

A Quick Tour of LEAD via the LEAD Portal & Application Orchestration

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**Year-2 Site Visit
21-22 July 2005**



Outline

- The Big Picture
- The Portal - overview
- Looking at your MyLEAD space
- How to build a simple workflow
 - Use remote ADaM services to do data mining.
- Creating and running an experiment
 - Launching a large simulation
- Monitoring the performance of WRF



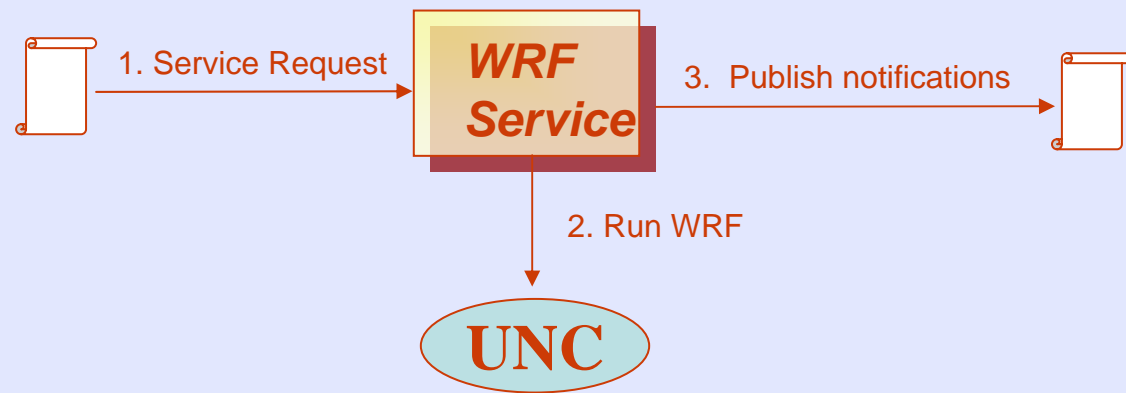
The User Perspective

- The Lead System Portal is designed to allow users to
 - Explore data
 - Compose, run and catalog experiments
 - Learn by interacting with the weather.
- The Foundation of the software is based on the concept of “services” and “service oriented architectures.”



What's a service anyway?

- A “web server” that runs an application for you.
 - You send it requests (XML documents) and it processes the information and send replies (notifications) when it is done.
- More on this concept and service architectures later (Beth's talk)



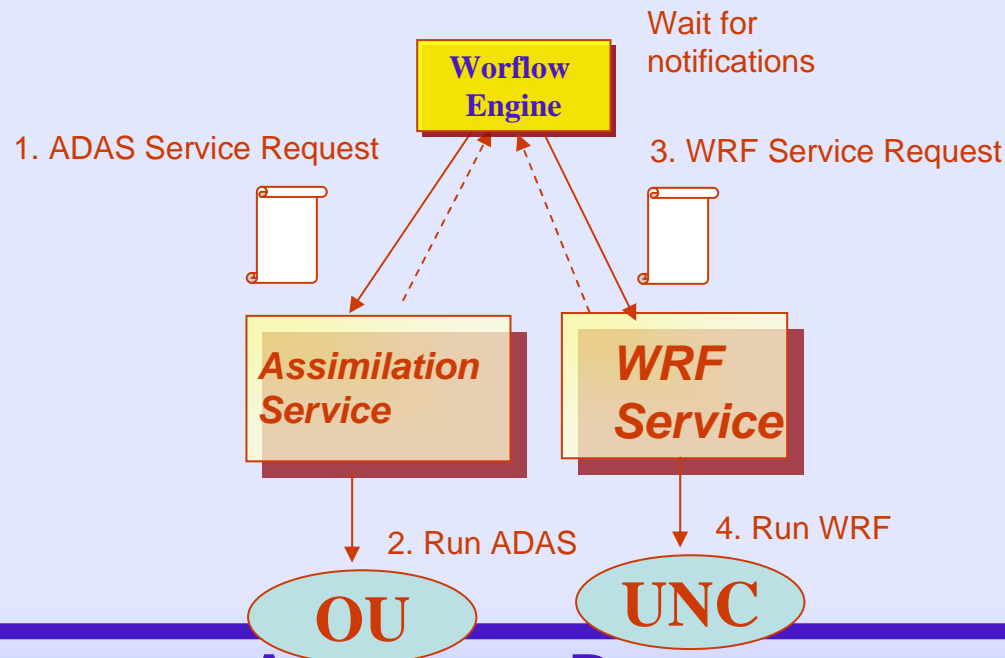
System Architecture Components

- Data Services
 - MyLEAD : a personal metadata catalog
 - Resource Catalog : finding data and services
 - (much more: next talk!)
- Experimental & Workflow Services
 - A way to compose a set of “remote services” into an application.
 - A way to run the application
 - A way to share it with others.



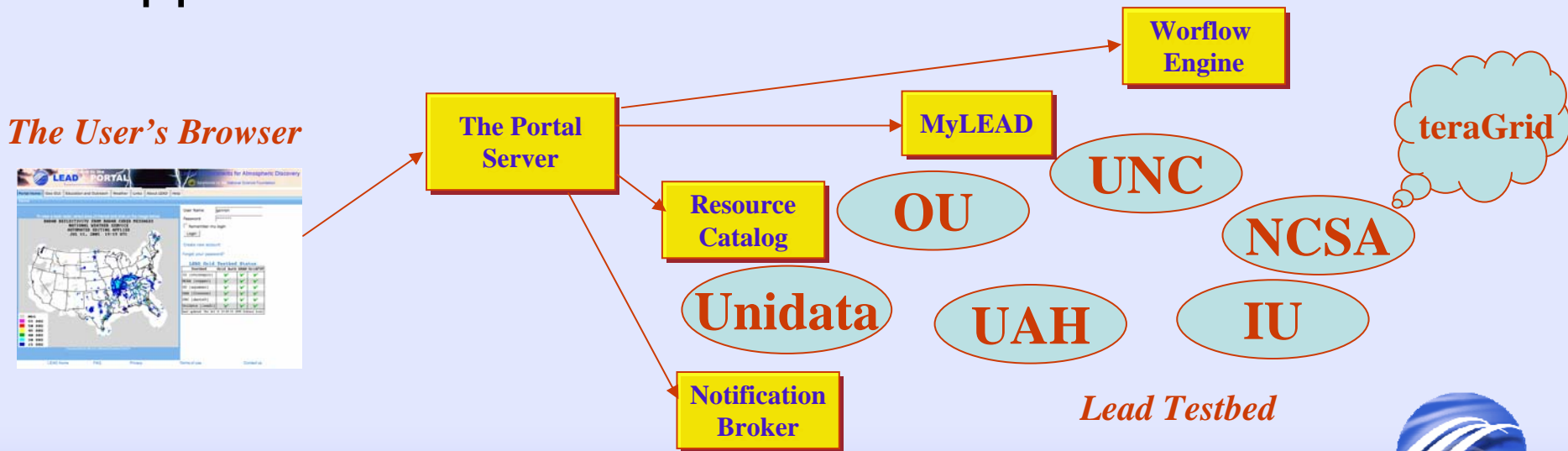
What's a Workflow?

- A sequence of service interactions that are needed to accomplish a bigger task.
 - We use two different workflow systems
 - BPEL & OGRE



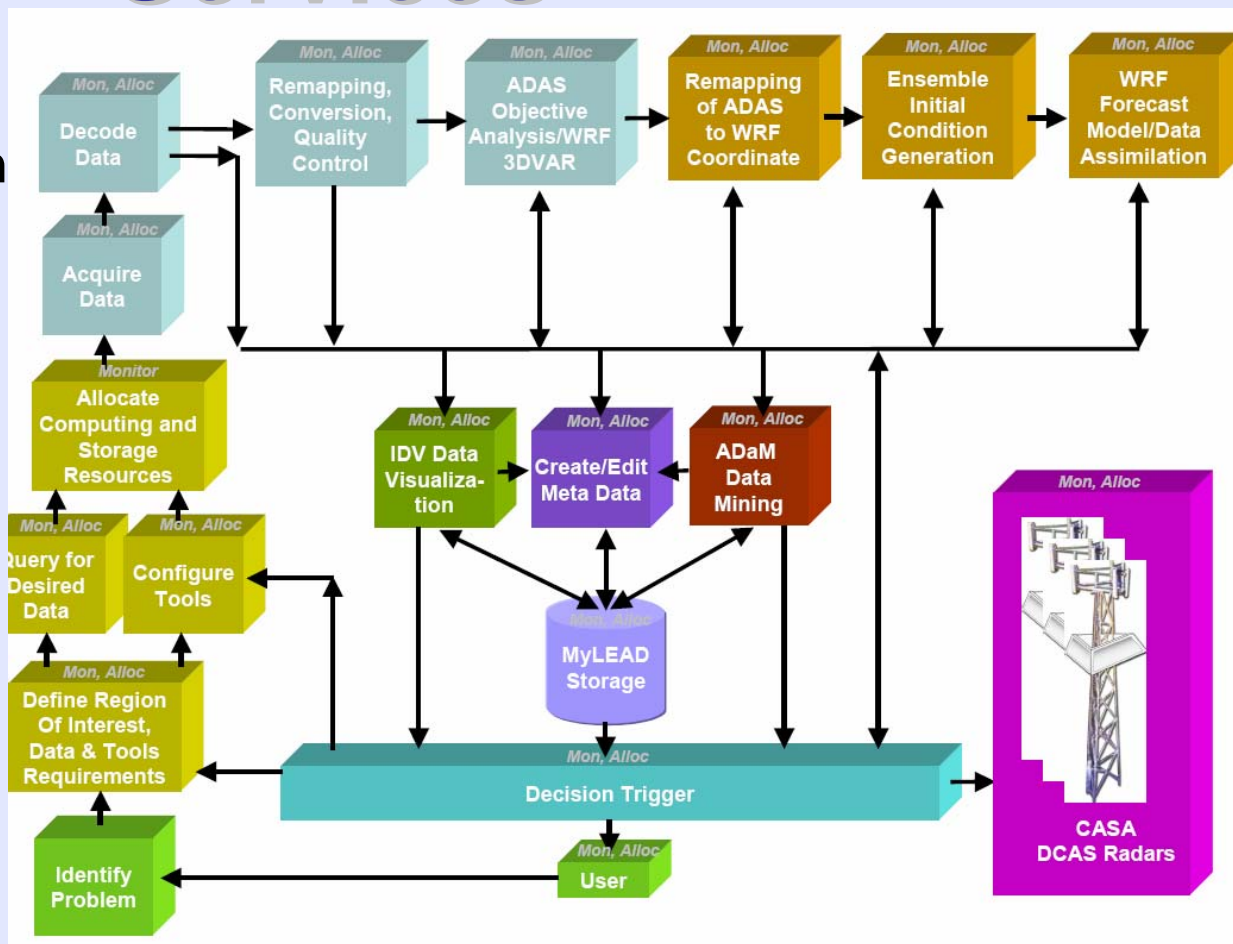
The Portal as a Gateway

- User interacts with a web portal
- The web portal talks to services running on the LEAD testbed “Grid” and, next year, teraGrid!
- These Services manage your data and run the applications



Building an application from Services

- Users create experiments by composing application services into “workflows”
- A workflow can be viewed as a pathway through this picture.
- When combined with data sources it is executed on the computational resources.

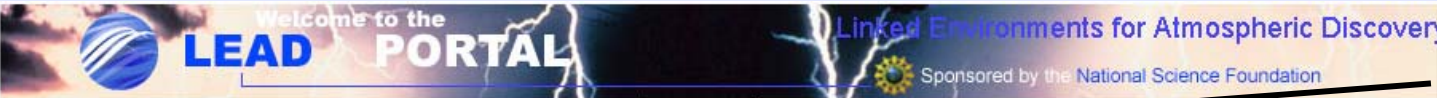


A Quick Look at the portal

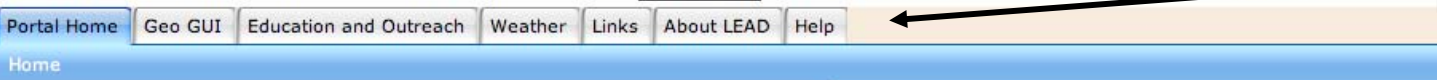
- The top level
 - Access to public resources
 - A look at the Geographic region selector under development
- Logging in
 - Your private view of LEAD.
 - MyLEAD
 - Doing a search over old experiments.
 - A few words about security.



