

# OnTimeMeasure: Centralized and Distributed Measurement Orchestration Software

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***ProtoGENI Cluster Meeting***

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# Topics of Discussion

- Project Overview
- Spiral 2 Accomplishments
  - Software Components
  - OnTimeMeasure Architecture
  - Measurement Service Capabilities
  - User Workflow
  - GENI Integration and Interoperability
- Spiral 3 Project Objectives

# Project Overview

- Goal:
  - Provide GENI community with a shared measurement service for provisioning on-going and on-demand measurement requests
- Expected Outcomes:
  - OnTimeMeasure Software to perform centralized and distributed measurement orchestration and provisioning of active measurements
    - *Centralized orchestration* for continuous monitoring, persistent measurements storage and processed network measurement feeds
    - *Distributed orchestration* for on-demand (real-time) measurement requests without need for persistent measurements storage
  - Measurement service that uses OnTimeMeasure software in GENI experiments to enable:
    - Network paths monitoring
    - Network weather forecasting
    - Network performance anomaly detection
    - Network-bottleneck fault-location diagnosis

GENI Project Wiki – <http://groups.geni.net/geni/wiki/OnTimeMeasure>

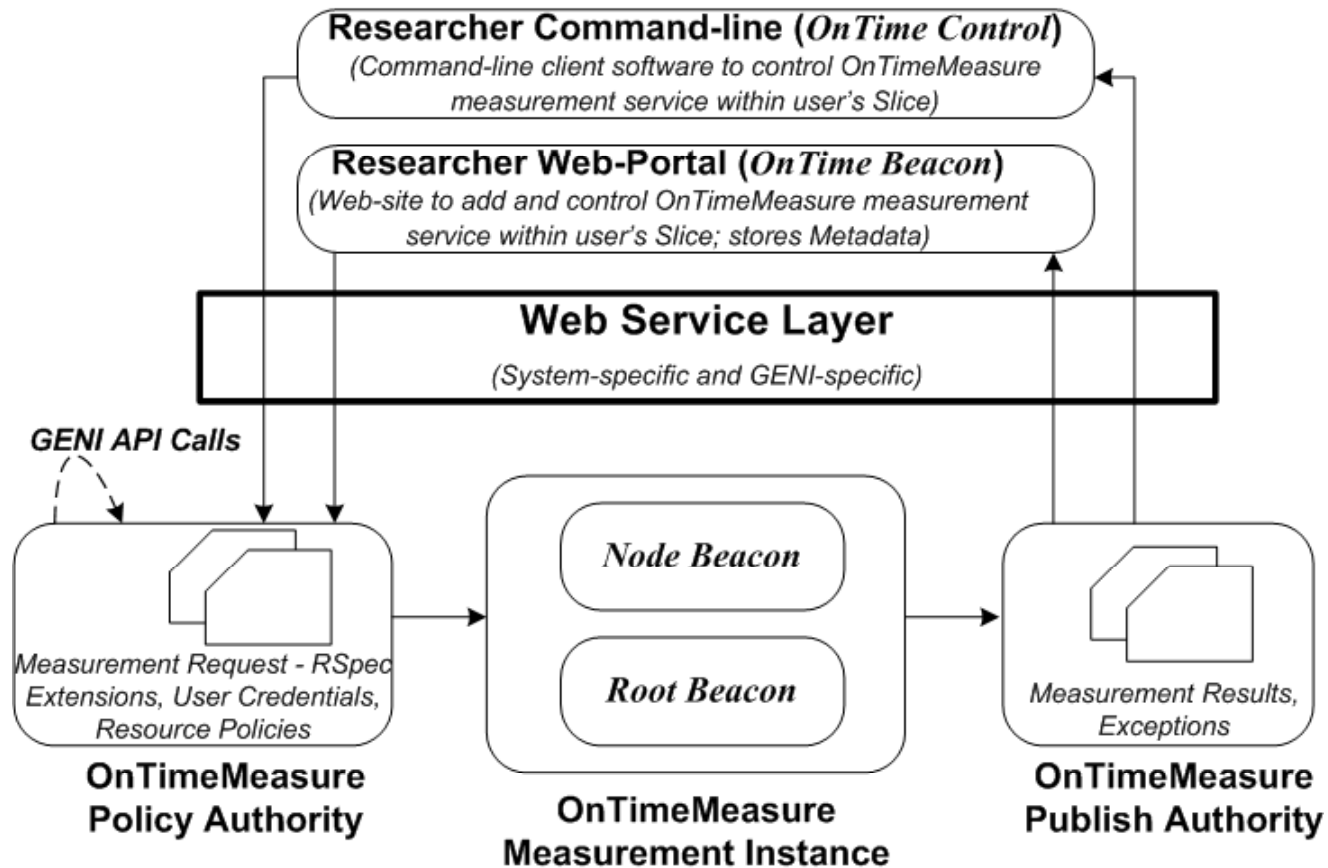
Researcher Web-portal – <http://ontime.oar.net>

