

Discussion Strawman – Operational Dataset

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Introduction

The GENI Meta-Operations Center is working in Spiral 1 to provide 2 main operations services for GENI:

- 1.) Emergency Shutdown – The ability to proactively detect or receive notification on GENI integrated slices that have violated the rules or limits GENI or individual GENI projects have set for them, and act on that information to isolate or shutdown the misbehaving slice or some portion of the infrastructure used by it. Examples of violations might include exceeding a limit of resources expected for a slice set by component or aggregate managers, or reports of abuse or other policy violations. Shutdown may include direct shutdown access by GMOC, shutdown requests passed through clearinghouses, or some combination of the two.
- 2.) GENI Unified Operational View – A view of GENI as a whole, showing the state and utilization of GENI across all projects. This would include a variety of maps, graphs, and other visualizations, as well as an interface for the raw collected operational data for use by the research users of GENI.

This document lays out the types of data about each GENI project we think are most relevant to these goals. This is not intended to be final. In fact, this is intended mostly to help focus discussion on these topics. Our goal is to reach consensus in GENI on the most important types of operationally significant data we can gather. This will require a balance between getting sufficient data to make these services useful, without becoming overly onerous on the control frameworks, or other GENI projects. This document does not discuss the protocols, formats, or processes that will be used to exchange and store this data.

We've created 5 categories of data that we think are most important. Each of these categories, the specific kinds of data in each category, and their relationship to our Spiral 1 goals are described in the Data Types section. We've also begun to prioritize the data according to how important that data is to the services GMOC will provide. This is intended to help guide GENI projects in what areas to focus on.

Data Types

Topology

Description: Topology includes the current relation among components, links, slivers, and slices. It is used to understand how components and aggregates are interconnected, and to map slivers and slices onto the infrastructure they are using. Topology also includes the administrative topology of slivers and components. This is necessary to provide as emergency shutdowns only to those slivers and/or components of GENI that are misbehaving. Topology data is also important for researchers and for understanding their system and in the development for new tools for network management.

Relation to GMOC Services: To build a unified view of the current state of GENI, it is essential to understand how GENI components and/or aggregates are connected. This is also essential to allow for emergency shutdown. Without some understanding of the infrastructure in use by a slice, it would be impossible for GMOC to shutdown the right infrastructure and/or to notify the correct clearinghouses. In this early stage, topology information might be manual, fairly static, and coarse, becoming more dynamic and granular as capabilities and operational requirements evolve.

Examples:

- Extant components and their relationship to aggregates
- Extant slivers and their relationship to components
- Connections between components (or at a higher level between aggregates?)
- Characteristics of links between components
 - • link bandwidth
 - • technology type (e.g. Myrinet, fiber channel, SONET, Ethernet ; point-to-point, multipoint)

Proposed Minimal Requirements:

- Component relationship to aggregates
- Resource relationship to components
- Interface relationship to components.
- Circuit/link relationship to interfaces

- Circuit/link relationship to other circuits/links (such as composition)
- Component geographic location.
- Circuit/link bandwidth (maximum throughput ?).
- Sliver relationship to components
- Sliver relationship to principals.
- Sliver relationship to clearinghouses.
- Component provider/manager

Operational Status

Description: Operational Status includes the actual state of a particular GENI or GENI-relevant component, link, aggregate, sliver, or slice at a given point in time.

Possible states would include:

- Up – a given GENI object is operational without any known service limitations
- Down – a given GENI object is unavailable to provide services
- Impaired – a given GENI object is running, but is limited in its services, or services are operating in a sub-optimal way

Relation to GMOC Services: Showing the actual state of object within GENI is essential for both Emergency Shutdown and the GENI Unified Operational View. It would be used by GMOC to understand the state of slices and underlying infrastructure so we can shut down misbehaving slices appropriately. It will also be important to visualize the current operational state of GENI on the Unified Operational View. Seeing up/down status of GENI components & aggregates will be especially useful in showing activity on GENI early on. This does not mean that we will need the operational status of every sliver of every component of every GENI project right away. Rather, getting aggregate and component status will be most useful early on, with additional details as they are required, and as capabilities for collecting and sharing the data evolve.

Examples:

- Component operational status
- Interconnection (link) operational status
- Sliver operational status (e.g. virtual machine running, Ethernet VLAN active, etc.)

Proposed minimum Requirements:

- Component operational status
- Interconnection (link) operational status (maybe not for spiral 1)

Administrative Status

Description: Administrative Status includes the expected state of a particular GENI or GENI-relevant component, link, aggregate, sliver, or slice at a given point in time. Some projects may be purposely configuring components to be down, or impaired in some way such as intentional congestion or security conditions.

