Monitoring: Introduction

Sarah Edwards, GPO

Chaos Golubitsky, GPO

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Goals

Goals for today’s meeting:

(1) Discuss major elements of a monitoring architecture

(2) Discuss a privacy proposal

(3) Update status on monitoring APIs and Portals

Agenda

- Monitoring Architecture [30 min]
  - Sarah Edwards, GPO
- Privacy [20 min]
  - Heidi Picher Dempsey, GPO
- Monitoring APIs + Experimenter/Operator Portal [20 min]
  - Chaos Golubitsky, GPO
- Status of Monitoring Pains [10 min]
  - Sarah Edwards, GPO

Monitoring: Architecture

Sarah Edwards, GPO

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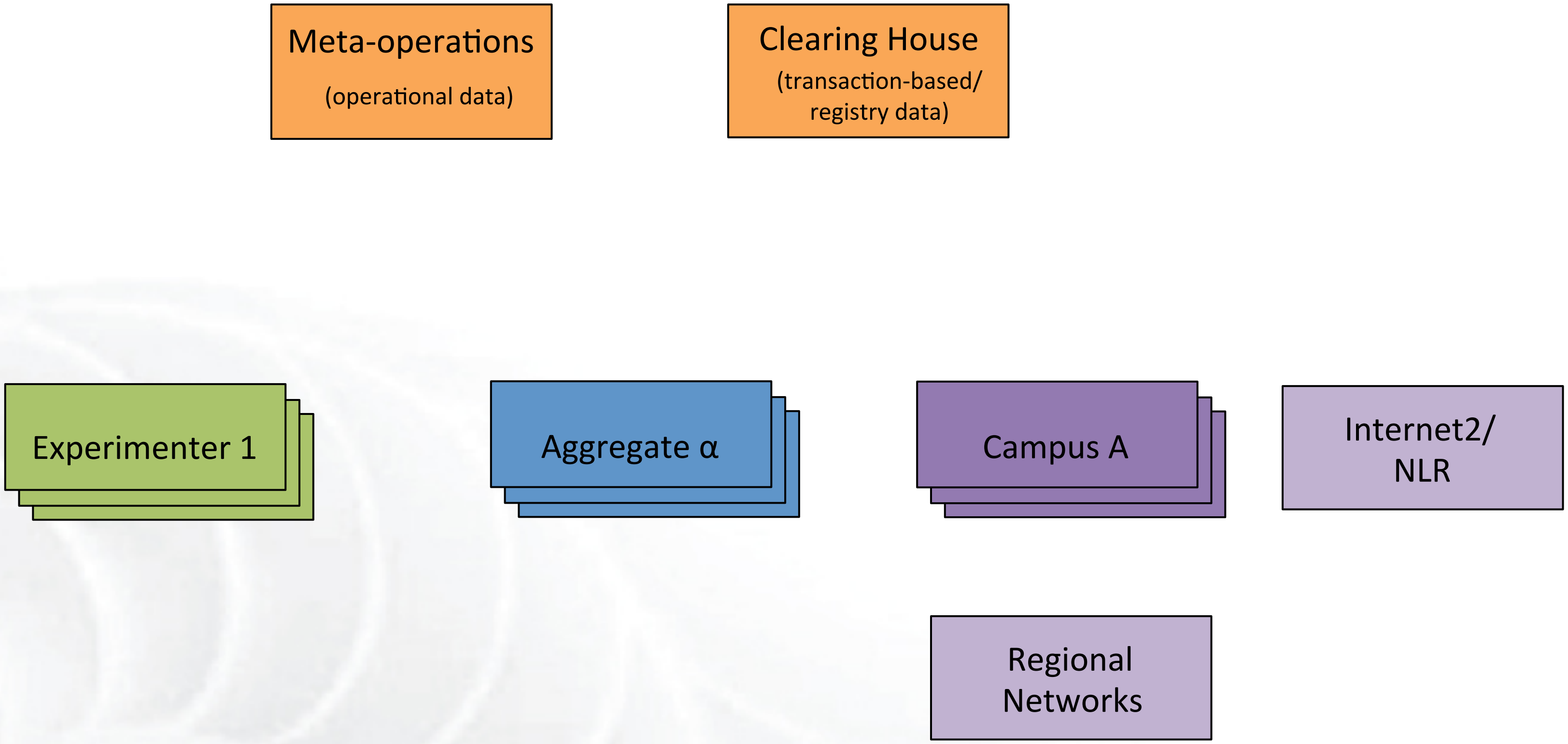
Why a monitoring architecture?