# OnTimeMeasure Software Modules

- Customizable software [\*] developed at OSC/OARnet
- Two main modules installed within a GENI experiment slice
  - **Node Beacon**
    - Installs tools that measure network health metrics such as: route changes, delay, jitter, loss, bandwidth
      - TCP/UDP Iperf, Traceroute, Ping, Pathload, OWAMP, etc.
    - Runs measurements based on a schedule and outputs results
  - **Root Beacon**
    - Installs Apache, MySQL and other packages
    - Creates database tables and configuration files
    - Generates measurement schedules for node beacons
    - Collects data and provides dashboard visualization, statistical analysis (i.e., anomaly detection and weather forecasting) with alarm generation
- Third module that is external to the GENI experiment slice
  - **OnTime Beacon** (Hosted by us - <http://ontime.oar.net>)
    - User management and web-interface to Node/Root Beacons

[\*] P. Calyam, C.-G.Lee, E. Ekici, M. Haffner, N. Howes, "Orchestrating Network-wide Active Measurements for Supporting Distributed Computing Applications", *IEEE Transactions on Computers Journal (TC)*, 2006.

# OnTimeMeasure Architecture



Download Node/Root Beacon Software – [http://ontime.oar.net/download/OnTimeMeasure\\_latest.php](http://ontime.oar.net/download/OnTimeMeasure_latest.php)  
Download OnTime Control Software (*Beta!*) – [http://ontime.oar.net/download/CommandLine\\_latest.php](http://ontime.oar.net/download/CommandLine_latest.php)

# Measurement Service Capabilities

- Measurement request handling
  - Path-based active measurements (e.g., delay, jitter, loss, throughput, route changes)
    - Measurement topology (e.g., full-mesh, tree, hybrid)
    - Sampling requirements (e.g., periodic, stratified random, random, adaptive)
  - Host-based system performance (e.g., CPU, memory)
- Enforce policies for measurements scheduling
  - Measurement level restrictions for probing tools (e.g., allowable measurement bandwidth and measurement flow duration for different nodes/paths/user-roles)
- Provide raw and processed measurement
  - Measurements provisioning interfaces (e.g., raw data or graph output to human/component-service, processed output of multiple tools to a dashboard)
  - Measurement use context hooks (e.g., verify network path(s) performance in a new slice, network-awareness in an experiment to develop a novel network control scheme)
  - OnTimeMeasure instance metadata (e.g., needed by GMOC, NetKarma)

