Summary

One of the essential early operational requirements for the GENI facility is the need to manage and coordinate the stop and/or containment of GENI resources among all GENI projects in the case of an urgent request. Emergency stop is the system used to respond to incidents of interference or resource exhaustion caused either unintentionally (misconfiguration), or intentionally (malware). This is intended to protect GENI aggregates when they begin to integrate with other aggregates, and when GENI begins to interconnect with outside networks.

For Spiral 4, GENI aggregates will have active experimentation and increased integration and interconnection with other aggregates or non-GENI networks. This document will provide an approach for an emergency stop service in Spiral 4, as well as a potential evolution for emergency stop for future spirals.

Spiral 4 Emergency Stop Model

In Spiral 4, the GENI Meta-Operations Center is tasked with providing emergency stop services for GENI, as well as continued enhancement and testing for the emergency stop process. This service is meant to provide the basic functionality needed by the active experimenters on GENI while remaining lightweight and simple.

General Goals/Architecture

The emergency stop system has 3 main goals:
1. To give experimenters and other GENI stakeholders a single place to go for notification of emergency stop issues
2. To facilitate emergency stop with GENI aggregates
3. To provide an easily understood, flexible service that minimizes disruptions for GENI experiments or GENI aggregates

These goals are accomplished through two mechanisms:

1. First, a coordination process to identify related GENI aggregates and/or slices for a given stop request via the operational dataset in the GMOC DB, notify appropriate Aggregate operators, facilitate communication among GENI users and Aggregate operators, verify resolution of the issue, and report issues to the appropriate GENI communities.
2. Last, a last resort isolation mechanism using the existing Internet2 and NLR GENI donations to effectively quarantine aggregates with issues from the rest of the GENI infrastructure.

In spiral 4, this emergency stop service will continue to be mostly manual, and still potentially coarse, if isolation is required. Nevertheless, it will provide a basic operational safety net to ensure overall stability of the GENI facility and will give experimenters the ability to request action from a single GENI contact and ensure that the right GENI parties are notified.

Emergency Stop Participants & Stakeholders

**GMOC** – GMOC will be the main coordinator and owner of emergency stop tasks: communication (internal and external to GENI), tracking, reporting, notification, and escalation to aggregate isolation from the GENI Mesoscale.

**Aggregate Operators** – Aggregate operators bear operational responsibility for their aggregates and thus will be responsible for timely response to
emergency stop requests. Response will include investigation of the issue, and intervention/shutdown of the source of the issue, if the Aggregate Operator confirms the issue. Aggregate operators will also be responsible for reporting their findings and results back to GMOC for tracking & reporting purposes.

**GENI-Interconnected Networks & Experimenters** – Spiral 4 experimenters and GENI-interconnected networks will be responsible only for reporting problems that may require emergency stop to GMOC and for providing as much information about the issue as possible.

**GENI LLR representative** – The GENI lawyer, law enforcement, and regulatory representative may receive DMCA or other similar requests which may require immediate emergency stop of a slice. The GENI LLR representative, who is responsible for fielding these requests and responding, is also responsible for working with the GMOC to appropriately shutdown appropriate slices.

**Emergency Stop Triggers**

In Spiral 4, no direct detection of emergency stop triggers will be required, however as GMOC’s pro-active monitoring and escalation procedures on the Mesoscale is improved, alarms and reports of trouble may lead to further investigation and potential requests for emergency stop. There are 3 main types of stop triggers, which may be reported to GMOC by GENI Aggregate operators, GPO, experimenters, or the GENI LLR representative:

1. *Disruptive or unexpected resource exhaustion:* cases in which an aggregate’s resources are being exhausted or in which an aggregate is being otherwise adversely affected by traffic from another aggregate
2.) *Disruption to non-GENI networks:* reported cases from external networks, such as campus operators, production research & education networks, or international peers in which these networks are being improperly affected by GENI resources

3.) *LLR requests:* cases of requested legal action (e.g. Cease & Desist, subpoena, AUP violations) based on the content or actions within a GENI slice

In all these cases, emergency stop action should be requested through the GMOC Service Desk by email – gmoc@grnoc.iu.edu or phone – 317-274-7783. If such a request comes to aggregates, aggregates should redirect these requests to this GENI stop contact unless the requests are limited to the aggregate and so are unrelated to the GENI facility as a whole.

In order to limit the parties who may request stop action, the GMOC will use a callback verification procedure to verify identity of the person/organization requesting the emergency stop. GMOC will use the operational contact dataset in order to authenticate these requests.