- Provide a clear description of where we are headed
  - Within the monitoring community
  - To allow us to talk to other communities such as software and I&M groups

Outline

- Why a monitoring architecture?
- Picture
  - Actors
  - Interfaces
- Deterministic vs Sampled
- Use Cases
- Data
- In a bit …
  - Privacy
  - Interfaces

GENI Actors



Meta-operations

(operational data)

Clearing House

(transaction-based/ registry data)

Experimenter 1

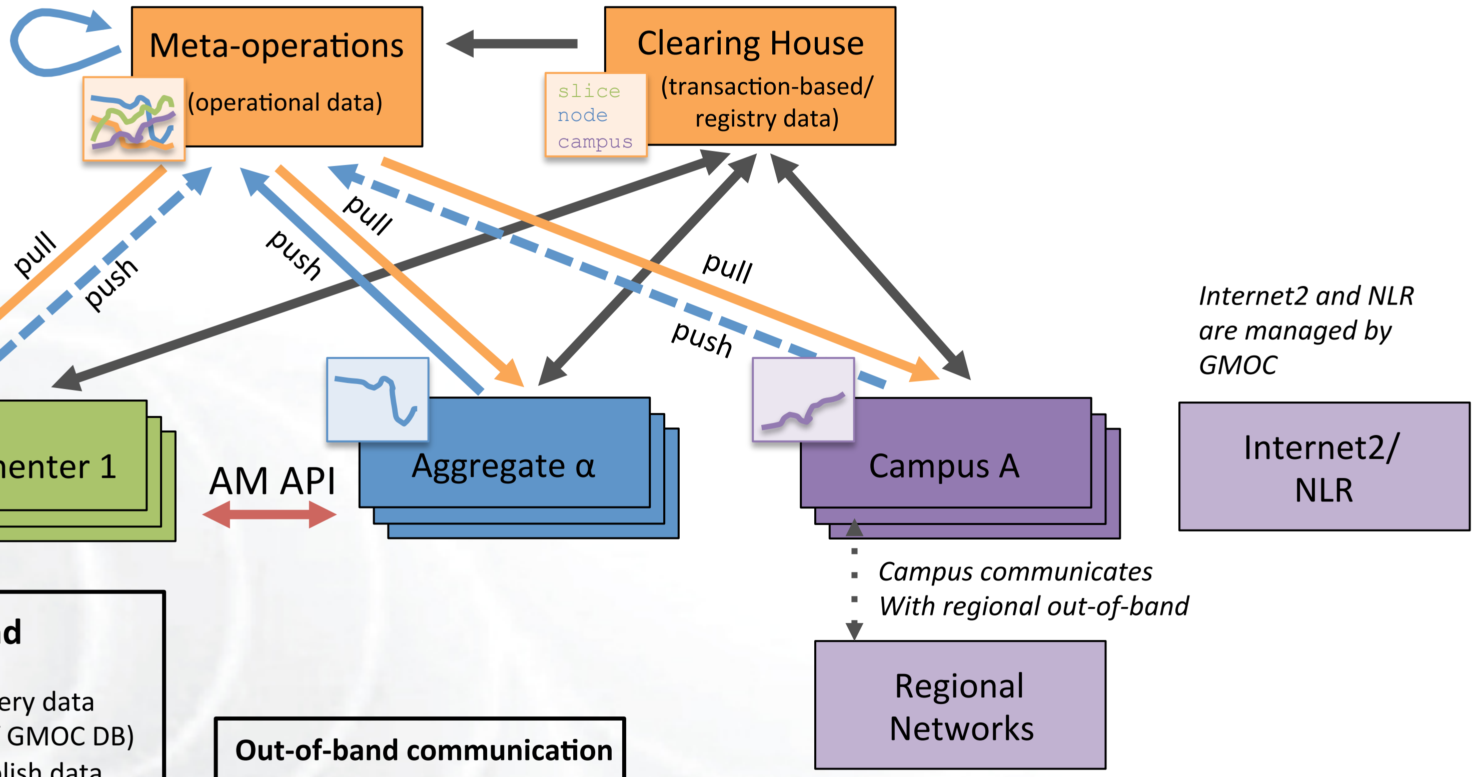
Aggregate α

Campus A

Internet2/ NLR

Regional Networks

Interfaces



Internet2 and NLR are managed by GMOC

Campus communicates With regional out-of-band

Legend

pull ←	Query data (out of GMOC DB)
push →	Publish data (into GMOC DB)
push - - →	Not yet implemented
↔	Publish/Query Clearinghouse
AM API ↔	AM API
◂ · · ▸	out-of-band