# User Workflow

## (ProtoGENI or PlanetLab Aggregates)

1. User creates an experiment slice using ProtoGENI or PlanetLab control framework tools
  - For ProtoGENI slice creation, see - <http://groups.geni.net/geni/wiki/OnTime-Install>
  - For PlanetLab slice creation, see - <http://groups.geni.net/geni/wiki/OTM-PlanetLabInstall>
2. User registers at the “Researcher Web-Portal” (<http://ontime.oar.net>), provides Slice RSpec information and requests installation of measurement instance
  - Slice RSpec should include reservation of any required measurement resources
3. Each experiment slice needing a measurement service gets its own OnTimeMeasure software instance
  - Node/Root Beacons need to be installed as slivers based on the instructions provided in Step-1 for the specific aggregate
4. Valid login to the “Researcher Web-Portal” allows user to interact with the measurement service in his/her experiment slice. Specifically, the user can:
  - i. Submit measurement requests
  - ii. Control the measurement service
  - iii. Query measurement data

View OnTimeMeasure Demo Videos at – <http://ontime.oar.net/demo>

# Screenshots

## Centralized Service Control

**1 2 3 Measurement Request Submission**

Please review and submit your measurement request to the OnTimeMeasure-GENI measure service.

**STEP 1 Resource Setup**  
Status: Complete ✓ [Modify](#)

Measurement topology architecture selected is: Centralized  
Measurement topology is as follows:  
Slice name: ontime\_m1  
Root Beacon: KANS(64.57.23.133)  
Node Beacon 1: WASH(64.57.23.165)  
Node Beacon 2: SALT(64.57.23.149)

**STEP 2 Request Specification**  
Status: Complete ✓ [Modify](#)

The tasks added to the measurement service are as follows:

Source	Destination	Metric	Pattern
WASH(64.57.23.165)	SALT(64.57.23.149)	Round-trip Delay	Periodic
WASH(64.57.23.165)	SALT(64.57.23.149)	Throughput	Periodic
WASH(64.57.23.165)	SALT(64.57.23.149)	Loss	Periodic
SALT(64.57.23.149)	WASH(64.57.23.165)	Round-trip Delay	Periodic
WASH(64.57.23.165)	SALT(64.57.23.149)	Jitter	Periodic

**STEP 3 Request Submission**  
Submit the request to initialize the measurement service. [Submit Request](#)

## Centralized Measurement Request

**Service Control**

[Start](#) Initiates communications between Root Beacons and/or Node Beacons to start the active measurements data collection

[Stop](#) Terminates communications between Root Beacons and/or Node Beacons to stop the active measurements data collection

Status: ▶ Running: Measurements are being collected in the experiment slice.

[Update](#) Refreshes the service status notification; can be used to verify whether or not any of the service components are functioning as expected

The status of the service components are as follows:

Component	Status
Slice Accessibility	OK ✓
Root Beacon Scheduler	OK ✓
Node and Root Beacon Communications	OK ✓
Measurements Data Collector	OK ✓
Analysis and Publish Authority	OK ✓
Measurement Data Visualization	OK ✓

[Proceed to query measurements data collected: Query Data](#)

**Measurement Query**

Please select from the following query options:

User: Centralized Demo Usr Metric: Round-trip Delay  
Start time: 2010-05-01 23:00:00 Source: WASH(64.57.23.165)  
End time: 2010-05-31 12:00:00 Destination: SALT(64.57.23.149)

Results type:  
 Raw Files  
 Time Series  
 Time Series with Anomalies  
 Time Series with Forecasts

[Submit Query](#)

Status: Measurement query was successful. [View Result](#)

View real-time graphs of measurement data: [View Dashboard](#)

