

MAX Quarterly Report

July 1, 2010 - September 30, 2010

Overview

The MAX project is building a GENI facility known as the "Mid-Atlantic Crossroads GENI (MAX GENI) Facility". This is an experimental fiber-based regional network in the Washington DC metro area. MAX GENI will provide the GENI community with access to a regional optical network consisting of wavelength-selectable switches, 10 Gbps Ethernet switches, and virtual machines. The network infrastructure is building upon the NSF-funded DRAGON network which provides end-to-end dynamic circuit provisioning via a standardized Web Services interface through the use of a distributed GMPLS control plane - ensuring deterministic, high-speed performance over dedicated network resources. DRAGON technologies and software are also deployed on multiple research and education networks throughout the world. This wide deployment will be utilized to facilitate access to the MAX GENI capabilities by remotely located researchers.

MAX GENI has leveraged the DRAGON network infrastructure (and related technologies) by adding server virtualization capabilities (PlanetLab nodes) at the edges of the network and programmable network hardware (NetFPGA hosts) at two core switching nodes. MAX GENI also has the capability to connect researchers in the Mid-Atlantic region to the rest of the GENI community via its connection to the private, high-speed Layer 2 backbone provided by Internet2 and the ProtoGENI project. The project web site is located here: <http://geni.maxgigapop.net>

A detailed listing and description of the MAX Spiral 2 project tasks and milestones is provided in Appendix A. The task and milestones identified for this reporting period are as follows:

Quarter 4 (9/30/2010):

MAX.S2.v: DRAGON Aggregate Manager Enhancement Performance Testing and Evaluation.

MAX.S2.w: DRAGON Aggregate Manager Common Control Framework Updates

MAX.S2.x: User Support

MAX.S2.y: DRAGON Aggregate Manager Documentation

This document provides a summary of the activities accomplished during this reporting period, and also summarizes the focus area and work plan moving forward.

Milestones Status Report for Spiral 2, Quarter 4

MAX.S2.v: DRAGON Aggregate Manager Enhancement Performance Testing and Evaluation. Conduct performance testing and evaluation of DRAGON Aggregate Manager. Solicit user feedback on use of DRAGON Aggregate Management. Summarize strengths and weakness of DRAGON Aggregate Manager and develop recommendations for future upgrades.

Status:

During this reporting period we completed the implementation and performance testing of topology based MAX Aggregate Manager provisioning. This testing includes use of a PlanetLab based MAX RSpec to specify a GENI experiment topology. These topologies can include PlanetLab slices and dynamically provisioned network paths. A summary of testing procedures and performance results are available on the project web site:

- <http://geni.maxgigapop.net/twiki/bin/view/GENI/ExperimentTopology>

This link includes detailed instructions for how to exercise these features, QuickTime movies showing example provisioning commands, and typical performance results. An example performance test shows that it typically takes about 3 1/2 minutes to provision an experiment topology consisting of three PlanetLab Nodes, three dynamically provisioned network paths, and a dynamically provisioned ProtoGENI network path.

We have solicited users feedback on the MAX AM. This includes working with a researcher at Yonsei University of Seoul Korea who have installed the MAX AM on their testbed for use and evaluation. This is early work at this stage, and our main focus has been on assisting with initial install and testing. We have also discussed potential areas for extended testing and development collaborations between us. We hope to obtain additional feedback and possible development contributions in the future. We also are working on finding additional users for the MAX AM and GENI facilities. Additional information on general user support status is provided in MAX.S2.x summary below.

Based our implementation and testing of the MAX AM so far, we have the following observations regarding strengths, weaknesses, and focus areas for future improvements:

-The strengths include the modular and extensible design of the MAX AM. We feel this is proper architecture for regional networks like MAX wishing to combine multiple resources into integrated GENI Experiment Topologies.

-Another strength is this modular approach has forced us to deal with the heterogeneous nature of multiple "resource managers" somewhat earlier than others in the community. However, this will be a general challenge for multi-aggregate GENI Experiment Topology building, and we feel the techniques we have applied within the MAX AM can be applied more broadly to the GENI control framework.