Out-of-band communication

Note that GENI participants can communicate with the others out-of-band:

- Slice e-mail (provides a way of contacting the experimenter who is the slice owners)
- Campus Point of Contact (POC)
- Aggregate POC

Types of Data

- The ***structure*** of the data falls in one of three categories:
  - *Time series* data is a particular piece of data measured over time.
    - Example: number of bytes sent on an interface over a series of adjacent 30 second time periods.
  - *Relational* data conveys entities and the relationship between them as observed at time T.
    - Example: "slice S contains resource R".
  - *Event* data denotes something happening or being noticed at a particular moment in time.
    - Example: "user U created slice S at time T”
    - Example: "the data rate on interface I exceeded threshold H at time T".
- The ***precision*** of the data can be described as either:
  - *Definitive* data is known to be definitive because it was generated by the source that created it.
    - The future GENI clearinghouse will contain a lot of definitive data.
    - Example: "slice S was created at time T by user U".
  - *Sampled* data is collected by measuring the state of the world periodically.
    - Meta-operations database contains a lot of sampled data.
    - Example: availability of an interface over time.

USE CASES

Use Case: AM Availability

Use case

- Experimenter:
  - Creates a slice & slivers at multiple aggregates
  - Gets an error using aggregate A
  - Sends the error to a GENI experimenter help mailing list
- Experiment support staffers:
  - Want to verify the current and recent health of aggregate A
  - Is there an obvious problem which explains what the experimenter is seeing?

Data to collect

- For each GENI aggregate:
  - Is it speaking the AM API (up) right now?
  - For each resource advertised by that aggregate, is it currently: available, in use, down/missing/unknown?

Interested parties

- Who needs to query this: **Everyone** might be interested in seeing the health of a GENI resource.
- Who needs to alert on this: Meta-operators. Site operators.

Use Case: Availability/utilization of an aggregate over time?

Use case

- After GEC14, GPO assesses how heavily utilized bare-metal compute resources were between GEC13 and GEC14
- GPO determines if there is generally a shortage of these resources.

Data to collect

- For each GENI aggregate, given a custom time period:
  - When was the aggregate speaking the AM API (up) during the time period?
  - During the time period, how many resources were: available, in use, down/missing/unknown?
  - During the time period, how many slivers were active?
  - During the time period:
    - How many slivers were active on the aggregate?
    - How many slivers were created on the aggregate?
  - (If possible): during the time period:
    - How many distinct GENI users had active slivers on the aggregate?
    - How many distinct GENI users created slivers on the aggregate?

Interested parties

- Who needs to query this: GPO, prospective experimenters, site operators, meta-operators.

Use Case: Status of inter-site shared network resources

Use case

- A core OpenFlow switch located at NLR in Denver starts misbehaving.
- Its control plane is operating normally, but drops all traffic on VLAN 3716 (a core shared VLAN).
- This leads to intermittent failures in experiments (traffic through Denver is dropped, traffic along other paths is fine).
- GMOC, GPO, and affected site operators gather on IRC to track down the location of the problem, using information about which sites and VLANs have fallen offline.

Data to collect

- For each L2 network resource such as the mesoscale OpenFlow VLANs which is shared between sites:
  - Is the network resource reachable at each site (from one or more central locations on the network)?
  - What is the utilization of the network resource at the site (bandwidth/packets sent/received, breakdown by type e.g. to detect excessive broadcasts)?
- For each pool of L2 network resources reservable between sites?
  - How much of the pool is available/in use/not available?
  - Is it possible to allocate and use an inter-site network resource right now (end-to-end test)?

Interested parties

- Who needs to query this: site operators, meta-operators, GPO. It may be useful to active and prospective experimenters.
- Who needs to alert on this: meta-operators, site operators.

Use Case: availability and utilization of inter-site network resources over time

Use case

- GPO is attempting to learn about bandwidth utilization over the past year to find out whether GENI experimenters tend to run numerous low-bandwidth experiments, or a smaller number of high-bandwidth ones.