## Centralized Measurement Query



View OnTimeMeasure Demo Videos at – <http://ontime.oar.net/demo>

# Screenshots (2)

Researcher Web-Portal

**Measurement Result**

✓ Measurement completed, please see below. Download raw files: WASH

```
[ 15] local 64.57.23.149 port 5001 connected with 64.57.23.165 port 5001
[ 15] 0.0-10.0 sec 494 MBytes 414 Mbits/sec
[ 15] MSS size 1448 bytes (MTU 1500 bytes, ethernet)
bwctl: stop_exec: 3484246228.794817

RECEIVER END

[WASH]$ bwctl -c 64.57.23.149 -f m -u -b 768k -a 10

RECEIVER START
bwctl: exec_line: iperf -B 64.57.23.149 -s -f m -m -p 5001 -u -t 10
bwctl: start_tool: 3484246254.590082

-----
Server listening on UDP port 5001
Binding to local address 64.57.23.149
Receiving 1470 byte datagrams
UDP buffer size: 0.11 MByte (default)

-----
[ 8] local 64.57.23.149 port 5001 connected with 64.57.23.165 port 5001
[ 8] 0.0-10.0 sec 0.92 MBytes 0.77 Mbits/sec 0.011 ms 0/ 655 (0%)
bwctl: stop_exec: 3484246280.789142

RECEIVER END
```

Distributed Measurement Result

OnTimeMeasure-GENI Measurement Request Creation - Mozilla Firefox

http://ontime.oar.net/MeasurementRequest.php

OnTimeMeasure-GENI | Mea...

CONTACT | LOGIN

OnTimeMeasure 1010001

geni Exploring Networks of the Future

NAVIGATION

MEASUREMENT REQUEST CREATION

To submit a measurement request to the OnTimeMeasure-GENI measurement service, please follow a 3-step process:

STEP 1 Resource Setup: You first need to setup a ProtoGENI experiment slice along with Node and Root Beacons

STEP 2 Request Specification: You next need to specify on-going measurement tasks between Node Beacons

STEP 3 Request Submission: You lastly need to review and submit your measurement request to initialize the measurement service

Proceed to Step-1: [Setup Resources](#)

Information

For details of the measurement request creation, please refer to the OnTimeMeasure Design Document.