-The primary weakness areas are in monitoring and status reporting after instantiation of topology. We expect that these issues will be addressed as part of the next set of development activities which will focus on making the current MAX AM capability set operational. This is expected to include status reporting to users and the GMOC.

MAX.S2.w: DRAGON Aggregate Manager Common Control Framework Updates. Incorporate updates and changes to the DRAGON Aggregate Manager based on the results of milestone Task r: Quarter 3 above and user feedback.

Status:

During this reporting period we completed the MAX AM updates to enable RSpec defined topologies which include PlanetLab slices, MAX dynamically provisioned network paths, and ProtoGENI provisioned paths. Details regarding the implementation, user api, and example provisioning cases are available at the project web site here:

- <http://geni.maxgigapop.net/twiki/bin/view/GENI/Software>

We also completed the MAX AM Plug-In for PlanetLab SFI/SFA. This allows a user to use the standard PlanetLab SFI/SFA or the MAX AM native API to request GENI Experiment Topology instantiation. Details on the MAX AM SFI/SFA Plug-In are available here:

- <http://geni.maxgigapop.net/twiki/bin/view/GENI/AggMgrSFA>

MAX.S2.x: User Support. Work with and support interested users on use of the DRAGON GENI Facility.

Status:

The main focus in this area has been for users who are closely associated with the GENI project development and deployment. This has included working with researchers from GpENI and Yonsei University of Seoul Korea. Our work with the GpENI group has included building of experiment topologies which included connections over ProtoGENI to GpENI resources. This includes the deployment on GpENI of a MAX Dynamic Network Resource Controller (IDC). This work may be expanded to include a complete MAX AM in the future. We have also begun discussions with the Washington University, St. Louis SPP team to utilize the MAX AM to instantiate resources on MAX GENI facility as

part of their operations. This work is in the initial stages, but we hope to have working topologies available as part of GEC9 demonstrations.

We hope to expand our user base to researchers outside the direct GENI development community. However, based on our experience to date, we feel we may need to progress a little further in cross-aggregate topology building to create the environment that will attract this new class of users. We hope that the ongoing collaborations with GpENI, WUSTL, and others will allow this to be realized.

MAX.S2.y: DRAGON Aggregate Manager Documentation. Update the design and installation documents for the DRAGON Aggregate Manager. Provide updated open source software distribution of GENI DRAGON Aggregate Manager and other related software.

Status:

The MAX GENI Aggregate Manager documentation has been updated to reflect the latest feature and implementation details. The below web site contains the Aggregate manager documentation:

- <http://geni.maxgigapop.net/twiki/bin/view/GENI/Software>

The documentation located here provides instructions on how to install the MAX Aggregate Manager for those interested in deploying the system to control their own set of substrate resources. In addition, this site includes documentation for those who desire to utilize the MAX Aggregate Manager Web Service interface to request instantiation of MAX GENI resources. Documentation is also provided for installation and use of the MAX Aggregate Manager API and PlanetLab SFI/SFA interface.

We will continue to update the main project web site (geni.maxgigapop.net) with the latest software distributions and configuration documents. Below is a listing of the locations of some of the most critical components:

MAX-DRAGON-GENI Aggregate Manager Repository:
<svn://svn.maxgigapop.net/geni-aggregate>

MAX Aggregate API Reference Implementation
<https://geni.maxgigapop.net/twiki/bin/view/GENI/AggMgrApiClient>
<https://geni.maxgigapop.net/twiki/pub/GENI/AggMgrApiClient/MAXGENIAggregateManager.pdf>

MAX Aggregate Manager SFI/SFA Integration (MAX AM Plug-In)
<http://geni.maxgigapop.net/twiki/bin/view/GENI/AggMgrSFA>

PlanetLab Control Framework MAX RSPEC:
<http://svn.planet-lab.org/svn/sfa/trunk/sfa/rspecs/aggregates/max.xml>
<http://geni.maxgigapop.net/twiki/pub/GENI/Software/max-rspec.xsd>