Data to collect

- For each item in the previous use case, track the state over time.

Interested parties

- Who needs to query this: site operators, meta-operators, GPO.
- Who needs to alert on this: no one.

Use Case:
What is the state of my slice?

Use case

- An experimenter has a slice with slivers on many GENI aggregates.
- The experimenter wants to go to one place and get a consistent view of the health and general activity level of his sliver resources.

Data to collect

- Given a slice owned by a GENI experimenter:
  - What mesoscale slivers are defined on that slice?
  - What is the state of each resource on each sliver (active, down), both now and over the course of the experiment?
  - What is the utilization of each sliver resource (as appropriate for its type: active processes, disk space used, flowspace rule count, bandwidth), both now and over the course of the experiment?

Interested parties

- Who needs to query this: active experimenters.
- Who needs to alert on this: probably no one.

Use Case: state of aggregate utilization at my campus

Use case

- An aggregate operator receives a complaint from site IT about heavy traffic over the campus control network which seems to be originating from the aggregate operator's lab.
- He wants to quickly determine which if any slivers might be responsible for the traffic.
- If his aggregate does not appear to be causing trouble, he'd like to be able to show site IT some evidence to demonstrate that the aggregate is currently sending a typical amount of traffic.

Data to collect

- Given an aggregate:
  - What mesoscale slivers are defined on that aggregate?
  - What users have active resources on the aggregate right now?
  - What is the state of each resource on the aggregate (active, down, in use (by whom)), both now and over the recent past?
  - What is the utilization of each aggregate resource (as appropriate for its type: active processes, disk space used, flowspace rule count, bandwidth), both now and over the recent past?

Interested parties

- Who needs to query this: site operators, site IT, meta-operators: site operators need to be able to go one place to answer questions about current activity on the aggregate, in order to be able to answer questions about broken or misbehaving slivers.
- Who needs to alert on this: site operators, meta-operators.

GENI DATA

Cross-GENI data

Be able to measure that:

- Each GENI aggregate is **speaking the AM API** right now.
- Each GENI aggregate is able to execute major element of the **sliver creation workflow** via the AM API right now.
- For each L2 network resource, is the **network resource reachable** at each site (from one or more central locations on the network)?
- For each pool of L2 network resources reservable between sites, is it possible to allocate and use an inter-site network resource right now (**end-to-end test**)?

Plus historical versions of the above info.

Per Aggregate Data

Store and be able to search the list of:

- **active/created slivers** on aggregate.
- **active users** on aggregate.
- The **state of resources** (available/in use (by whom)/down/missing unknown) on aggregate.
- The **utilization and history of resources** on aggregate (as appropriate for its type: active processes, disk space used, flowspace rule count, bandwidth).
- **distinct GENI users who had active slivers** (or created slivers on said aggregate).

Plus historical versions of this info.

NOTE: the privacy of that data should be protected

L2 Network Resources Data

- For each L2 network resource (ie a static VLAN shared between sites):
  - **Utilization** of the network resources at the site (bandwidth/packets sent/received, breakdown by type e.g. to detect excessive broadcasts)?
- For each pool of L2 network resources reservable between sites:
  - Portion of the pool of VLANs that **is available/in use/ not available**?

Plus historical versions of this info.

Slice data

- Given a slice owned by a GENI experimenter:
  - Find **resources** on slice.
  - Find **state** of resources on each sliver (active/down).
  - What is the **utilization** of each sliver resource (as appropriate for its type: active processes, disk space used, flowspace rule count, bandwidth).

Plus historical versions of this info.

Discussion

- Comment?
- Suggestions?

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Privacy in GENI: Recommendations

Heidi Picher Dempsey, GPO

Adam Slagell, NCSA

Privacy for GENI Operations Data

- Privacy has been discussed many times as a general concern for GENI Operations
- No longer just academic
  - GENI currently operating at several campuses
  - GMOC campuses collecting and sharing data
  - Regionals and GENIRack projects starting to do the same in Spiral
- Monitoring group asked to provide guidance for GENI operations groups on handling data that might be private (GEC12)
- This is just a start – we recognize this is complex
- Thanks to Adam Slagell for the analysis and ideas

Assumptions

- Make guidelines that GENI participants can use to help them decide how to handle GENI data.
- Basic guidelines should be true for all, even though there may be more specific guidelines needed in some areas (examples: GMOC, GPO, experimenters, aggregate owners)
- All privacy decisions are the responsibility of the data owner (current examples: aggregate owners, GMOC)
- Privacy for opt-in users is an important but difficult topic not covered yet. No opt-in data should be shared yet.