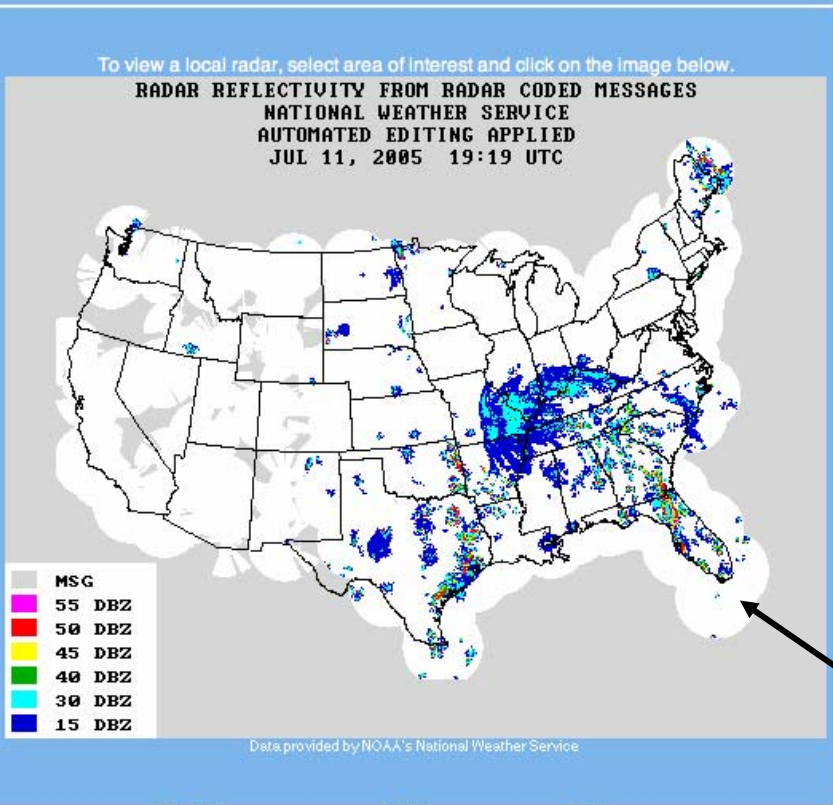
The top level view



Top Level tabs to public Tools and information.



To get to your stuff, log in here Or create a new account



LEAD Grid Testbed Status

Testbed	Grid Auth	GRAM	GridFTP
IU [chinkapin]	✓	✓	✓
NCSA [copper]	✓	✓	✓
OU [aquaman]	✓	✓	✓
UAH [frozone]	✓	✓	✓
UNC [dante0]	✓	✓	✓
Unidata [lead1]	✓	✓	✓

Last updated: Mon Jul 11 14:00:01 2005 Indiana local

The current testbed status

The current weather. Click on a location for more data



GEO Reference GUI Prototype

Portal Home **Geo GUI** Education and Outreach Weather Links About LEAD Help

Geo Reference GUI

initialize

Spatial Extent

Zoom to State(s)

Selection Layers Legend

refresh

Select by Rectangle

Left: -180.0 Top: 90.00
Right: 180.00 Bottom: 0.00

Select by Polygon

(lon, lat) Pairs:

Lon, Lat: -88.2528, 34.4075

Temporal Range

From Date: 07-10-05 Time: 12:00
To Date: 07-11-05 Time: 9:00

Data Products

- Hourly Surface METAR Obs
- 12-hourly UpperAir Balloons (Rawinsondes)
- 5-minute ACARS Commercial Aircraft T, V
- NEXRAD Level II (5-10 min)
- NEXRAD Level III (5-10 min)
- Half-hourly GOES Vis/IR

- Use mouse to drag a region of interest.
- Fill in the data requirements
- The tool, when finished will gather the data for you.



Educational Resources

Portal Home | Geo GUI | Education and Outreach | Weather | Links | About LEAD | Help

Education Home

LEAD Education and Outreach

Home | LEAD Learning Communities | Shared Workspace | News LEADers | LEAD Educator Workshops | Evaluation Rubric

Modules



LEAD Main Home

Lead E&O Vision

IDV Beginner's Tutorial

IDV Webstart Download

IDV Users Guide

Links to Related Material



LEAD is funded by the National Science Foundation

LEAD-TO-LEARN

EXPLORING TEMPERATURE CONTRASTS THROUGH VISUALIZATIONS

Purpose

To introduce students to visualization as a tool for scientific problem solving using temperature data from the [NCEP Eta Model](#) as an example.

Overview

In this learning activity, students will use the [Integrated Data Viewer \(IDV\)](#) tool to visualize temperature data from a numerical model output in order to explore the relationship between temperature contrasts, weather patterns, and geographical features so that important patterns become evident. The IDV will allow the student to visualize how temperature contrasts vary across North America, as well as how they change over time.

Student Outcomes

By exploring a LEAD patterns in the model

Students can analyze visualization as a tool

Science Concepts (General)

Visual models help us

Earth Sciences

Visualizations help or heights above the Ea

Geography

Geographical visualiz

Science Inquiry Ability

Identify answerable q

Design and conduct a

Use appropriate tools

Develop and construc

Think critically and lo

TEMPERATURE WORKSHEET-1.doc

LEAD-TO-LEARN

EXPLORING TEMPERATURE CONTRASTS THROUGH VISUALIZATIONS

WORK SHEET

In this activity you will visualize temperature data from a numerical model and use it to explore the relationship between temperature contrasts, weather patterns, and geographical features.

PART A: Generating the visualization

a. [Launch IDV](#)

b. Four windows should appear: 1) The Display Window, 2) The Data Selector Window, 3) Parameter Control Window, and the User's Guide.

PART B: Orienting and Problem Solving with IDV

a. You will notice that there are regions where the temperature contours are spaced closely together (strong [gradients](#)), and others where they are spread far apart (weak gradients).



Log in and see your MyLEAD Space

Welcome to the **LEAD PORTAL** Linked Environments for Atmospheric Discovery
Sponsored by the National Science Foundation

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MyLEAD Workspace Security

My Workspace Portlet

- myWorkSpace
 - Hurricane Ivan
 - Workflow template vizEta 2004-08-03 13:35:
 - Workflow template ARPS 2004-09-22 05:25:5
 - TestWorkflowTemplate01
 - Experiment: Ensemble run-5
 - Workflow instance ARPS 2004-09-22 05:25
 - Collection: Ensemble Run Input Collection
 - Collection: Case 1
 - Collection: Case 2
 - Collection: Case 3
 - Collection: Case 4
 - Collection: Case 5
 - Experiment: 84hr ARPS forecast
 - Collection: Input Observational for 84hr AR
 - Collection: ARPS-out for 84hr ARPS forecas
 - CompletelyNewExperiment
 - HurricaneExperiment01
 - Mesoscale meteorology for college school stu

Information of your current selection

Desc: 84hr ARPS forecast
ExpDate: 2004-10-28 00:00:00



Searching MyLEAD

MyLEAD Query Client Interface (v0.3alpha)

Your DN
/C=US/O=National Center for Supercomputing Applications

Target: Experiment

Set Creator Search Range

	Month	Day	Year	Hour	Minute	Second	AM/PM
Start:	Jul	19	20...	01	35	20	PM
End:	Jul	19	20...	02	35	20	PM

myLEAD Query Result

myLEAD Query Results

Experiment: test_adas

- **GUID:** E242
- **Description:** testing adas
- **Date Added:** 2005-05-11 00:00:00
- **Experiment Date:** 2005-05-11 00:00:00
- **Attribute:** **WFInstance**
 - Element: **WFInstName** = WRF-Initilization-ADAS_2
 - Element: **WFInstDesc** = Adas components to initialize both arps and wrf
 - Element: **WFInstCont** = Text Details Omitted - Length: 47895

Results Display Options
Target only

Start Over Run Query



The Experiment Builder

- To review your previous experiments and create new ones
- Experiments are organized into projects
 - You can select an old one to look at,
 - Or create a new project or experiment.
 - Let's do a new experiment! (click "new")

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MyWorkspace Experiment Builder Generic Service Toolkit Security

Experiment Builder Portlet

User: Dennis Gannon Project: ADaM Data Mining

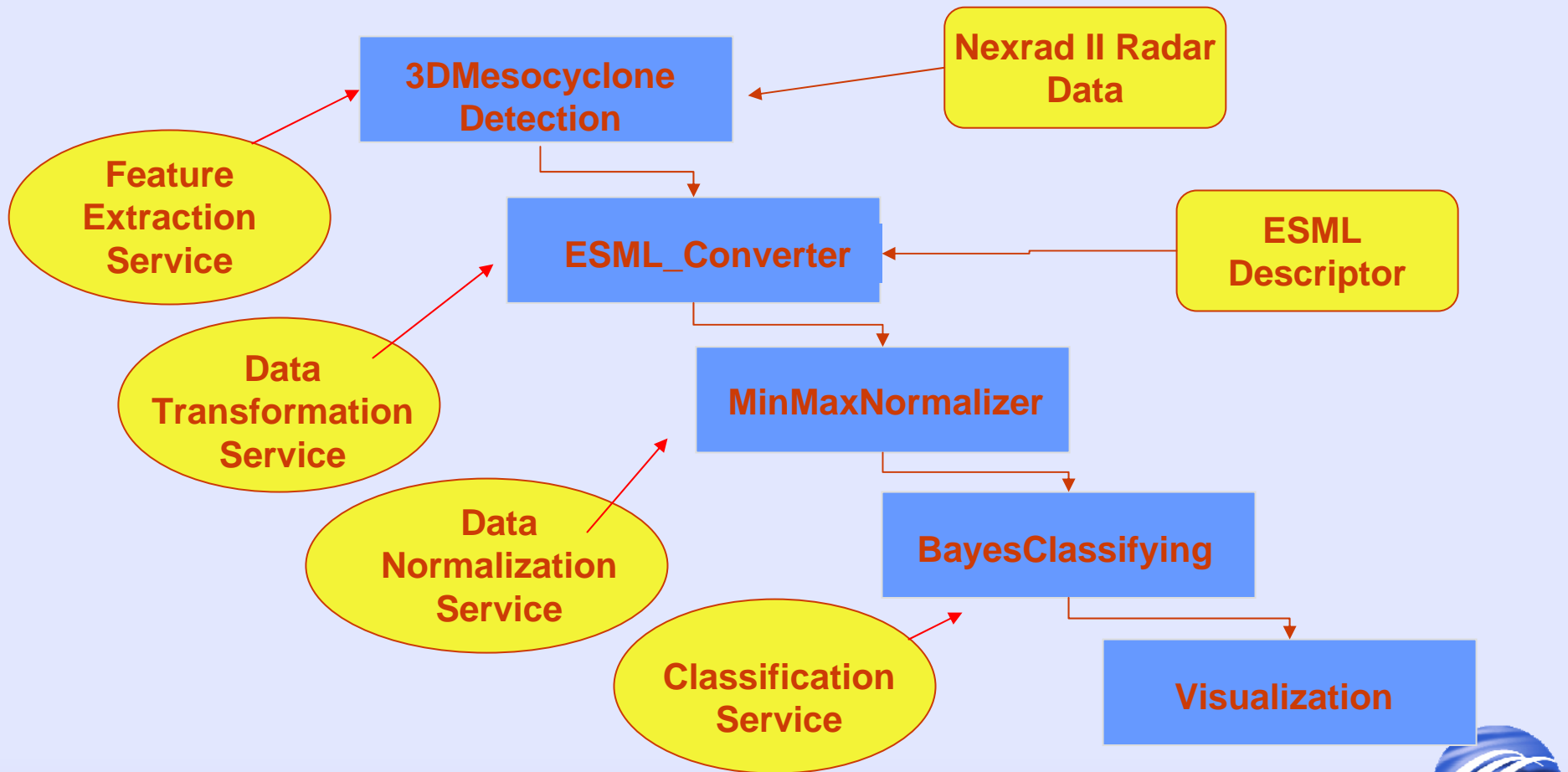
Experiments

Experiment Name	Description	Last Action Time
Simple_ADaM_test	This is a simple ADaM experiment using a fixed data set.	2005-07-20T15:48:46.499-05:00
EZ_ADaM	an easy version of the ADaM demo with canned input	2005-07-20T15:48:47.278-05:00

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Creating a workflow for Data Mining

- Use ADaM services from UAH



Provide a name and description

- Next select an application from the dropdown list or create a new workflow.
- Once we have selected the app, we push “next” to add data.

The screenshot shows the 'Experiment Wizard' interface within the 'Experiment Builder Portlet'. The user is 'Suresh Marru' and the project is 'template_workflows'. The current step is 'Specify a name, description, and select workflow'. The 'Name' field contains 'Datamining_Experiment'. The 'Description' field contains 'This is a test of the ADaM data mining system from UAH. We are using the "ADaM Demo" from the sample workflows.'. The 'Workflow' section has two tabs: 'My Workflows' and 'Sample Workflows'. Under 'Sample Workflows', there is a dropdown menu with 'ADaM Demo' selected and a 'Refresh' button. Below the dropdown is a 'Description' field containing 'Dataming services workflow'. At the bottom right, there are buttons for '< Back', 'Next >', 'Cancel', and 'Launch'.