PlanetLab Control Framework SFA:
<http://svn.planet-lab.org/svn/sfa/trunk/>

DRAGON/OSCARS/IDC Software Package:
<https://wiki.internet2.edu/confluence/display/DCNSS>
<http://dragon.east.isi.edu>

Project Participants

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Appendix A

MAX GENI Project

Tasks and Milestones

1. Introduction

This appendix defines the tasks and deliverables for Spiral 2 phase of the MAX project which is constructing the Mid-Atlantic Network Facility for Research, Experimentation, and Development (MANFRED) GENI Facility. A listing of the deliverables and milestones organized by due date is provided below. Section 2 provides a more detailed description of the tasks and deliverables.

Quarter 1 (12/31/2009):

MAX.S2.a: NetFPGA Integration into DRAGON
MAX.S2.b: NetFPGA as a GENI Resource Plan
MAX.S2.c: DRAGON Aggregate Manager Enhancement Design
MAX.S2.d: Common Control Framework Design
MAX.S2.e: User Support
MAX.S2.f: DRAGON Aggregate Manager Documentation

Quarter 2 (3/31/2010):

MAX.S2.g: NetFPGA as a GENI Resource Implementation
MAX.S2.h: DRAGON Aggregate Manager Enhancement Initial Implementation.
MAX.S2.i: Common Control Framework Design Update
MAX.S2.j: Common Control Framework Implementation
MAX.S2.k: Common Control Framework Documentation
MAX.S2.l: User Tool Evaluation and Development Plan
MAX.S2.m: User Support
MAX.S2.n: DRAGON Aggregate Manager Documentation

Quarter 3 (6/30/2010):

MAX.S2.o: DRAGON Aggregate Manager Enhancement Updated Implementation.
MAX.S2.p: DRAGON Aggregate Manager Common Control Framework Integration Plan
MAX.S2.q: DRAGON Aggregate Manager Common Control Framework Integration Implementation
MAX.S2.r: DRAGON Aggregate Manager Common Control Framework Integration Testing
MAX.S2.s: User Tool DRAGON Framework Implementation
MAX.S2.t: User Support
MAX.S2.u: DRAGON Aggregate Manager Documentation

Quarter 4 (9/30/2010):

MAX.S2.v: DRAGON Aggregate Manager Enhancement Performance Testing and Evaluation.
MAX.S2.w: DRAGON Aggregate Manager Common Control Framework Updates
MAX.S2.x: User Support
MAX.S2.y: DRAGON Aggregate Manager Documentation

2. Tasks and Deliverables

a) Virtualization Servers Integration into MANFRED

This task will include the integration of the PC/NetFPGA systems into the DRAGON network environment. These systems will be connected to the edge of the DRAGON network and will be available as a resource for GENI researchers. These NetFPGA cards have multiple Gigabit Ethernet interfaces which will be connected to the DRAGON network to facilitate multiple topologies in support of experiment configurations. The PC/NetFPGA systems will be made available for use as a PlanetLab node or as standalone system with access to NetFPGA card and programming interface. Other organizations in the

ProtoGENI cluster are working on techniques to virtualize the NetFPGA resource. This capability will be tested and incorporated as possible into the DRAGON environment.

The Quarterly Milestones for this task are defined below.

- Quarter 1 (12/31/2009):
 - i) (S2.a) NetFPGA Integration into DRAGON. Complete the placement and configuration of the NetFPGA systems into the DRAGON network. This will include configuration and integration to allow use of the NetFPGA systems as end-systems connected to DRAGON provisioned network paths. This will not include integration into the general GENI slice/sliver provisioning system. That functionality will be dependent on results from study in item ii below.
 - ii) (S2.b) NetFPGA as a GENI Resource Plan. Develop a plan to enable the NetFPGA systems to be generally available as part of a GENI slice/sliver and topology provisioning. This will include a review of the work by ProtoGeni and others on the development of NetFPGA virtualization technologies.
- Quarter 2 (3/31/2010):
 - i) (S2.g) NetFPGA as a GENI Resource Implementation. Implement the results of the plan from milestone Task a:Quarter 1:ii above. The expected result is for the NetFPGA systems to be available as MANFRED GENI slice/sliver resource.