Privacy Recommendations in GENI

- Data that CAN be shared publically:
  - Existence of slices (slice urn, UUID)
  - Slice status is active (has resources)
  - SliceName

Privacy Recommendations in GENI

- Much monitoring data CAN be shared with group access controls (based on a preliminary review of data examples from current monitoring collections)
  - GMOC access controls (protected web interface, Emergency Stop contacts)
  - Aggregate access control (ExoGENI, FOAM logs, emails)
  - Experimenter access controls (Digital Object Repository, CpMon)
  - Opt-in user could "opt-in" (or not "opt out") of sharing their monitoring data with groups via opt-in tools
- Aggregates should make sure they are not sharing user data in what they provide to other GENI groups (e.g. GMOC)
- LLR requests are a special case of sharing data. See LLR Plan (http://groups.geni.net/geni/wiki/GpoDoc#LegalLawEnforcementandRegulatoryPlan)

Privacy Recommendations in GENI

- Data that should NOT be shared at all
  - Opt-in user data (no examples now)
  - Data that identifies experimenters by username/real name
  - Data that identifies experimenter contact info

Privacy Recommendations to Experimenters

- As a slice owner, you create your slice name but may not realize it is public. GENI needs to get better warnings out about this.
- Your slice credential includes a slice email (not now, but soon). This is given to aggregates and GMOC and might be shared. If you don't want it shared (with access control), don't use a personal email
- Your personal email is part of your experimenter credential, and will be shared with the aggregate and GMOC. The GMOC will never share this info from the aggregate outside of GMOC.

Experimenters Code of Ethics

- GENI Experimenters Code of Ethics

http://groups.geni.net/geni/attachment/wiki/GENISecurity/experimenters-code-of-ethics-draft-0.9.pdf

- *"Respect the privacy and confidentiality of other GENI participants and users."*
- Access to GENI may be denied for violations

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GMOC API for Monitoring Data

GEC13 Status Report

Chaos Golubitsky, GPO

March 14, 2012

www.geni.net

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GMOC Data Submission API Status

Overview

Recent progress

Next steps during Spiral 4

Overview: Projects and Participants

- GENI Meta-Operations Center (GMOC) project:
  - Collects slice metadata, measurement data, and operational data from GENI aggregates and slice authorities
  - Beginning in Spiral 4, runs the GENI Service Desk to detect and respond to operational problems in GENI
- Participants:
  - Mitch McCracken (GMOC), primary software developer working on the data submission API and user interfaces
  - GPO infrastructure group, testing the API and user interfaces as part of Tango GENI

Overview: GMOC tools

- Collect operational slice metadata and measurement data from GENI projects:
  - Using per-project custom tools (PL, PG, ORCA, OF)
  - Using standardized APIs for data submission
- Display the collected operational data:
  - Map UI: http://gmoc-db.grnoc.iu.edu/
  - SNAPP interface for custom graph views: http://gmoc-db.grnoc.iu.edu/api-demo/
  - Experimenter interface (openid login required): https://gmoc-db.grnoc.iu.edu/protected-openid/
- Alert on and respond to problems (nagios)