Composing the Workflow

- Graphical Composer
 - Standard drop-and-drag composer model (like Kepler and others)
 - Compiles Python or PBEL code

The screenshot displays the ADaM graphical composer interface. At the top, there are tabs for 'Workflow', 'MyLead', 'Component', and 'Monitor'. Below these are buttons for 'Add Node', 'Remove Node', and 'Connect/Disconnect'. The main workspace is titled 'Composer' and shows a workflow diagram with two components: 'Output_Dir Config' and 'ADaM-FeatureExtraction'. A connection line links the 'Config' port of 'Output_Dir' to the 'Output_Dir' port of 'ADaM-FeatureExtraction'. On the left, the 'Component List' pane shows a tree view of components, with 'ADaM-FeatureExtraction' selected. Below the list is the 'Component Information' pane, which is split into two sections: 'Selected Output Port' and 'Selected Input Port'. The 'Selected Output Port' section shows details for the 'Output_Dir' component, including its port name 'Parameter', type 'any', and description. The 'Selected Input Port' section shows details for the 'ADaM-FeatureExtraction' component, including its port name 'Output_Dir', type 'string', and description.

Workflow MyLead Component Monitor

Add Node Remove Node Connect/Disconnect

Component List

- http://whitney.extreme.indiana.edu:22002/resourc
- http://www.extreme.indiana.edu/lead
 - MyLEADNotificationTest
 - Terrain_Preprocessor
 - ARPS_to_WRF_Data_Interpolator
 - ARPS_Plotting_Program
 - 3D_Model_Data_Interpolator
 - PostScript_to_Image_Converter
 - WRF_Forecasting_Model
 - WRF_to_ARPS_Data_Interpolator
 - ADaM-Applications
 - ADaM-Classification
 - ADaM-DataNormalization
 - ADaM-DataTransformation
 - ADaM-FeatureExtraction**
 - WRF_Ensemble_Launcher

Composer

Output_Dir Config

ADaM-FeatureExtraction

Port Information Notification

Selected Output Port

Component: Output_Dir
Port: Parameter
Type: any
Description: This port can be connected to any type.

Selected Input Port

Component: ADaM-FeatureExtraction
Port: Output_Dir
Type: string
Description: Enter the gridftp URL of the data file, the service will put the results in this location

Component Information

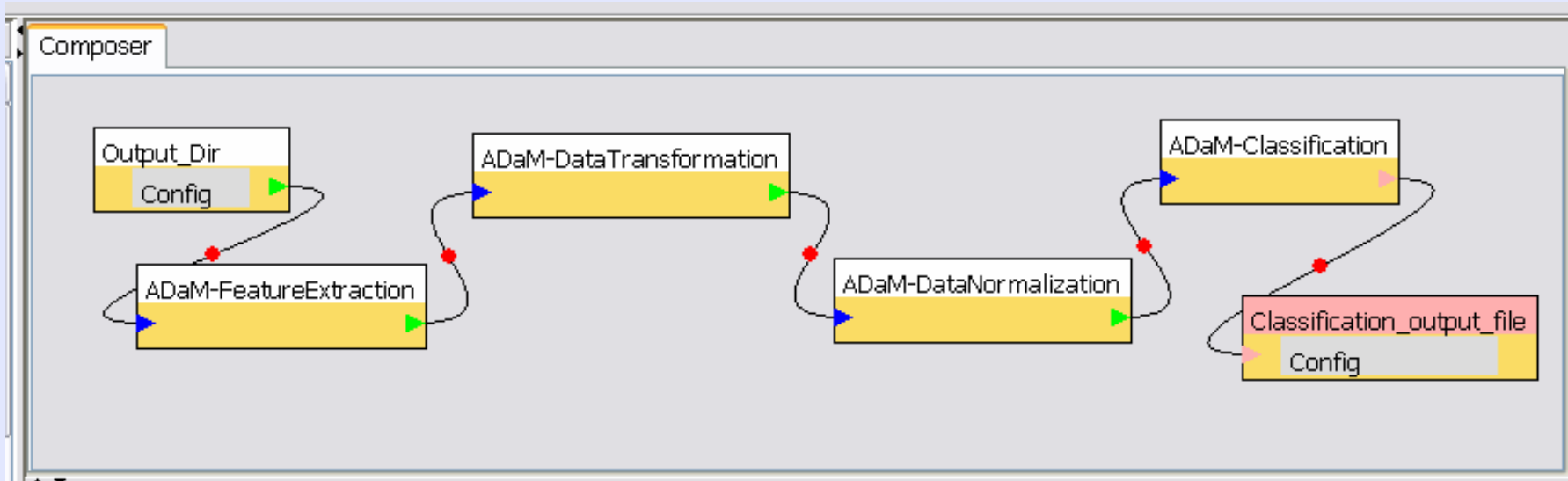
Service:
ADaM-FeatureExtraction

Description:
A set of methods for extracting features from raw data

Operation: Run

Final Workflow

- Save it back to my lead
- Next we must bind the inputs to the workflow



Wizard understand the workflow requirements

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Welcome, dennis gannon

[Education and Outreach](#) [Help](#) [Profile](#)

[Experiment Builder](#) [Generic Service Toolkit](#) [Security](#)

Experiment Builder Portlet

Experiment Wizard

User: Dennis Gannon Project: ADaM Data Mining
Name: building_a_workflow
Description: demo of composer
Workflow: ADaM test version

Select Data Stores

Output_Dir
Enter the gridftp URL of the data file, the service will put the results in this location

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Select an output location

[Back to Search Home](#)

Search for Storage Resource [Clear](#) [Find](#)

Name Protocol

Found 8 match(es) ...

Query Results

[Select](#)

<input type="checkbox"/> Chinkapin Tmp Storage	Toggle XML... Toggle Details...
<input type="checkbox"/> IU Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> IU Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> UAH Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> UNC Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> Unidata Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> OU Testbed Public Space	Toggle XML... Toggle Details...
<input type="checkbox"/> NCSA Testbed Public Space	Toggle XML... Toggle Details...

[Select](#)



Submitting the workflow

The screenshot shows a web application interface for submitting a workflow. At the top, there is a navigation bar with links: LEAD, Portal Home, Education and Outreach, Help, and Profile. Below this is a secondary navigation bar with links: MyWorkspace, Experiment Builder, Generic Service Toolkit, and Security. The main content area is titled "Experiment Builder Portlet" and contains an "Experiment Wizard" section. The wizard displays the following information: User: Suresh Marru, Project: template_workflows, Name: Datamining_Experiment, Description: This is a test of the ADaM data mining system from UAH. We are using the "ADaM Demo" from the sample workflows., Workflow: ADaM Demo, and Data Stores: Selected. Below this information is a "Review and Submit" section with instructions and links. At the bottom right of the wizard, there are four buttons: "< Back", "Next >", "Cancel", and "Launch". The footer of the page contains links: LEAD Home, FAQ, Privacy, Terms of use, and Contact us.

LEAD Portal Home Education and Outreach Help Profile

MyWorkspace Experiment Builder Generic Service Toolkit Security

Experiment Builder Portlet

Experiment Wizard

User: Suresh Marru Project: template_workflows
Name: Datamining_Experiment
Description: This is a test of the ADaM data mining system from UAH. We are using the "ADaM Demo" from the sample workflows.
Workflow: ADaM Demo
Data Stores: Selected

Review and Submit

Please review the created workflow and if satisfied, click the "Launch" button below. You may use the "Back" button to change or review in greater detail your selections for this experiment.

[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.

The [RENCI monitoring applet](#) provides additional additional information relating to the performance characteristics of the hosts where the workflow is executing.

For debugging purposes only, you may want to [start the notification viewer](#) prior to launching the workflow so that you can see the workflow notifications as they arrive.

< Back Next > Cancel Launch

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Monitor results in real time

Add Node Remove Node Connect/Disconnect

Composer

```

    graph LR
      ADaM-FeatureExtraction --> ADaM-DataTransformation
      ADaM-DataTransformation --> ADaM-DataNormalization
      ADaM-DataNormalization --> ADaM-Classification
      ADaM-FeatureExtraction --- Output_Dir_Config[Output_Dir Config]
      ADaM-Classification --- Classification_output_file_Config[Classification_output_file Config]
  
```

Port Information Notification

Time	Component	Status	Message
07/20/05 16:0...	Workflow	Started	
07/20/05 16:0...	ADaM_Feature...	Invoking	
07/20/05 16:0...	ADaM_Feature...	Started	Host: 146.229.234.73
07/20/05 16:0...	ADaM_Feature...	INFO	install location of the lead tools is /home/grid5070/production/adam-services
07/20/05 16:0...	ADaM_Feature...	INFO	the local temporary directory is /tmp
07/20/05 16:0...	ADaM_Feature...	INFO	the input url of the data file is gridftp://frozone.itsc.uah.edu/home/grid5070/production/adam...
07/20/05 16:0...	ADaM_Feature...	INFO	the output url to push the output files is gridftp://frozone.itsc.uah.edu/tmp
07/20/05 16:0...	ADaM_Feature...	INFO	the site name is KOUN
07/20/05 16:0...	ADaM_Feature...	INFO	the local work directory is /tmp/nexrad_1121893788358/3DMesocycloneDetection
07/20/05 16:0...	ADaM_Feature...	INFO	attempting to copy input data file to /tmp/nexrad_1121893788358/3DMesocycloneDetection/in...
07/20/05 16:0...	ADaM_Feature...	Received a file	From gridftp://frozone.itsc.uah.edu/home/grid5070/production/adam-services/FeatureExtract...
07/20/05 16:0...	ADaM_Feature...	DEBUG	attempting to run the detection
07/20/05 16:0...	ADaM_Feature...	Consumed a file	gridftp://frozone.itsc.uah.edu/home/grid5070/production/adam-services/FeatureExtraction/in...
07/20/05 16:0...	ADaM_Feature...	Finished comp...	0 sec
07/20/05 16:0...	ADaM_Feature...	INFO	attempting to push output files to gridftp://frozone.itsc.uah.edu/tmp



Check it out in MyLEAD

Experiment Builder Portlet

User: Suresh Marru

Project: demo-demo-run

Experiment Status Page

Experiment Details

Name: Datamining-demo

Last Notification Time: 2005-07-19T14:25:32.590-05:00

Description: Datamining demo

Status: INFORMATION

Workflow

Name: ADaM Demo

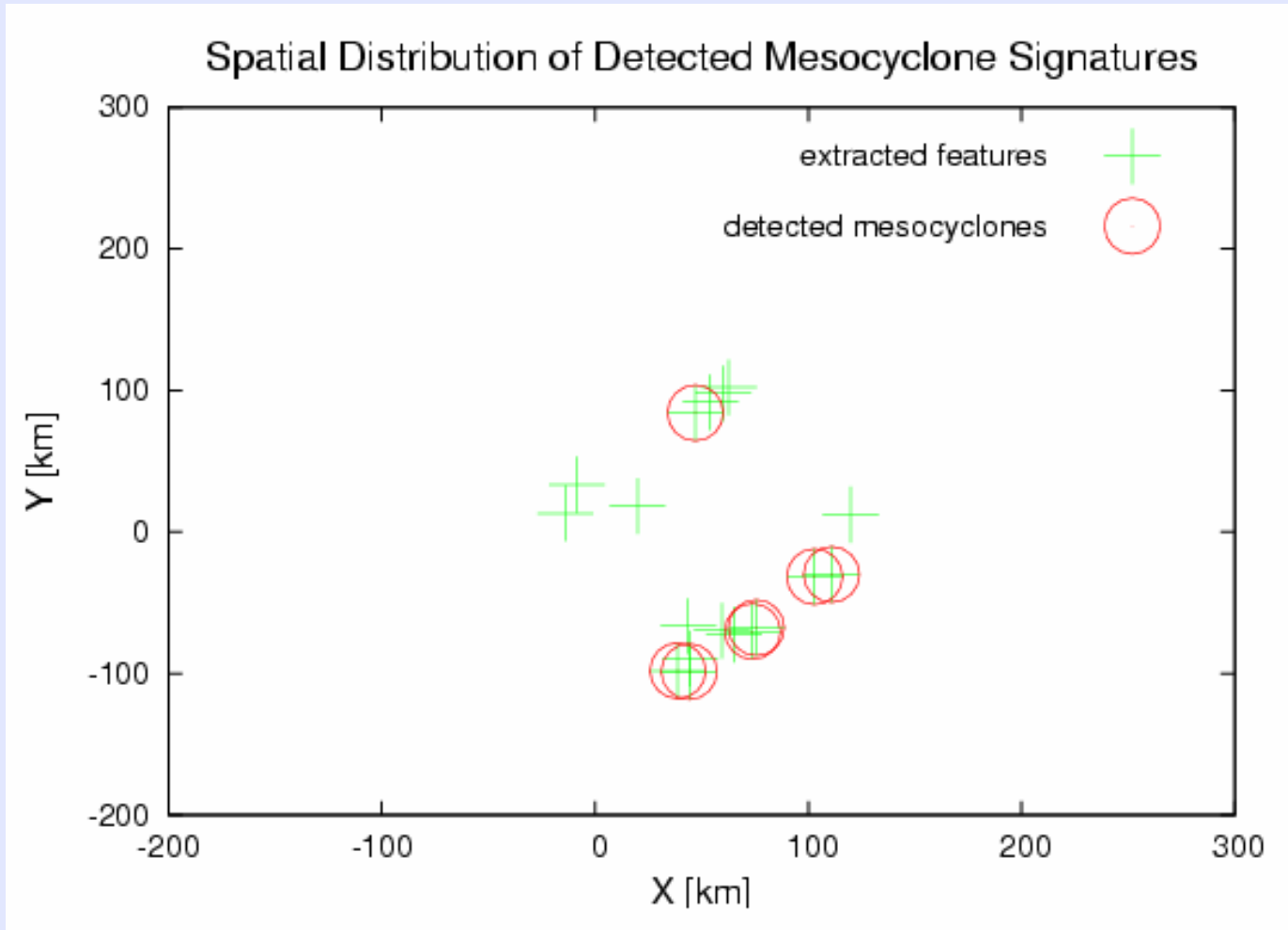
Description: Datamining services workflow

