

Centralized and Distributed Measurement Orchestration Software **Prasad Calyam, Ph.D.** (PI) ^{1,2,3}, **Paul Schopis** (Co-PI) ², **Chris Hartley** (Network Testbed Engineer)² & Tony Zhu (Student Programmer)^{1,3} Ohio Supercomputer Center¹, OARnet², The Ohio State University³, email: pcalyam@osc.edu¹, pschopis@oar.net²

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 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

Software Modules

- Customizable software [*] developed at OSC and OARnet
- Two main modules installed within a GENI experiment slice as part of an active

OnTimeMeasure Integration in ProtoGENI



User Workflow

- User creates an experiment slice using ProtoGENI control framework tools
 - For ProtoGENI slice creation details, see https://users.emulab.net/trac/protogeni/wiki/TutorialNew
- User registers at the "Researcher 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
- 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 at http://groups.geni.net/geni/wiki/OnTime-Installv1
- Valid login to the "Researcher Portal" allows user to interact with the measurement service in his/her experiment slice. Specifically, the user can:

measurement service

- 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 in "raw" and "processed" formats

- 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

[*] 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

Service Capabilities

- Active measurement request handling
 - Sampling requirements (e.g., periodic, stratified random, random, adaptive)
 - Active measurement tools to be used (e.g., Ping, Traceroute, Iperf)
 - Measurement topology (e.g., full-mesh, tree, hybrid)
- Enforce policies for measurements scheduling
 - Semantic priorities (e.g., superGENI-er vs. GENI-er)
 - Measurement level restrictions (e.g., allowable measurement bandwidth and measurement flow duration for different nodes/

- i. Submit measurement requests
- ii. Control the measurement service
- iii. Query measurement data

Screen Shots



Distributed Measurement Result

] local 64.57.23.149 port 5001 connected with 64.57.23.165 port 5001] 0.0-10.0 sec 494 MBytes 414 Mbits/sec

iperf -B 64.57.23.149 -s -f m -m -p 5001 -u -t 10

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

ment completed, please see below. Download raw files: WASH

15] MSS size 1448 bytes (MTU 1500 bytes, ethernet

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

tl: stop_exec: 3484246228.79481

ctl: start_tool: 3484246254.590082

P buffer size: 0.11 MByte (default

1: stop exec: 3484246280.789142

erver listening on UDP port 5001 inding to local address 64.57.23.149 ceiving 1470 byte datagrams

ECEIVER END

ECEIVER START

	Control	
Start	Initiates communications between Root Beaco the active measurements data collection	ns and/or Node Beacon:
Stop	Terminates communications between Root Be stop the active measurements data collection	acons and/or Node Bea
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Researcher Web-Portal



Centralized Measurement Query



User Customizable Dashboard





Measurement Requests Measurement Schedules Measurement Results

Researcher Web-portal



Ohio Supercomputer Center

Jhio

OARnet

paths/user-roles)

- Provide raw and processed measurement
 - Measurements provisioning interfaces (e.g., raw output of a tool to human/ component-service, processed output of multiple tools to a viz application)

- Measurement use context (e.g., curiosity about network path(s) performance in a new slice, network-awareness in an experiment to develop a novel network control scheme, troubleshoot a network bottleneck affecting an advanced application)

- Every OnTimeMeasure instance metadata gets stored for GMOC use



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