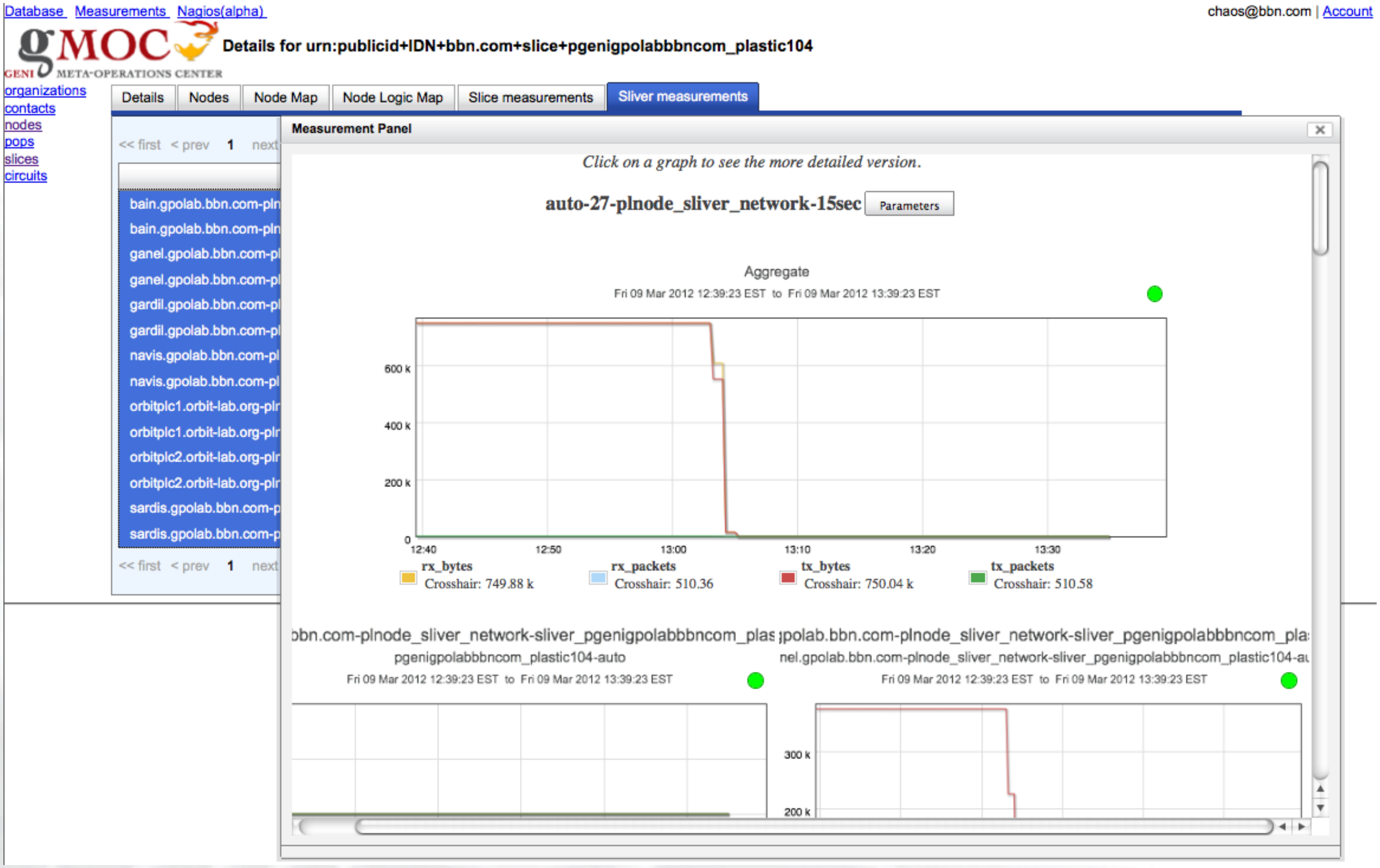
Overview: Tool Improvement Goals

- Standardize data submission:
  - Make it easy for new projects (e.g. GENI racks) to submit data to GMOC or have it collected
  - Provide consistent data naming so that GENI data can be used in standard ways
- Improve user interface:
  - Data of interest should be easy for experimenters and operators to find
  - Data should be tied together in meaningful and standard ways, e.g. slivers belonging to the same slice are grouped together
  - Operational health information (“is this thing on?”) should be easy to find

Progress: Data Submission APIs

- Currently, two APIs for submitting GENI operational data:
  - Measurement API for numeric data collected over time (key, timestamp, value)
  - Relational API for metadata: information describing something in GENI (a sliver, an interface, a VM) at a point in time
- Spiral 3 work:
  - GMOC and GPO tested and improved time-series API
  - Collected a year of data from mesoscale AMs
  - Improved reliability of API collection mechanisms
  - Improved tools for data display and reporting

Progress: GMOC Experimenter UI



Database Measurements Nagios(alpha)

chaos@bbn.com | Account

Details for urn:publicid+IDN+bbn.com+slice+pgenigpolabbbncom_plastic104

organizations
contacts
nodes
pops
slices
circuits

Details | Nodes | Node Map | Node Logic Map | Slice measurements | Sliver measurements

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sardis.gpolab.bbn.com-p
sardis.gpolab.bbn.com-p