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Mozilla Firefox

http://ontime.oar.net:8080/ov/

OnTimeMeasure-GENI | Mea... | http://192.168.63.8080/ov/

WASH\_AND\_UTAH\_Path\_Over

WASH\_AND\_UTAH\_Path\_Over

WASH\_AND\_UTAH\_Path\_Over

WASH\_AND\_UTAH\_Path\_Throughput

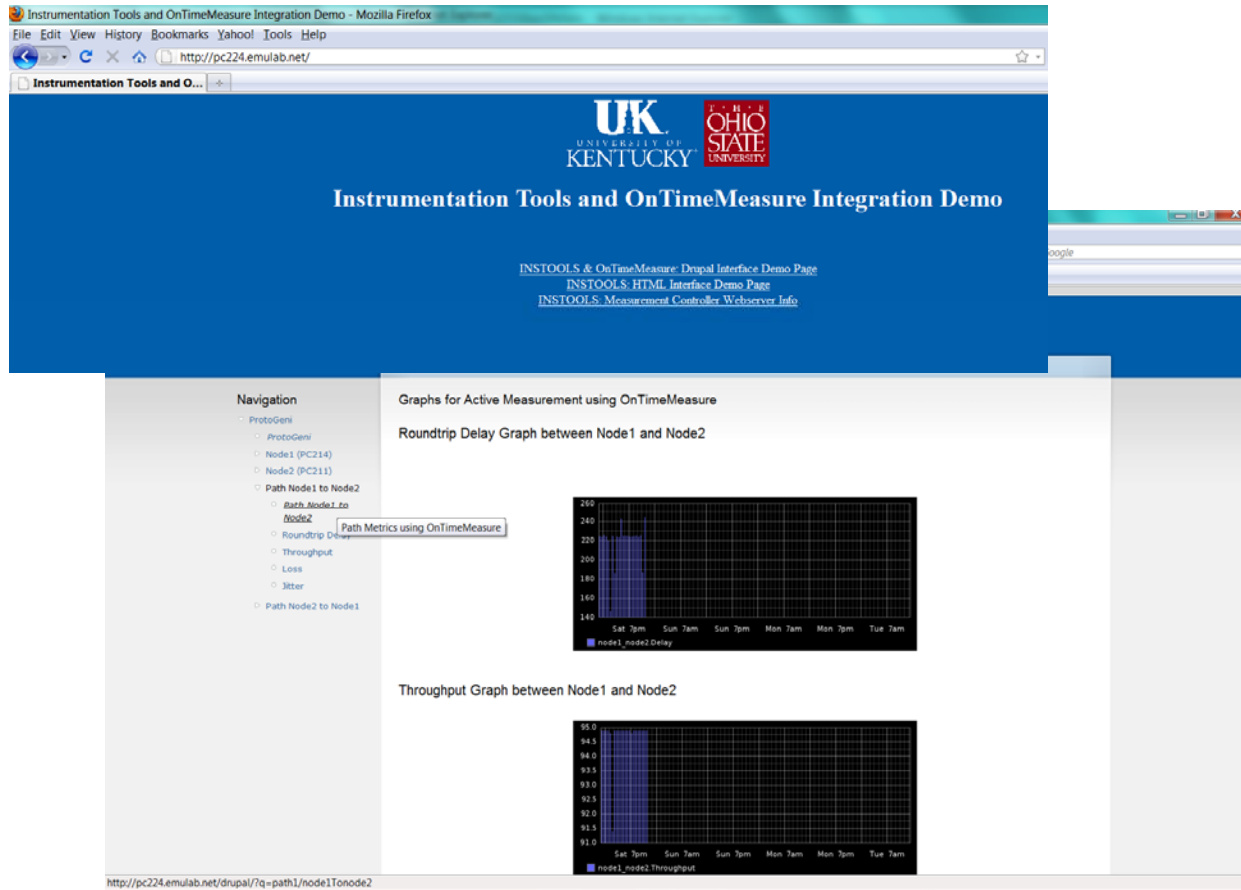
User Customizable Dashboard

# Early Experimenters

- Software released to several early experimenters
  - GENI Project Office
  - CRON 10Gbps Testbed, Louisiana State University
  - GMOC, Indiana University
  - Instrumentation Tools, University of Kentucky
  - Experiments Security Analysis, University of Alabama
  - Digital Object Registry, CNRI
  - Davis Social Links, University of California, Davis
  - S3, Purdue University, HP Labs
  - PEIBAIRA, Rochester Institute of Technology