Parameter	Value
Output_Dir	gridftp://frozone.itsc.uah.edu/tmp

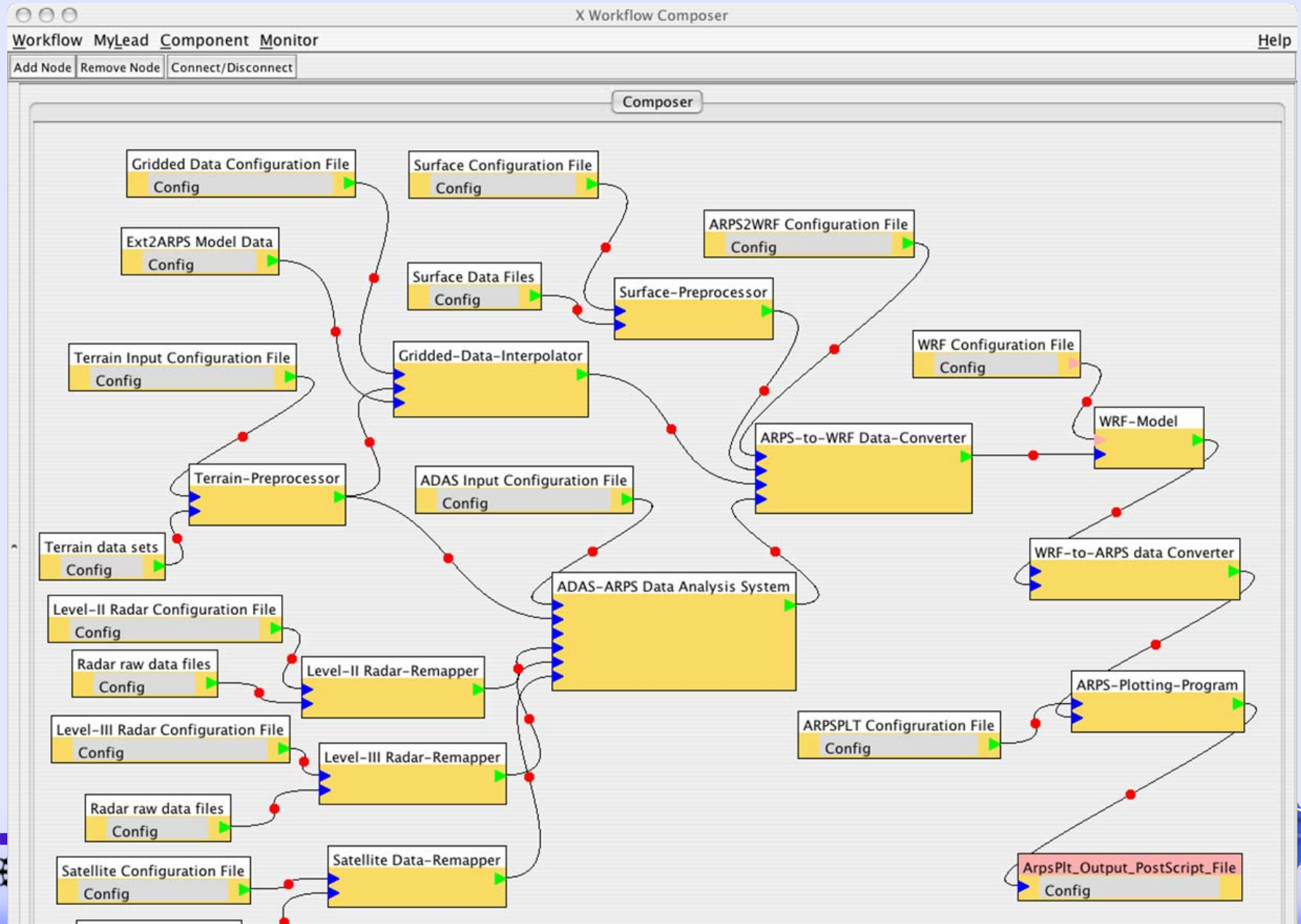
Notifications

Message	Status	Timestamp
INVOKE SERVICE START	INFORMATION	2005-07-19T14:25:32
APPLICATION START	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: install location of the lead tools is /home/grid5070/production/adam-services	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: the local temporary directory is /tmp	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: the input url of the data file is gridftp://frozone.itsc.uah.edu/home/grid5070/production/adam-services/FeatureExtraction/input.dat	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: the output url to push the output files is gridftp://frozone.itsc.uah.edu/tmp	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: the site name is KOUN	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: the local work directory is /tmp/nexrad_1121800848241/3DMesocycloneDetection	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: attempting to copy input data file to /tmp/nexrad_1121800848241/3DMesocycloneDetection/input.data	INFORMATION	2005-07-19T14:25:32
FILE RECEIVE DURATION Duration(Millis): 1452 FILE UUID: testUUID	INFORMATION	2005-07-19T14:25:32
FILE CONSUMED FILE UUID: testUUID	INFORMATION	2005-07-19T14:25:32
LEVEL: INFO MESSAGE: attempting to push output files to gridftp://frozone.itsc.uah.edu/tmp	INFORMATION	2005-07-19T14:25:32
FILE SEND DURATION FILE SIZE (Bytes): 1025 FILE UUID: testUUID	INFORMATION	2005-07-19T14:25:32
PUBLISH URL: http://chinkapin.cs.indiana.edu/data-output/input.data_3Dmesocyclone_1121800848241.dat	INFORMATION	2005-07-19T14:25:32
PUBLISH URL: http://chinkapin.cs.indiana.edu/data-output/detection_1121800848241.output	INFORMATION	2005-07-19T14:25:32

Click on the output file to see visualization



Large workflows can be composed



Launch a Simulation

- Creating an experiment with the experiment builder. (Dan's big case.)
- Go to the experiment builder and
 - Look at your old experiments or create a new project
 - Name and describe it.
 - Select the application/workflow service
 - Bind your data set to it.
 - Where do you want the output to go?
 - Run it.
 - Monitor it.



Launching an Ensemble with detailed monitoring

- Lavanya Ramakrishnan from UNC will take us through this part.



Dynamic Adaptive LEAD System

- Meteorology goal
 - To provide **timely** and **accurate** forecasts using dynamic adaptation
- Computer Science goal
 - Map application **requirements** to resource **capabilities**
 - Adapt to **weather** as well as **resource behavior**

Need real time monitoring to make adaptation decisions

Adaptation Challenges

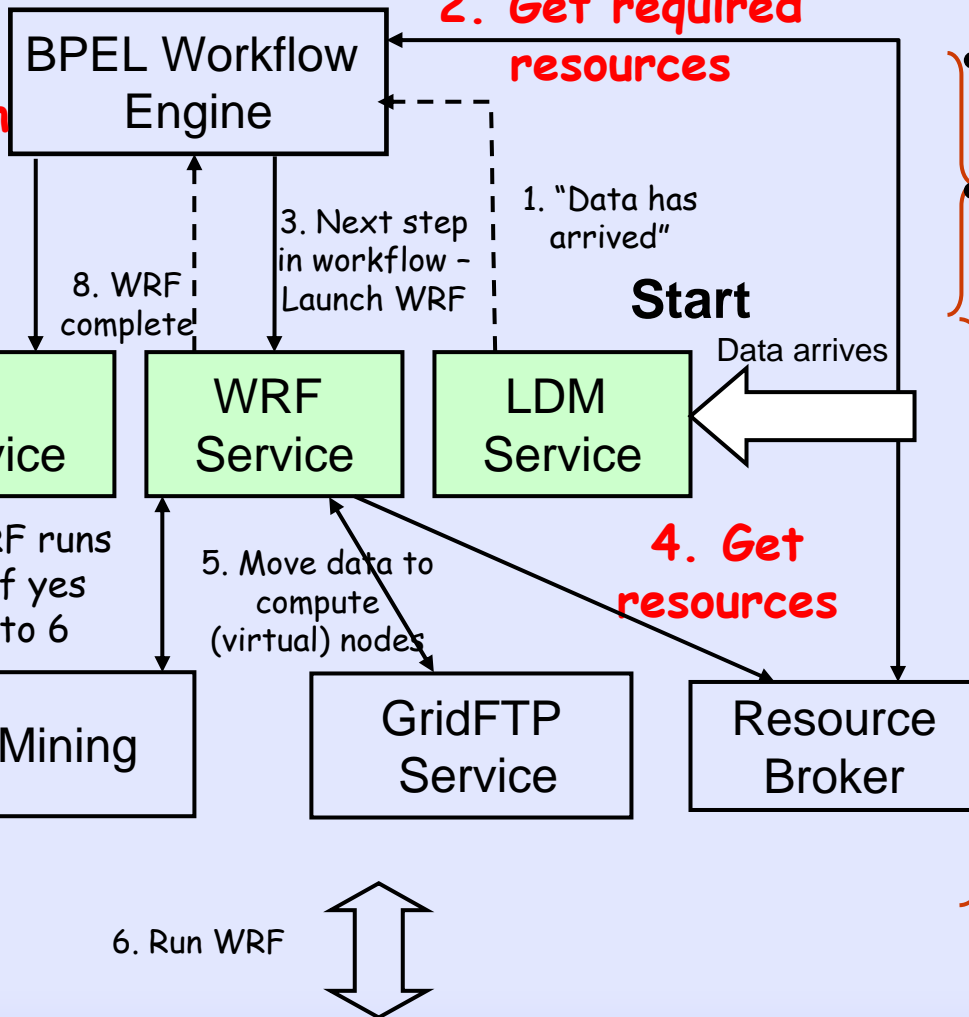
- LEAD system
 - Streaming data, respond to weather
- Proactive multilevel monitoring
 - Workflow, resource and application
- Intelligent control
 - Dynamic response to weather
 - scheduling based on priority and accuracy
 - Performance and reliability guarantees of the resources



Dynamic Workflows

0. Possible advanced reservation

2. Get required resources



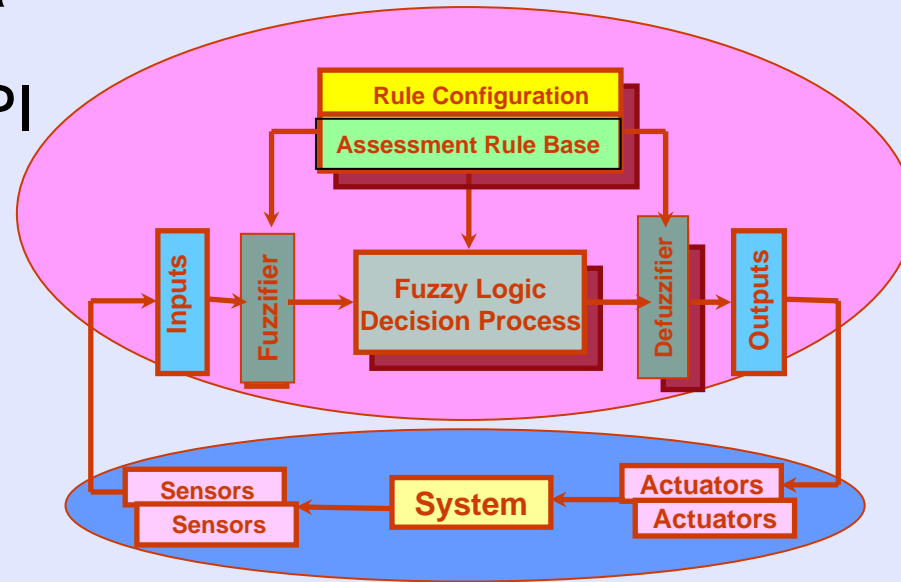
- Correlate multilevel monitoring
- Multiple Decision Points
- Service Monitoring
 - load of web service
- Application
 - application behavior on resources
- Resource
 - performance (e.g. CPU utilization)
 - reliability (e.g. temperature)