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Measurement Panel

Click on a graph to see the more detailed version.

auto-27-plnode_sliver_network-15sec Parameters

Aggregate

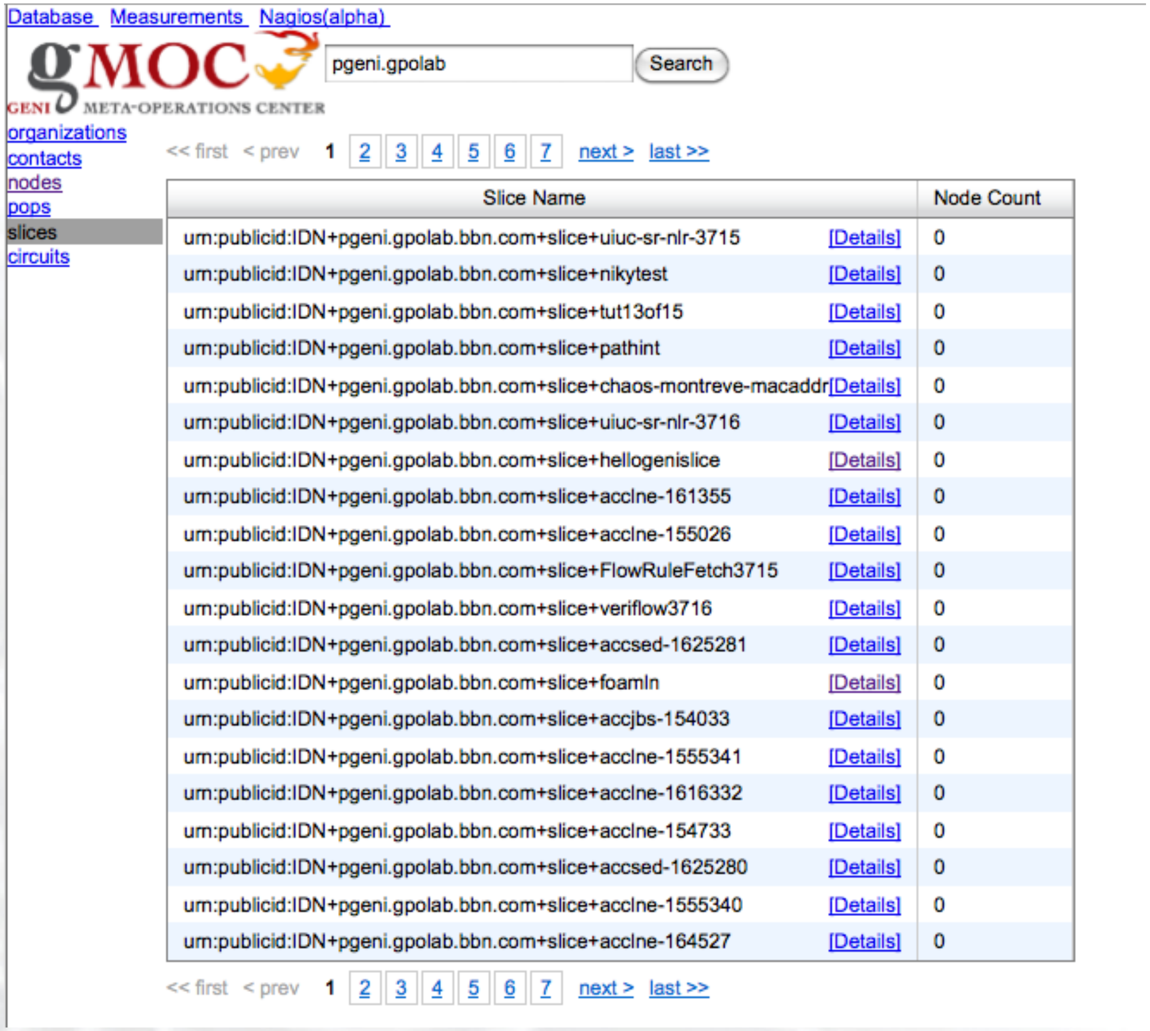
Fri 09 Mar 2012 12:39:23 EST to Fri 09 Mar 2012 13:39:23 EST

