex functionality in a service-oriented way

The SPRUCE Gateway allows for three administrative domains, each of which has token issueing and monitoring powers for their respective resources. Administrators can login and manage tokens, users and usage on their particular site. The Virtual Org (e.g. TeraGrid) administrators can issue cross-site tokens to teams that may require co-scheduling capabilities.
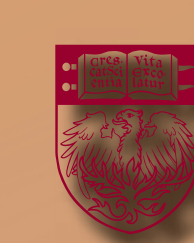
Site Admin
- Manage site tokens

Virtual Org Admin
- Manage site resources
- User management
- Cross-site tokens

Root Admin
- Manage virtual organizations
- Administrator access to all portal functions

6
- Periodic code validation to maintain the user application in ready mode

In the same way that emergency equipment, personnel, and procedures are periodically tested for preparedness and flawless operation, SPRUCE applications are tested in 'warm standby' mode to ensure readiness. The codes are periodically validated and a grid wide catalog with results of the validation runs is published for use by the advisor (see 4). This crucial feature is still in development.

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