Resources - compute, network storage



Leveraging Other Activities

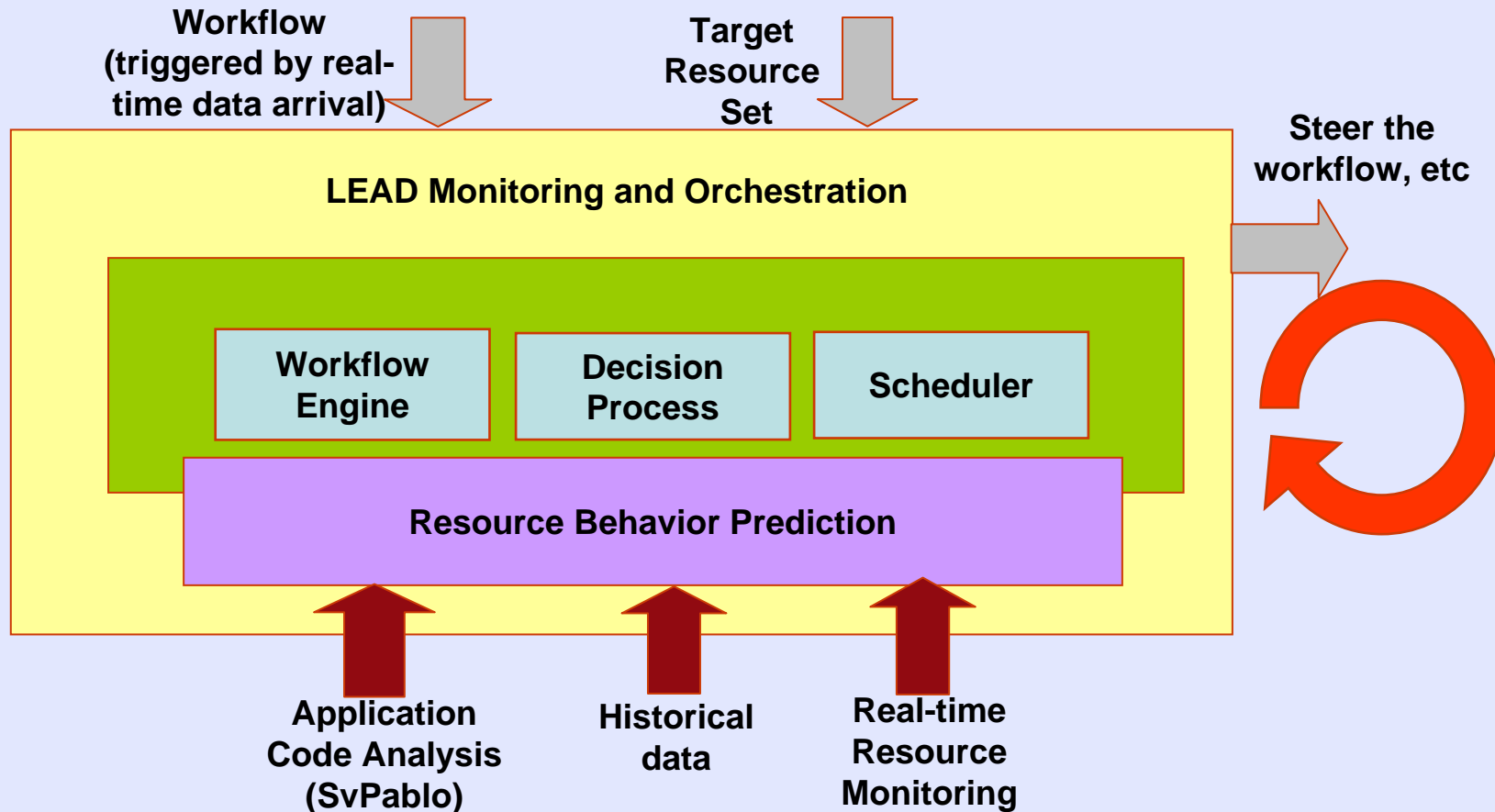
- Health Application Programming Interface (DOE LACSI)
 - standard interface for health monitoring
 - e.g. power, disk health, temperature
 - failure prediction from health data
- Network Weather Service- HAPI (NSF VGrADS)
 - leverage NMI tool infrastructure
 - integrate performance and failure indicator data
- Autopilot and SvPablo
 - control infrastructure to steer the workflow
 - source code performance data correlation



Autopilot Toolkit



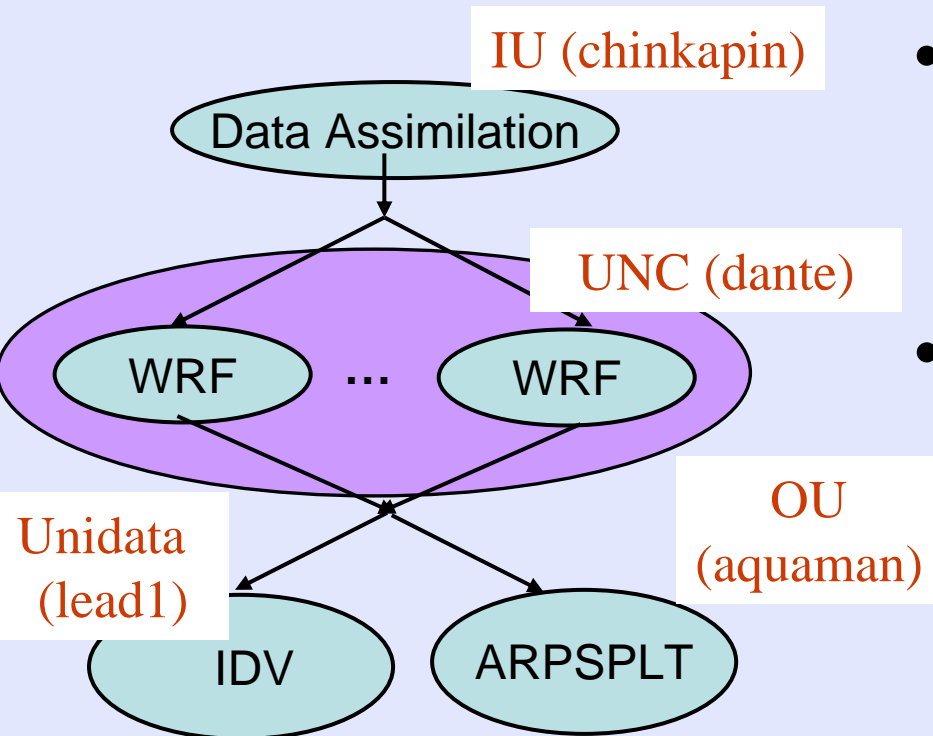
LEAD Monitoring Architecture



**Poster: Performance and Reliability
Monitoring of the LEAD System**



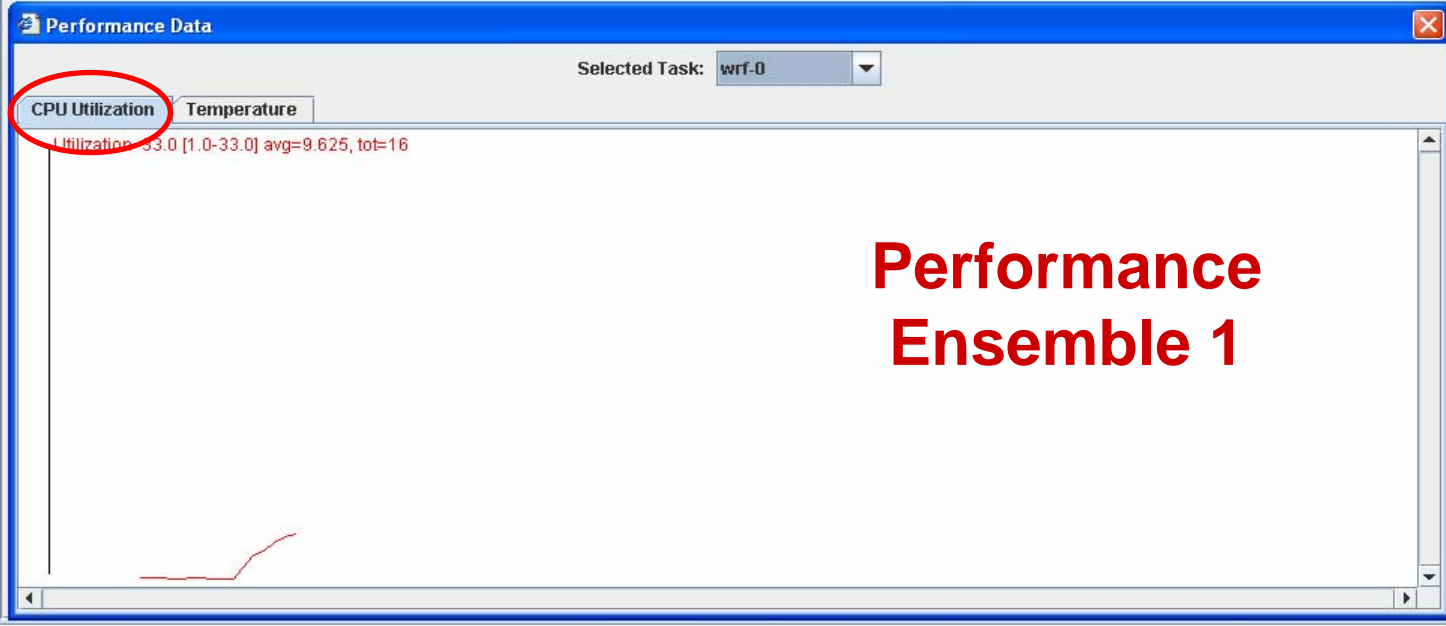
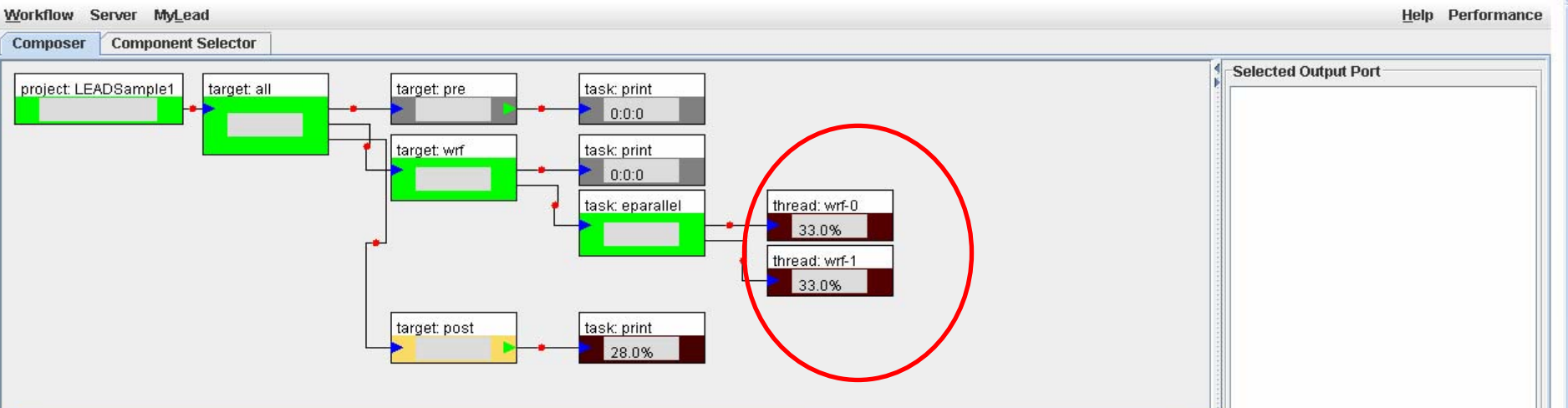
Experimental Ensemble



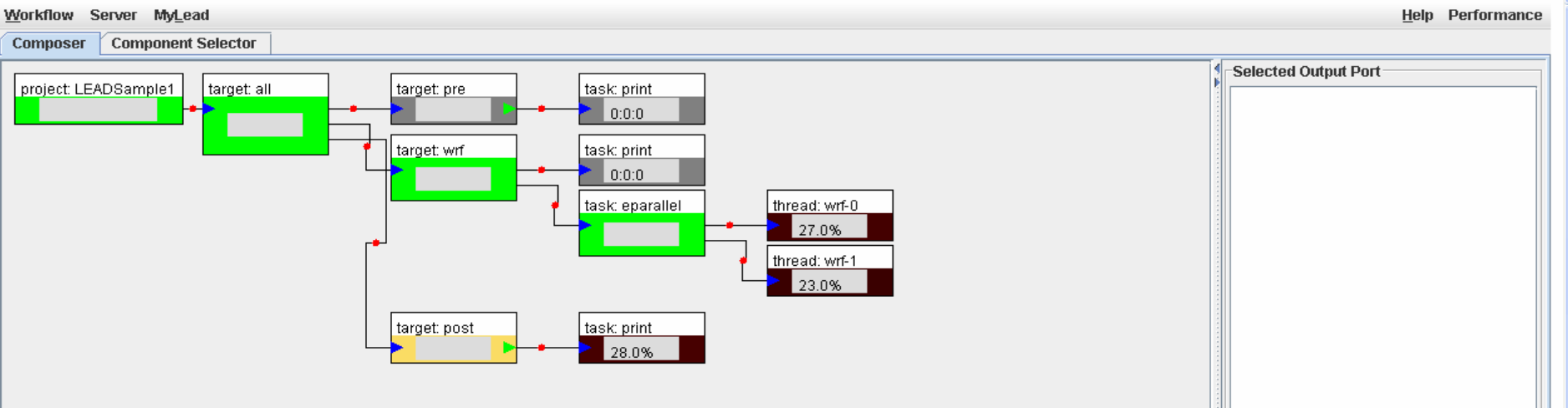
- Software components
 - IU Dynamic Workflow toolkit and Portal, NCSA OGRE, UNC Monitoring, OU WRF data
- Infrastructure
 - Testbed: IU, UNC, OU
 - Metrics
 - CPU utilization, temperature

- Test Problem (ensemble = 2) on 16 nodes each
 - 60 secs timestep(34 mins),
 - 101 x 101 x 51, 27 km resolution forecast





Performance Ensemble 1



Performance Data

Selected Task: wrf-1

CPU Utilization Temperature

Utilization 23.0 [2.0-23.0] avg=5.214286, tot=14

The Performance Data window displays a graph of CPU utilization for the selected task 'wrf-1'. The utilization is shown as a red line on a white background. The current utilization is 23.0%, with a range of 2.0% to 23.0%. The average utilization is 5.214286, and the total utilization is 14. The window also has tabs for 'CPU Utilization' and 'Temperature'.