🟨 rx_bytes Crosshair: 749.88 k
🟦 rx_packets Crosshair: 510.36
🟥 tx_bytes Crosshair: 750.04 k
🟩 tx_packets Crosshair: 510.58

bbn.com-plnode_sliver_network-sliver_pgenigpolabbbncom_plas
pgenigpolabbbncom_plastic104-auto
Fri 09 Mar 2012 12:39:23 EST to Fri 09 Mar 2012 13:39:23 EST

polab.bbn.com-plnode_sliver_network-sliver_pgenigpolabbbncom_pla
nel.gpolab.bbn.com-plnode_sliver_network-sliver_pgenigpolabbbncom_plastic104-au
Fri 09 Mar 2012 12:39:23 EST to Fri 09 Mar 2012 13:39:23 EST

Progress: Slice name data from GPO SA



Slice Name		Node Count
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+uiuc-sr-nlr-3715	[Details]	0
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+nikytest	[Details]	0
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+tut13of15	[Details]	0
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+pathint	[Details]	0
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+chaos-montreve-macaddr	[Details]	0
urn:publicid:IDN+pgeni.gpolab.bbn.com+slice+uiuc-sr-nlr-3716	[Details]	0
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Next Steps: Data Submission API

- Spiral 4 work in progress:
  - Test and improve the relational data API:
    - Test relational data submission using mesoscale SA and AMs
    - Expand the relational data schema
    - Create and test standardized tools for submitting relational data from GENI AMs, SAs, and racks
  - Continue work on data definitions and time-series API:
    - Define and collect data so it is consistent among aggregate types, with the clearinghouse proposals, with I&M, etc
    - Keep operating and improving data submission format
  - Collect data from ExoGENI and InstaGENI racks

Next Steps: User Interface Improvements

- Continue to improve documentation for UI users
- Improve operational health reports (e.g. AMs which have/have not reported recently)
- Use relational data to make sure time-series graph metadata is meaningful and useful
- Use URNs and UUIDs consistently with other GENI entities, to uniquely identify things over time
- Support specific use cases of interest:
  - Display/sort GENI slices with slivers on a given AM
  - Display/sort data for a given slice

Questions?

- We're always interested in:
  - Early adopters for the experimenter portal
  - GENI health tests that people are running or would like to see run
  - Feedback!
- Contacts:
  - GENI operational monitoring list: monitoring@geni.net
  - GMOC: Mitch McCracken (mrmccrac@grnoc.iu.edu)
  - GPO: Chaos Golubitsky (chaos@bbn.com), Sarah Edwards (sedwards@bbn.com)

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GEC13 Status & Change since GEC12

Status		Requirement/Pain Point
🟢	(1)	Standard monitoring stats: cpu, mem usages; i/f stats
🟠	(2)	Topology information. (a) End-to-end testing/Network reachability (b) Integrity of topology.
🟠	(3)	OpenFlow Stats
✔ 🟠	(4)	Make monitoring software easier to deploy (ie. plastic slices monitoring software)
🟢	(5)	Administering OpenFlow AM (OF Opt-In) and tie-together GENI things for OF (ie slivernames hard to determine from slice name)
✔ 🟠	(6)	Aggregate/campus/slice view of resources and their availability
🟠	(7)	Sharing data (a) SNMP data (b) Sharing of non-SNMP data
✔ 🔴	(8)	Privacy
🔴	(9)	Collecting and sharing of GENI usage/overall experiment stats
🔴	(10)	Accountability report: How to prove if this is not my fault?

GEC13 Status & Change since GEC12

Status		Requirement/Pain Point
NEW ● @ GEC12	(11)	Security (incl. supporting experimentation)
NEW ● @ GEC12	(12)	Accessing, finding and visualizing data
NEW ● @ GEC12	(13)	Event notification system
NEW ● @ GEC12	(14)	How does a third party help troubleshoot a slice?
NEW ● @ GEC12	(15)	Universal names for shared resources (e.g. circuits and switches)
NEW ● @ GEC12	(16)	Timing: Speed we can respond to issues is affected by delay caused by polling
✔ NEW ● @ GEC12	(17)	Minimal set of data required by Aggregates at each site. (a) Balance usefulness of data with not being a burden and privacy. (b) Define what is publicly identifiable and what should be private.
NEW ● @ GEC12	(18)	Racks

Get Involved

- Biweekly conference call:
  - Every other Friday at 2pm Eastern
  - Information on GENI monitoring mailing list
- GENI operational monitoring list: monitoring@geni.net