Possible states would include:

- Up – a given GENI object is expected to be running without any limitations
- Down – a given GENI object has been made intentionally unavailable
- Impaired – a given GENI object is running, but has been intentionally configured with limitations of some kind

Relation to GMOC Services: Generally speaking, Administrative Status is important to both Emergency Shutdown and the GENI Unified Operational View, for the same reasons as Operational Status. Operational Status and Administrative Status will be used in conjunction to understand overall status. For instance, a slice that has an Administrative Status of down, but Operational Status of up may be misbehaving and may need to be shutdown.

Examples:

- Interface administrative state for network interfaces used to interconnect GENI components. May also include things like provisioned reserved bandwidth across an interconnect.
- Component administrative state (configured to be up / configured to be down)
- Sliver administrative state (configured to be up / configured to be down)

Proposed minimal requirements:

- Component administrative state (configured to be up / configured to be down)
- Sliver administrative state (configured to be up / configured to be down)

Utilization Measures

Description: Utilization Measures would be measures of the resources in use by a particular GENI or GENI-relevant component, link, aggregate, sliver, or slice, especially over time. This would not include data that

might determine operational condition, but would be especially useful in visualizing activity across GENI.

Relation to GMOC Services: Some utilization measures will be very useful to collect early on for both Emergency Shutdown and the GENI Unified Operational View. This would include data needed to ensure a slice is operating within its specifications, in the case of Emergency Shutdown, or to visualize traffic on the GENI Unified Operational View. Some other measures may be less crucial to these functions, but would still be useful to GENI research users looking for this data. Again, utilization on an aggregate and component level may be the first data of this type shared, with slice and sliver level utilization measures coming as needs and capabilities evolve.

Examples:

- Link utilization (# bits, # frames, # packets, etc.) for resources that interconnect components
- CPU utilization both at the component and sliver level
- Disk utilization both at the component and sliver level
- Utilization/consumption of other reservable resources (e.g. wireless spectrum)

Proposed minimal requirements:

- Link utilization (# bits, # frames, # packets, etc.) for resources that interconnect components
- CPU utilization at the component level.

Condition Measures

Description: Condition measures are a subset of utilization measures that may be useful in determining whether a particular GENI or GENI-relevant component, link, aggregate, sliver, or slice is behaving correctly and is not impaired in some way.

Relation to GMOC Services: Condition measures would be most crucial to the task of Emergency Shutdown. This category would include information such as error or packet loss rates which would help to identify slices exceeding or mishandling resources. For the GENI Unified Operational View, these measures would be as needed as the other utilization measures, in the form of useful graphs and other visualizations of GENI-wide performance.

Examples:

- Link Error Rates
- Packet Loss Counters

- Packet Queues/Drops

Proposed minimal requirements:

- Interface(Link) Error counters
- Interface packet loss/drops counters

Specialized Data

Description: Specialized Data would include any Utilization or Condition Data that is only of particular use for a particular type of GENI component or aggregate. For example, a wireless component might have utilization data that is not significant for a GENI Unified Operational Interface, but which projects may wish to share, for access by GENI research users.

Relation to GMOC Services: Specialized data would be most relevant to the sharing of data with GENI researchers through the GENI Unified Operational View. Researchers in a specific arena may need access to the data and measures specific to that area. For example, a wireless experimenter might want to look at both the signal strength of a component over a period of time, as well as the end to end performance of the experiment over the same time. A single interface into that data would likely be attractive to potential GENI research users.

Examples:

- Wireless signal interference, propagation characteristics, etc.
- Disk cache performance
- Optical FEC statistics, propagation characteristics, etc.
- Opt-in user statistics

Priorities

The following list is in order of importance of each type of data to the functions of the GMOC in Spiral 1:

1. Static Aggregate & Component Topology Data
2. Aggregate & Component Administrative Status / Operational Status
3. Aggregate & Component Basic Condition Measures, including error rates, queue levels, and packet loss
4. Aggregate & Component Basic Utilization Measures, including packet and bandwidth counters
5. Slice Topology Data (what components are used to support a given slice)
6. Sliver & Slice Administrative Status/Operational Status

7. Sliver & Slice Basic Condition Measures, including error rates, queue levels, and packet loss.
8. Sliver & Slice Basic Utilization Measures, including packet and bandwidth counters
9. Detailed and/or Dynamic Topology Updates, including details about bandwidth interconnecting Components and automated Topology changes
10. Additional Specialized Data
11. Additional Condition Measures, such as wireless or optical interference

Characteristics, predictive error data, or environmental conditions that might affect wireless or sensor networks

12. Additional Utilization Measures, including data categorization (protocol, src/dst AS, etc), opt-in user characteristics (technical or demographic)