Performance Ensemble 2

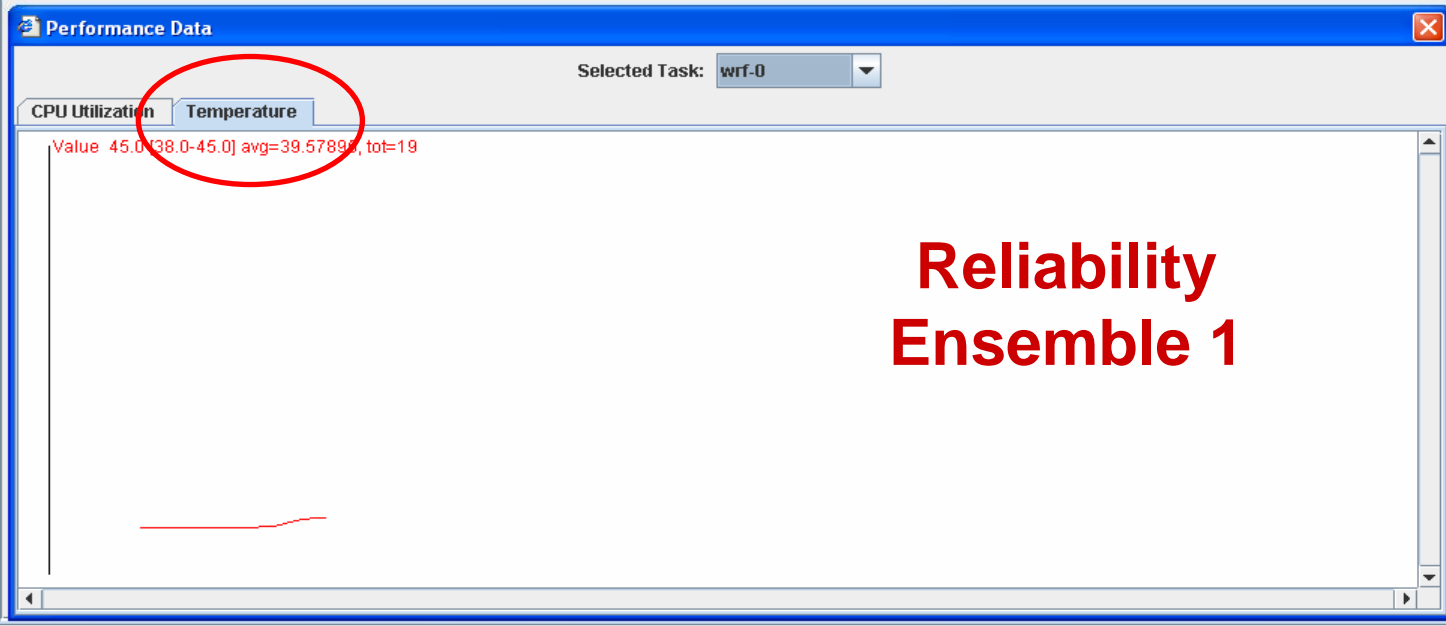
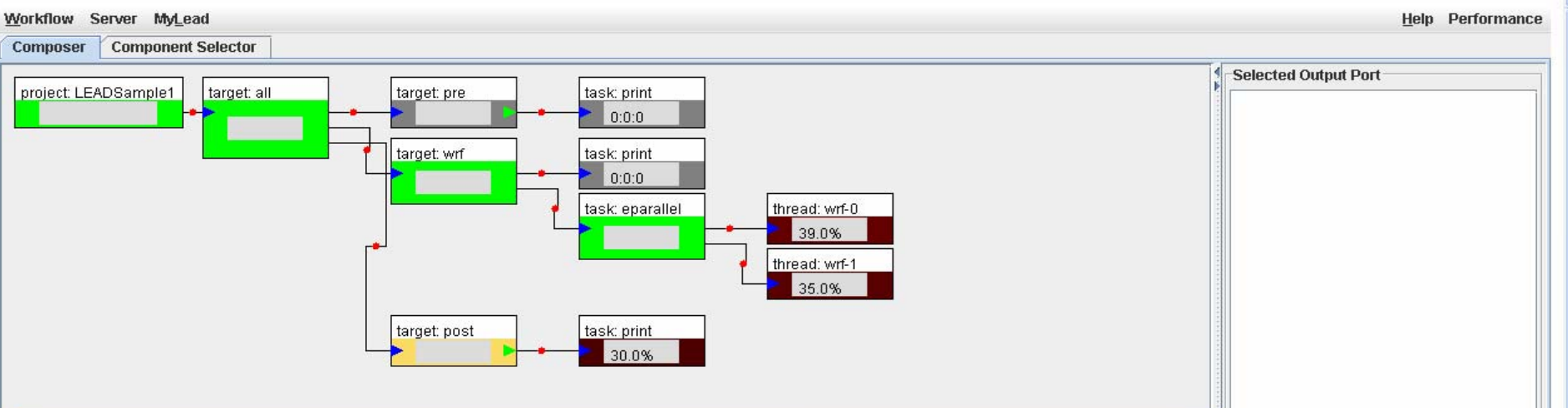
Selected Output Port

Connect/Disconnect

Selected Input Port

Add Node Remove Node

The right-hand side of the interface contains several panels. At the top is the 'Selected Output Port' panel, which is currently empty. Below it is a 'Connect/Disconnect' button. Underneath that is the 'Selected Input Port' panel, also empty. At the bottom of this section are 'Add Node' and 'Remove Node' buttons.