If an Aggregate Operator would like to authenticate GMOC for stop requests, they should use a callback procedure. After being contacted by someone claiming to be the GMOC, the Aggregate Operator may call the GMOC back using the published GMOC phone number, and ask to speak to the requester who made the initial contact. Using a callback process for GMOC authentication is optional, left to each Aggregate Operator to decide.

**The GENI Operational Contact List**

To serve as a coordinator for emergency stop, GMOC will require an accurate, well-maintained contact list for contacting the appropriate GENI aggregates for stop issues.
The GENI operational contact list should consist of 2 contacts for each GENI aggregate:

1.) an initial contact or list to receive notification of an emergency stop request
2.) a personal, long-lived contact to receive escalation notifications of emergency stop requests.

Contacts will need to have both an email and phone number.

This list exists today within the GMOC operational database. GMOC will maintain and improve this list, to ensure we have this data for every GENI aggregate, and that the data is up to date.

Security Implications for Emergency Stop

In Spiral 4, the emergency stop system will require a basic system to ensure authentication of the manual contacts among the GENI parties. This will consist of a simple callback mechanism for the contact between GMOC and Aggregate operators. As automated mechanisms for emergency shutdown are incorporated into the GENI API, the specific mechanisms for automated message/connection authentication should also be specified.

Correlation of Requests to Aggregates

One of the challenges for the emergency stop service is connecting a stop request to the appropriate related projects in the absence of a unique GENI identifier for a slice that GMOC could use to identify the projects providing resources.

In Spiral 4, GMOC will continue to gather the rich operational data from the GENI projects, mapping slivers and slices to the responsible aggregates and
contacts. As GMOC begins to gather more data relating slices to aggregates, and as GENI identifier issues begin to mature, GMOC will improve the precision and chattiness of emergency stop communication.

GENI URNs are the preferred identifier for GENI resources. In cases where URNs can’t be used, GMOC will make best efforts to identify the resources using whatever identification methods are available.

Response Time Expectations & Escalation Path

Response Expectations - emergency stop will be limited to the most severe and urgent cases, so timely response by Aggregate operators will be crucial. Because of this, appropriately notified parties should provide acknowledgement of an emergency stop request (but not necessarily issue resolution) within one business hour.

First Escalation - If GMOC receives no acknowledgement from notified parties in the appropriate time frame, GMOC will escalate to the escalation contact for that project (or it’s PI). GMOC will then wait another business hour for the response for the project.

Isolation - If no acknowledgement is received after initial escalation, a decision will need to be made about whether to contain the aggregate that is the suspected source of the issue. If it is decided that containment is proper and feasible, GMOC will either directly contain the aggregate or request that containment. For Spiral 4, GMOC will make these decisions based on the severity of the situation and the anticipated side effects of the isolation. These decisions can be reviewed and improved.

User Expectations - This process means that those who request emergency stop should expect some issue acknowledgment or response by two business
hours from the reported time for emergency stop request. Timeframes for the actual resolution of issues is not guaranteed and users must be aware of this.

The effectiveness of this process will depend on 3 things:

1. The quality of contact information and data to relate contacts to the aggregate or slice data provided by those reporting issues
2. Widespread understanding among GENI projects and users of the overall process, especially the expected triggers for emergency stop
3. Understanding within the GENI community about their expectations and roles for emergency stop

**Post Spiral 4 Emergency Stop**

Evolution of the Spiral 4 emergency stop system will depend largely how GENI as a whole evolves. However, six areas of improvement seem likely:

1. *Isolation on Slice Level vs. Aggregate Level* – significant interactions between GMOC and project operations teams will help to give better information to make stop actions less intrusive.
2. *Better correlation of requests to the appropriate related projects and components* – as GENI evolves, GMOC will make use of better and more consistent data to make faster, more accurate correlation between Emergency stop requests and the related projects.
3. *Development of automated interactions* – interact with interested GENI projects to develop better ways to automate the process of issue tracking and resolution, exploring the issues surrounding automated control plane access for emergency stop.
4. *Additional Triggers for Emergency Stop* – Additional cases for emergency stop may be added as needed.
5. *Integration with the GENI API* - Aggregate operators should have a unified API to provide management services to groups like GMOC. Automated and Authenticated emergency shutdown hooks should be part of any GENI API compliant aggregate.

**GMOC Emergency Stop Contact Information**

Phone: (317) 274-7783  
Email: gmoc@grnoc.iu.edu  
A workflow figure of this process can be seen here:

**GENI – Emergency Stop Procedure Workflow (Spiral 4)**