b) Enhance DRAGON Aggregate Manager

This task is to enhance the current reference implementation of the DRAGON Aggregate Manager. The objective here is to facilitate the provision of the DRAGON network resources in support of GENI researcher and experiment use. This will include enhancement of the current Aggregate Manager to enable user specification of a topology which includes both compute and network resources. The DRAGON Aggregate Manager will be responsible for authorization and resource verification (topology computation) in advance of resource provisioning in accordance with the user specified topology descriptions. This work will extend the previous DRAGON Aggregate Manager to provide the basis for an extensible control and provisioning framework.

The Quarterly Milestones for this task are defined below.

- Quarter 1 (12/31/2009):
 - i) (S2.c) DRAGON Aggregate Manager Enhancement Design. Complete design for the enhancements to the DRAGON Aggregate Manager to include the features described in above task description.
- Quarter 2 (3/31/2010):
 - i) (S2.h) DRAGON Aggregate Manager Enhancement Initial Implementation. Complete initial implementation of enhanced DRAGON Aggregate Manager based on design work in milestone Task b:Quarter 1:i above. This initial implementation will focus on user interface and topology specification which combines compute and network resources into a common user request format.
- Quarter 3 (6/30/2010):
 - i) (S2.o) DRAGON Aggregate Manager Enhancement Updated Implementation. Complete updated implementation of enhanced DRAGON Aggregate Manager based on design work in milestone Task b:Quarter 1:i above. This updated implementation will extend the work completed in Task b:Quarter 2:i above to include features for more robust user authorization and resource verification (topology computation) techniques.
- Quarter 4 (9/30/2010):
 - i) (S2.v) DRAGON Aggregate Manager Enhancement Performance Testing and Evaluation. Conduct performance testing and evaluation of DRAGON Aggregate Manager. Solicit user feedback on use of DRAGON Aggregate Management. Summarize strengths and weakness of DRAGON Aggregate Manager and develop recommendations for future upgrades.

c) Participate in the development of a common GENI Control Framework or set of Interoperable Mechanisms

This task will include working within the larger GENI community to work on development of a common or compatible set of GENI control frameworks. This may include the normalization of the existing GENI control frameworks to a common GENI interface definition, or possibly the development of a common set of mechanisms for individual framework specification. The latter would allow mechanisms such as

translators to be developed to enable cross framework interactions. It is anticipated that the details of the technical solution will be the subject of specially focused GENI working groups consisting of PlanetLab, ProtoGENI, ORCA, ORBIT, and other control frameworks. This task will include participating in these larger discussions to work toward a common GENI control framework.

The Quarterly Milestones for this task are defined below.

- Quarter 1 (12/31/2009):
 - i) (S2.d) Common Control Framework Design. Work with GENI community to develop an approach for a common control framework and/or other mechanisms to allow interoperation between GENI facilities. Develop initial documentation of this plan in sufficient detail for the various clusters to take implementation action for their respective control frameworks.
- Quarter 2 (3/31/2010):
 - i)(S2.i) Common Control Framework Design Update. Continue work with the GENI community to develop an approach for a common control framework and/or other mechanisms to allow interoperation between GENI facilities. Update associated documentation.
 - ii) (S2.j) Common Control Framework Implementation. Develop an initial common framework implementation sufficient for interoperability testing. Conduct interoperability testing with other GENI Facilities to evaluate ability for multiple GENI facilities to interoperate.
 - iii) (S2.k) Common Control Framework Documentation. Generate a document summarizing the results of interoperability testing and general capabilities for GENI Facilities to interoperate.

d) Integrate enhanced DRAGON GENI Control Framework with DRAGON Testbed

The primary objective of this task is to apply the results of task c above, to the actual DRAGON network and facilities. The common GENI framework, or inter-framework mechanisms, that result from task c will require changes to the current DRAGON Framework and Aggregate Manager. This will include adaptation for the unique set of resources located on the DRAGON network, as well as enhancements to the experimenter facing interface.