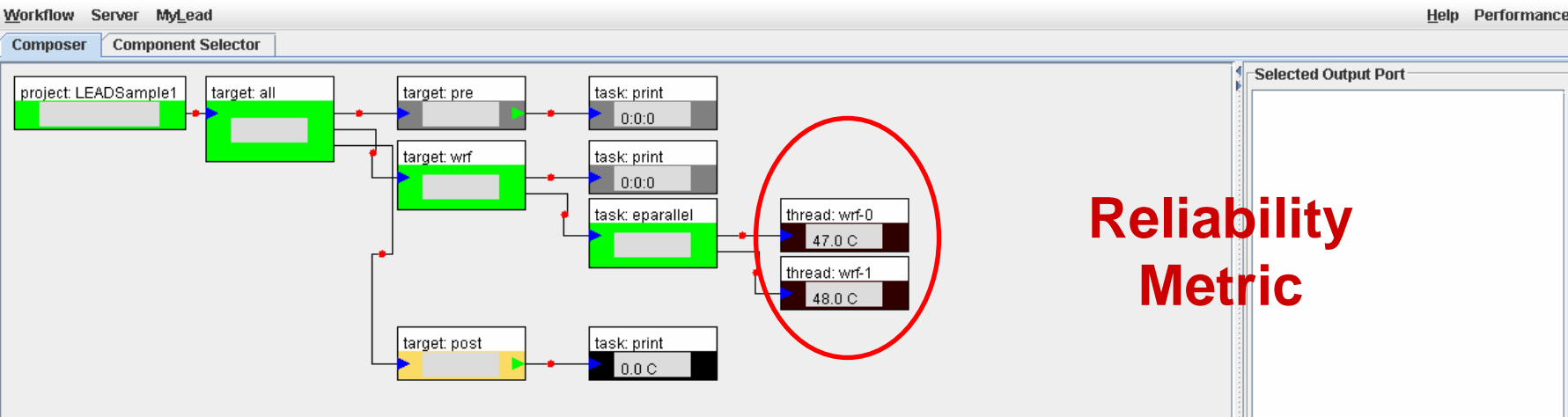


Selected Output Port

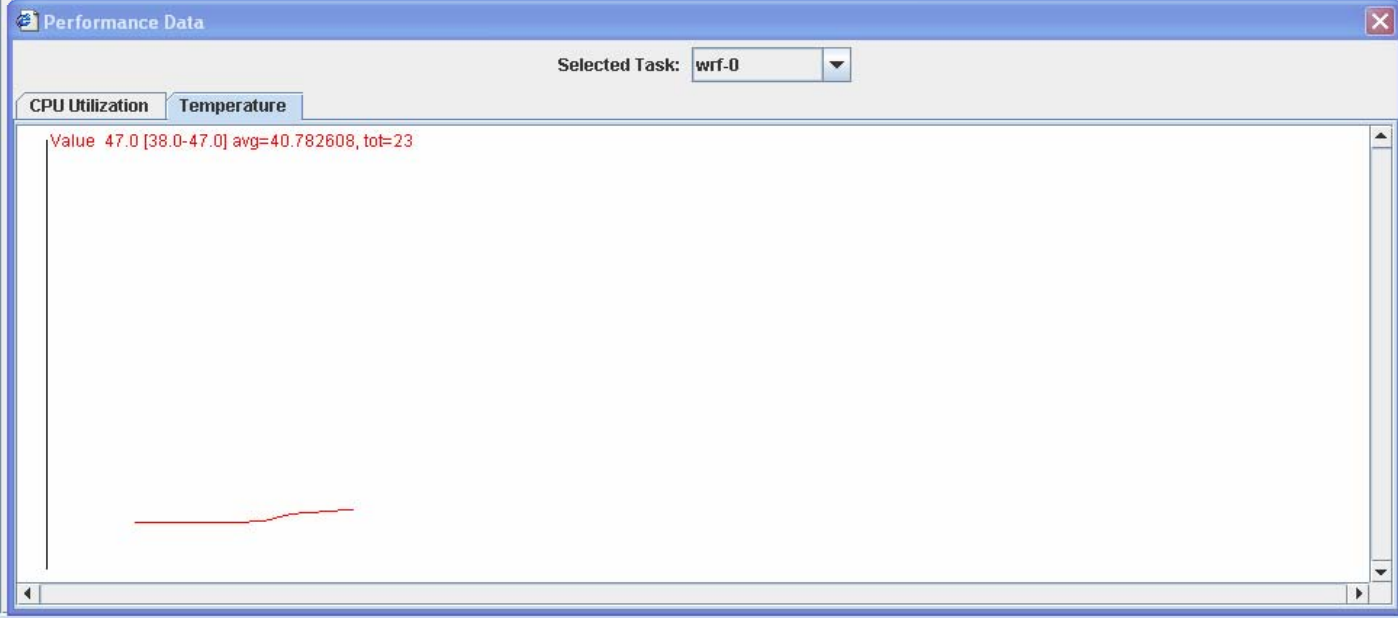
Connect/Disconnect

Selected Input Port

Add Node Remove Node



Reliability Metric

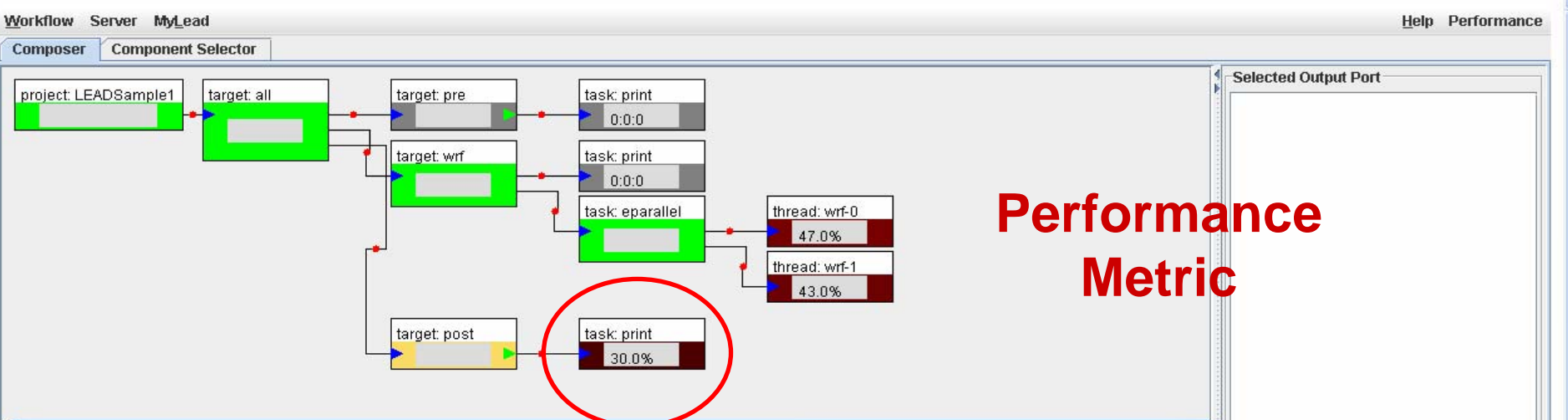


Selected Output Port

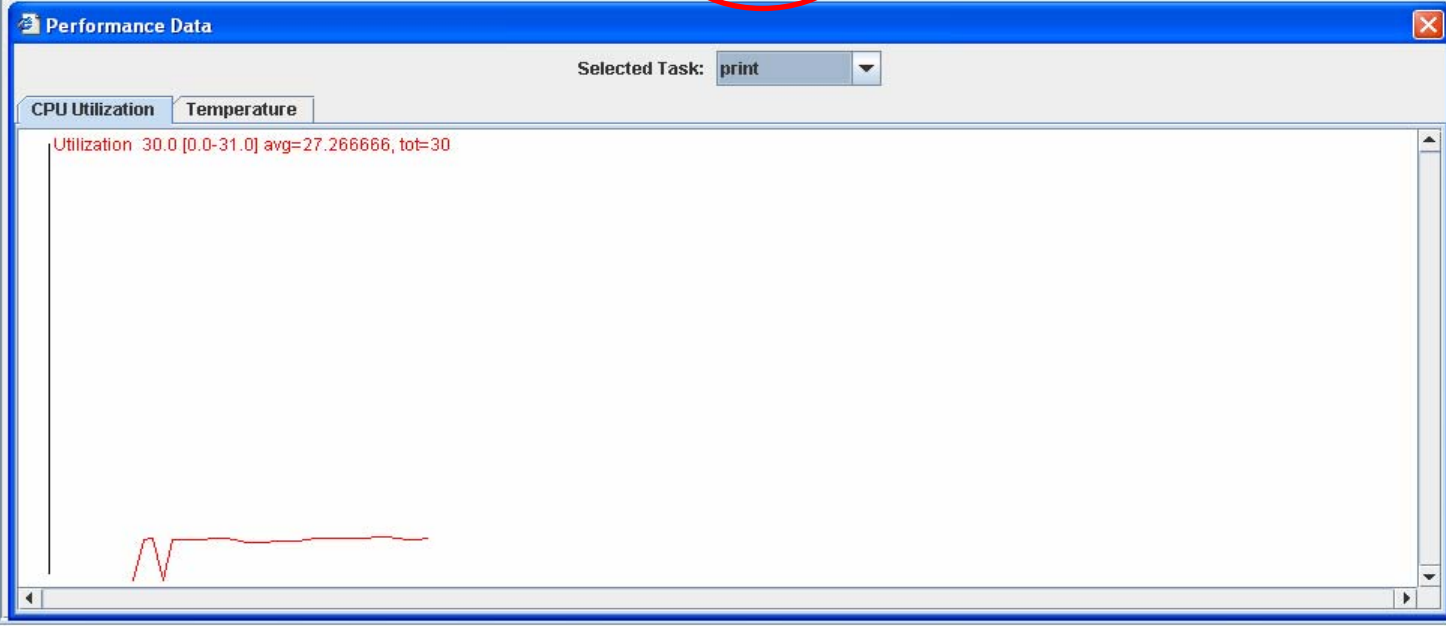
Connect/Disconnect

Selected Input Port

Add Node **Remove Node**



Performance Metric

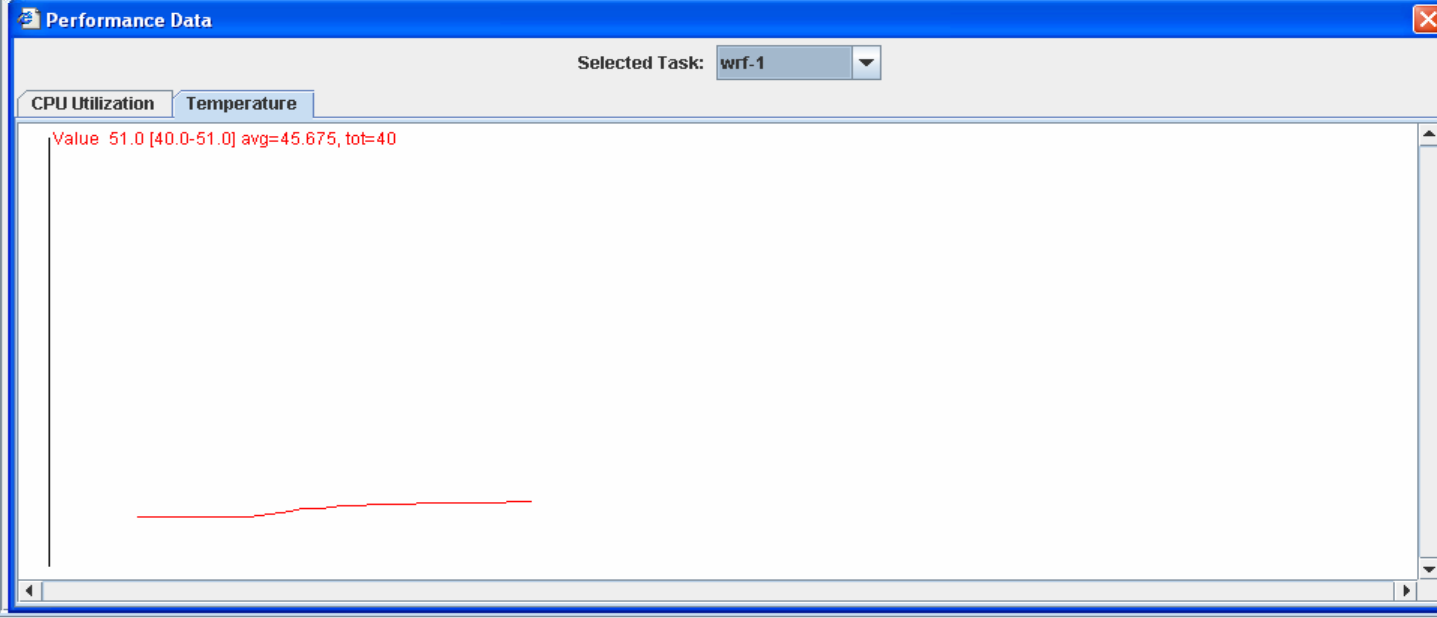
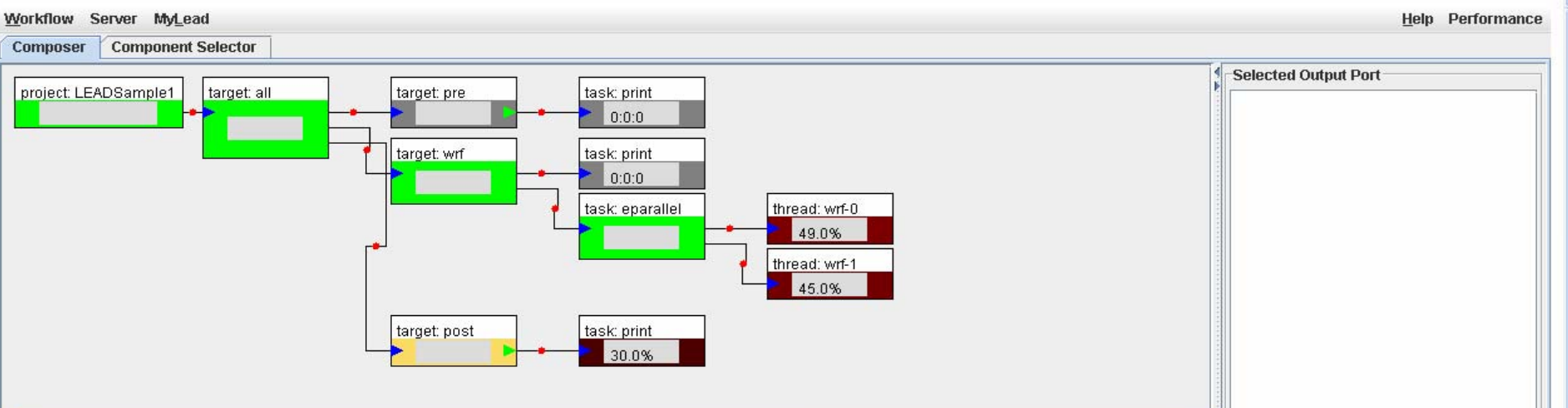