# Integration with Instrumentation Tools

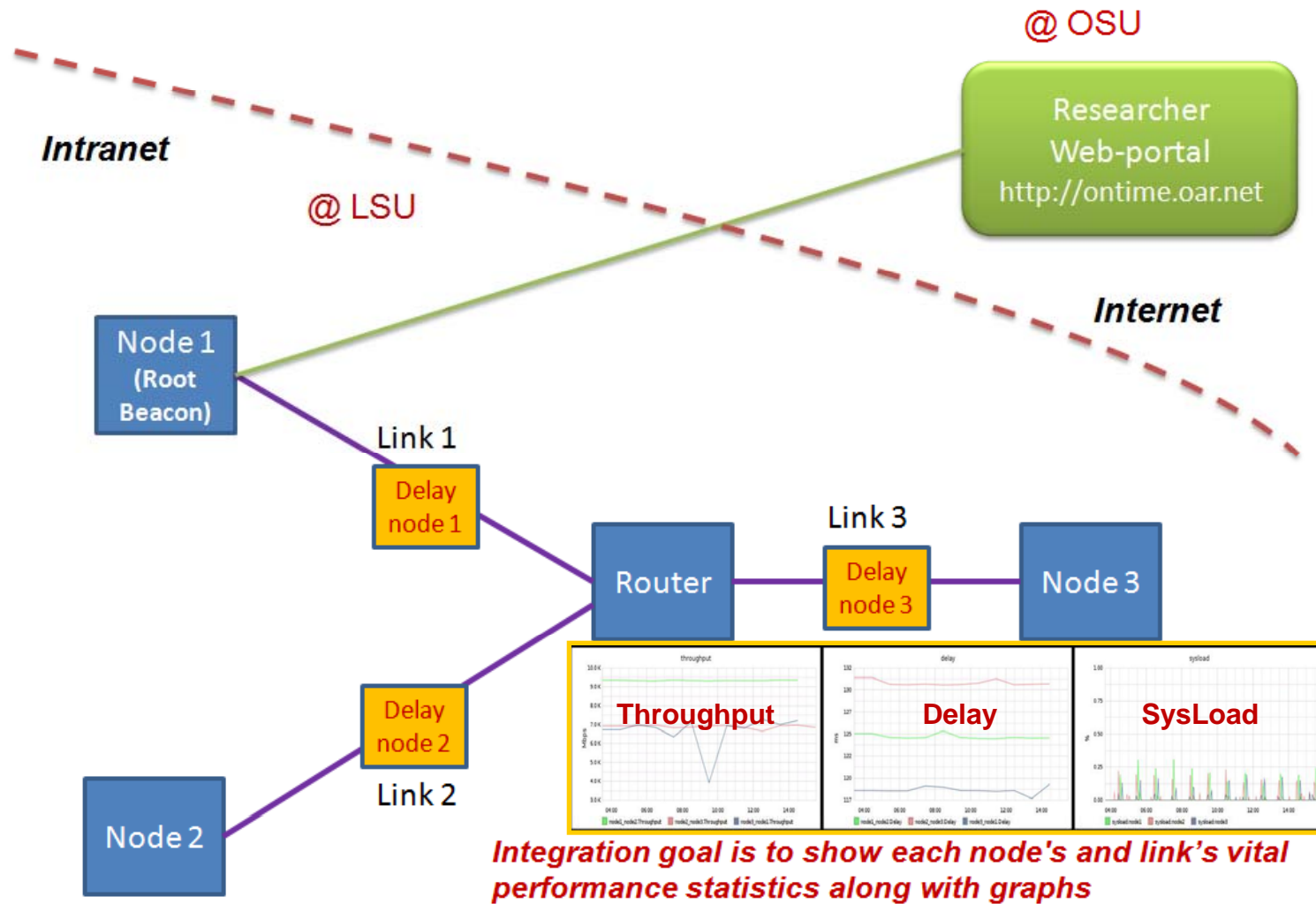
See details at - <http://groups.geni.net/geni/wiki/OTM-InsToolsDemo>



*Integration goal is to having both INSTOOLS and OnTimeMeasure software running within the same slice, and OnTimeMeasure results and graphs accessible through INSTOOLS web-interface*

# Integration with CRON 10Gbps Testbed

See details at - <http://groups.geni.net/geni/wiki/OTM-CRONInstall>



*Integration goal is to show each node's and link's vital performance statistics along with graphs*

# Spiral 3 Project Objectives

- Interoperability across multiple control frameworks and aggregates
  - Demonstrate OnTimeMeasure with mix of ProtoGENI and PlanetLab sites
  - Release package that can function across multiple aggregates
    - E.g., ProtoGENI, PlanetLab, CRON, KanseiGenie, ...
- Integrate with existing GENI tools and services including experiment control
  - InsTools, GUSH, NetKarma, ...
- Support experiment users and customize features
  - Demonstrate a GENI experiment requesting/managing/querying measurements to address a network science and engineering research issue
    - E.g., Resource allocation in a virtual desktop cloud - <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=1050225>
  - Other experiments using multiple aggregates
- Release a software version(s) of OnTimeMeasure that is integrated with as many mature GENI software tools/services

# Conclusion

- OnTimeMeasure measurement service is now available to experimenters
  - Please register at <http://ontime.oar.net> if you would like to be an experimenter, and we will follow-up with instructions
- Development is on-going, but the core measurement service capabilities are ready for testing and use
- We are seeking ideas to use OnTimeMeasure in GENI experiments
- We are looking to integrate OnTimeMeasure with other GENI software systems

Thank you for your attention ! 😊

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