The Quarterly Milestones for this task are defined below.

- Quarter 3 (6/30/2010):
 - i) (S2.p) DRAGON Aggregate Manager Common Control Framework Integration Plan. Develop a design and implementation plan for the DRAGON Aggregate Manager to incorporate the results common/interoperable control framework approach developed in Task c above.
 - ii) (S2.q) DRAGON Aggregate Manager Common Control Framework Integration Implementation. Incorporate changes to the DRAGON Aggregate Manager based on the results of milestone Task d: Quarter 3: i above.
 - iv) (S2.r) DRAGON Aggregate Manager Common Control Framework Integration Testing. Conduct testing with updated DRAGON Aggregate Manager and common control framework. Document results and changes needed.
- Quarter 4 (9/30/2010):
 - i) (S2.w) DRAGON Aggregate Manager Common Control Framework Updates. Incorporate updates and changes to the DRAGON Aggregate Manager based on the results of milestone Task d: Quarter 3 above and user feedback.

e) Improve user access to prototype GENI via enhanced tools

This task will include development of user focused tools to facilitate and enhance the ability and ease with which users can access the GENI DRAGON environment. This will likely include working with other project and cluster developed APIs such as GUSH and RAVEN to ensure they work seamlessly with the DRAGON control frameworks.

The Quarterly Milestones for this task are defined below.

- Quarter 2 (3/31/2010):
 - i) (S2.l) User Tool Evaluation and Development Plan. Review the available user tools across the GENI facilities and clusters and identify best candidate for integration into the DRAGON facility and control framework.
- Quarter 3 (6/30/2010):

i) (S2.s) User Tool DRAGON Framework Implementation. Incorporate user tools identified in milestone Task e: Quarter 2: i above. into the DRAGON facility and control framework

f) Support increased use of testbed by external researchers

This task will include the outreach and support of external researchers who would like to use the GENI DRAGON facilities. The exact support will be tailored to the individual users and researchers as they are identified.

The Quarterly Milestones for this task are defined below.

- Quarter 1 (12/31/2009):
 - i) (S2.e) User Support. Work with and support interested users on use of the DRAGON GENI Facility.
- Quarter 2 (3/31/2010):
 - i) (S2.m) User Support. Work with and support interested users on use of the DRAGON GENI Facility.
- Quarter 3 (3/31/2010):
 - i) (S2.t) User Support. Work with and support interested users on use of the DRAGON GENI Facility.
- Quarter 4 (9/30/2010):
 - i) (S2.x) User Support. Work with and support interested users on use of the DRAGON GENI Facility.

g) Deliver aggregate manager design documentation to GPO

This task will be to deliver design and usage documentation to the GPO for the DRAGON Aggregate Manager. This is expected to include architecture and design documents, configuration and usage documentation, and open source software distributions.

The Quarterly Milestones for this task are defined below.

- Quarter 1 (12/31/2009):
 - i) (S2.f) DRAGON Aggregate Manager Documentation. Update the design and installation documents for the DRAGON Aggregate Manager. Provide updated open source software distribution of GENI DRAGON Aggregate Manager and other related software.
- Quarter 2 (3/31/2010):
 - i) (S2.n) DRAGON Aggregate Manager Documentation. Update the design and installation documents for the DRAGON Aggregate Manager. Provide updated open source software distribution of GENI DRAGON Aggregate Manager and other related software.
- Quarter 3 (6/30/2010):
 - i) (S2.u) DRAGON Aggregate Manager Documentation. Update the design and installation documents for the DRAGON Aggregate Manager. Provide updated open source software distribution of GENI DRAGON Aggregate Manager and other related software.
- Quarter 4 (9/30/2010):
 - i) (S2.y) DRAGON Aggregate Manager Documentation. Update the design and installation documents for the DRAGON Aggregate Manager. Provide updated open source software distribution of GENI DRAGON Aggregate Manager and other related software.