Selected Output Port

Connect/Disconnect

Selected Input Port

Add Node Remove Node



Selected Output Port

Selected Input Port

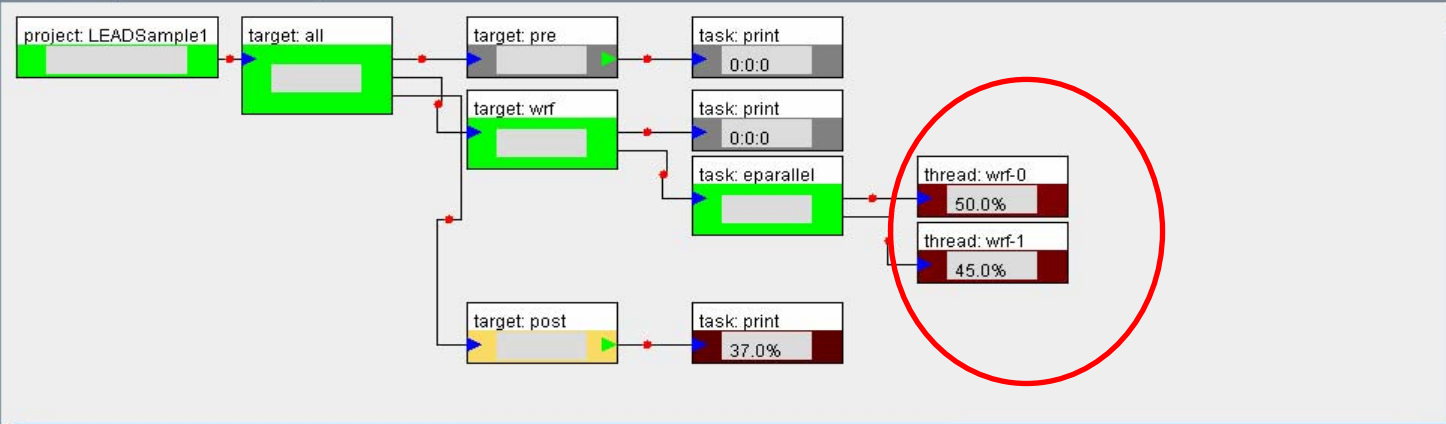
Connect/Disconnect

Add Node Remove Node

Workflow Server MyLead

Help Performance

Composer Component Selector

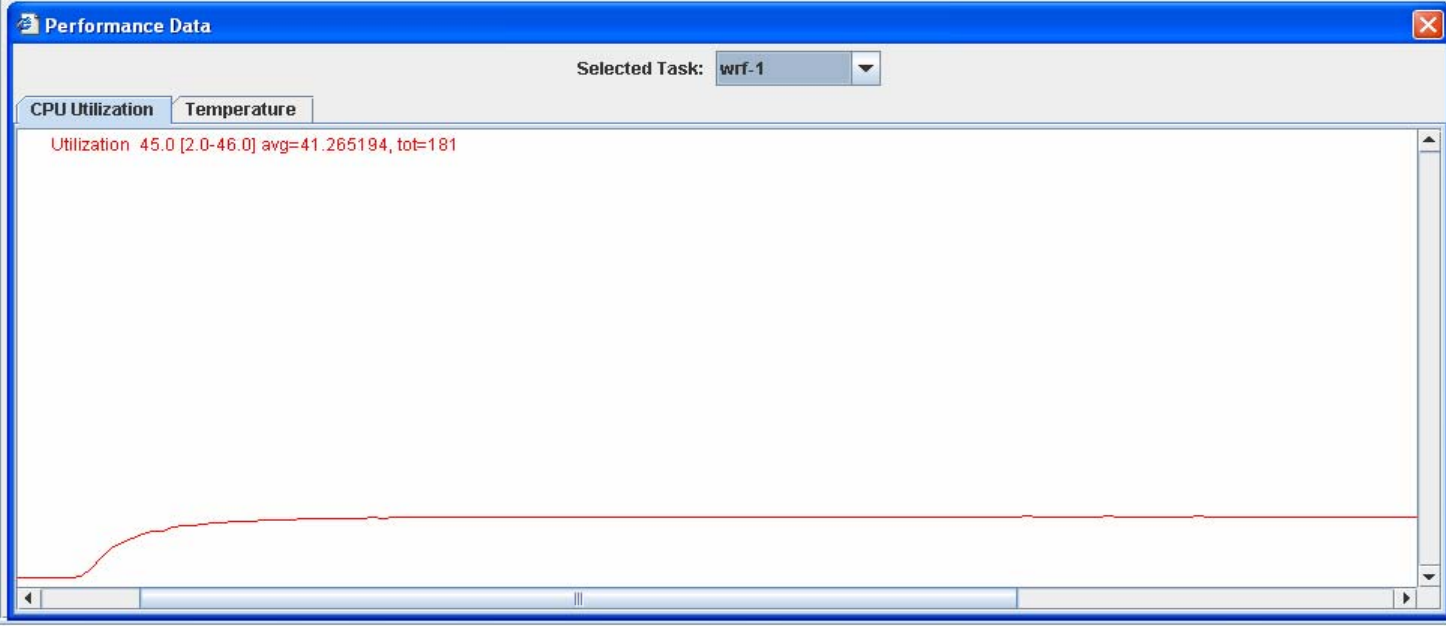


Selected Output Port

Connect/Disconnect

Selected Input Port

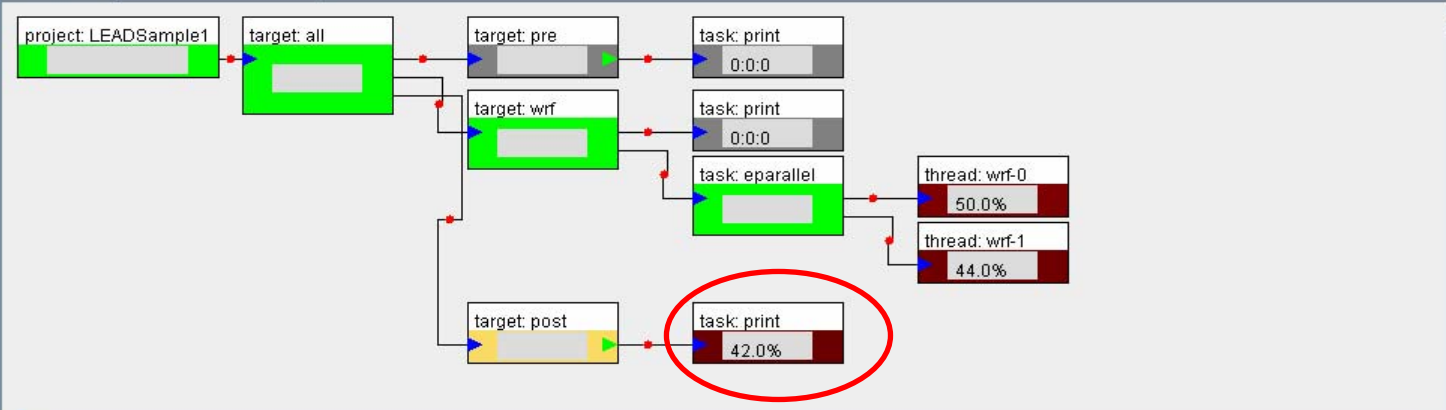
Add Node Remove Node



Workflow Server MyLead

Help Performance

Composer Component Selector



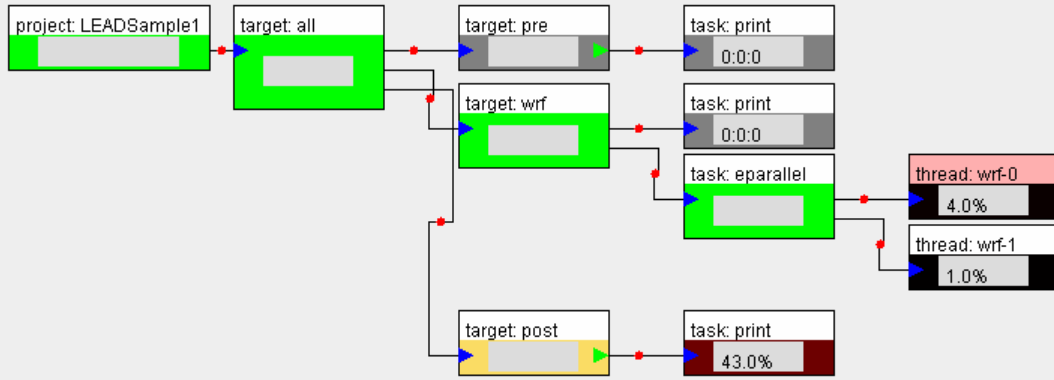
Selected Output Port

Connect/Disconnect



Selected Input Port

Add Node **Remove Node**



Selected Output Port

Empty area for selected output port.

Connect/Disconnect

Selected Input Port

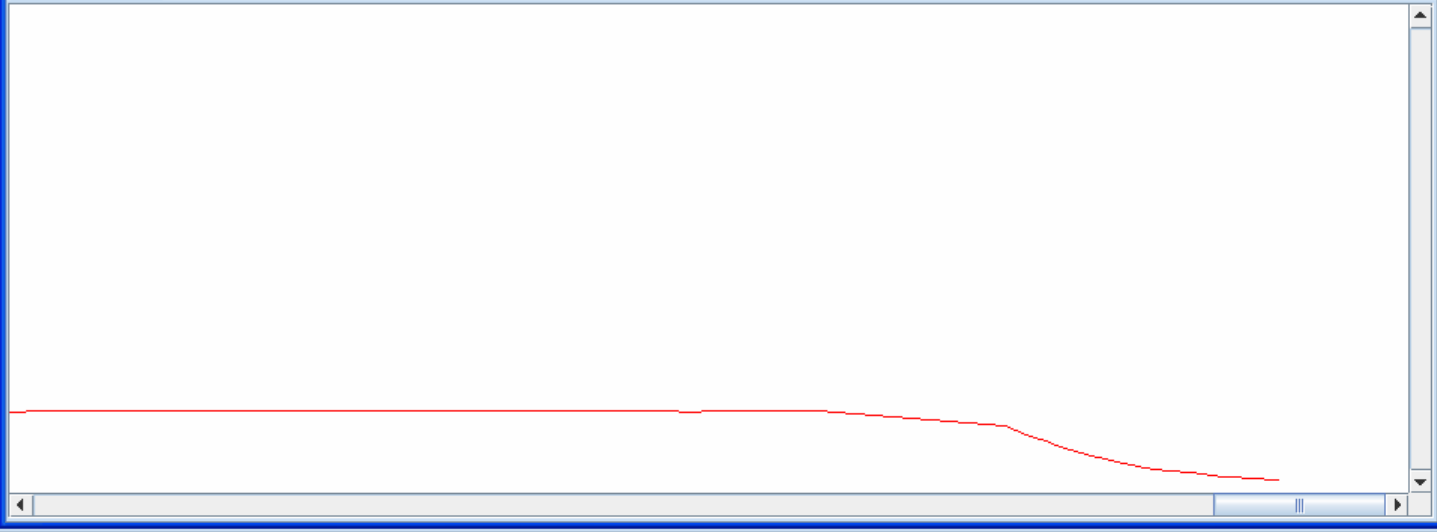
Empty area for selected input port.

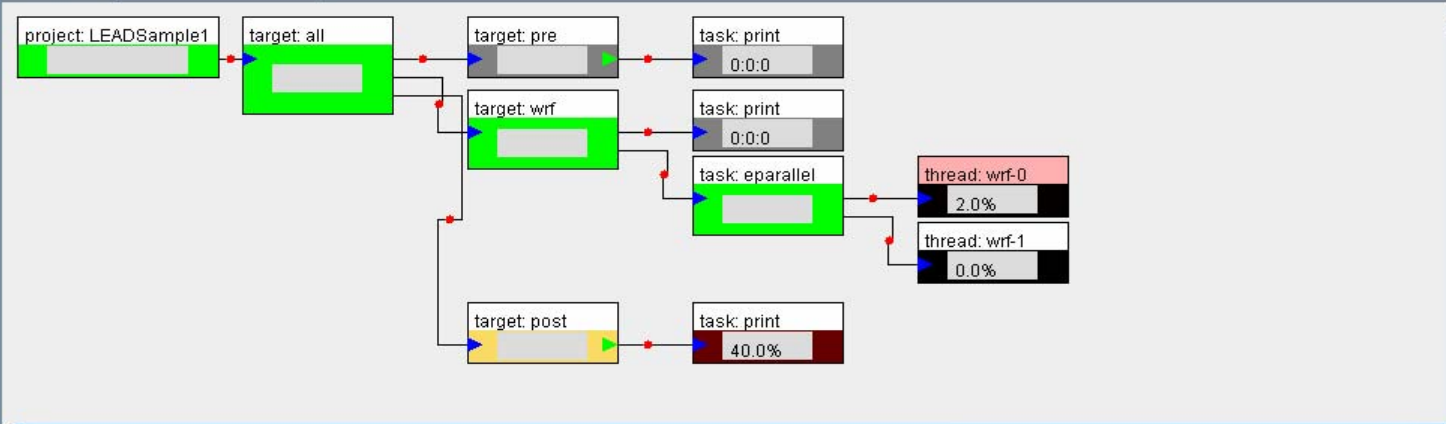
Add Node Remove Node

Performance Data

Selected Task: wrf-0

CPU Utilization Temperature



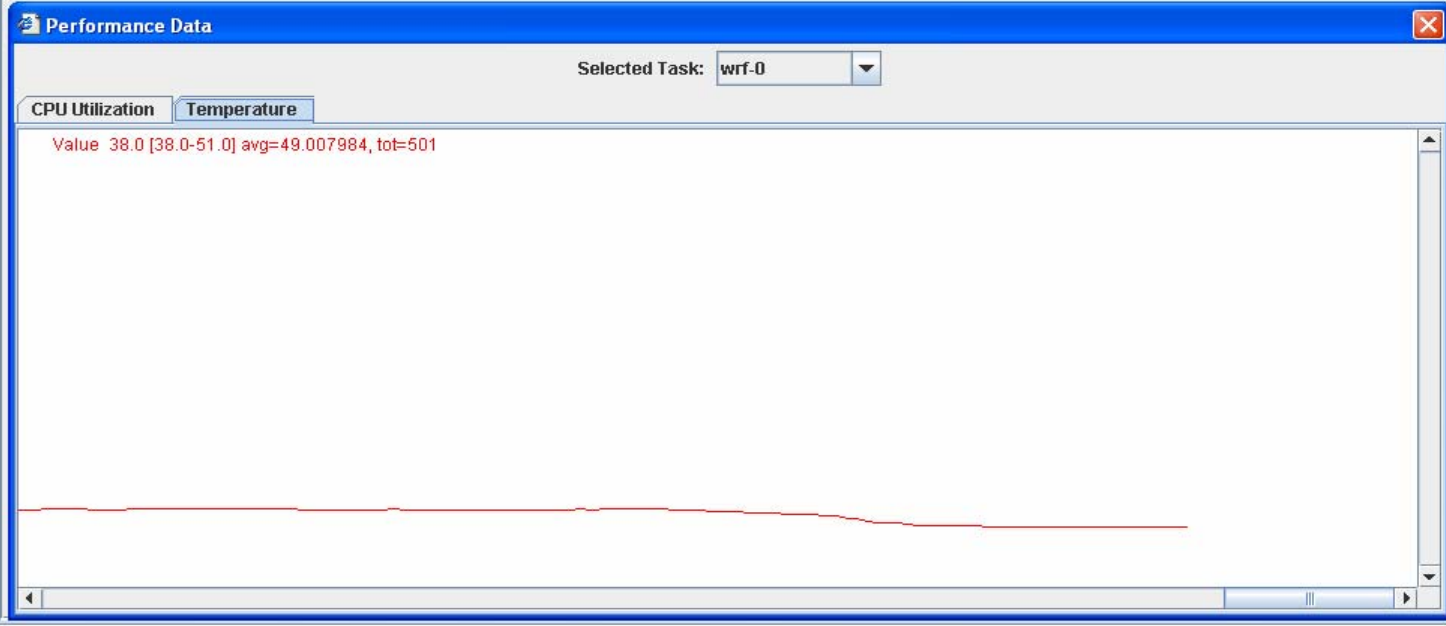


Selected Output Port

Connect/Disconnect

Selected Input Port

Add Node Remove Node



Research Issues for the Portal

- How to make it more focused on data discovery and analysis
 - and less about applications/workflow?
- How can we make it possible for the Education group to create and upload interactive learning scenarios?
 - What is the authorization model for using the scenarios?
 - How much can a student do on TeraGrid?
 - How do we conduct the best usability test?



Research issues: Workflow

- Understanding the dynamic case
 - Dynamic in both application structure and in the use of resources
- Extending the graphical language to describe dynamic workflow.
 - Is the current workflow language (BPEL) really sufficient for our dynamic workflow scenarios?
- How do we generate user interfaces for workflows
 - Experts can build workflow graphs, but basic users don't need to see the details. They just want to use them.

