G E N I

Global Environment for Network Innovations

Milestone 6
Candidate Control Framework for GENI Real-Time Measurements

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“Embedding real-time measurements for cross-layer communications”

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1 Document Scope

This section describes this document's purpose, its context within the overall GENI project, the set of related documents, and this document's revision history.

1.1 Executive Summary

This technical note presents the outcome of work package, "Milestone 6: Identify a candidate control framework," of Project Nr. 1631, "Embedding real-time substrate measurements for cross-layer communications."

At the beginning of Spiral 1, our ERM project was not part of any specific GENI cluster, instead working with the goal to pick one cluster during the first year. During Spiral 1, we evaluated the various control frameworks in order to assess the feasibility of joining a cluster and integrating our work on real-time measurements within one of these clusters. In this milestone, we discuss this endeavor and our recent decision to join the Cluster D ORCA team.

In Section 2, we provide the details of our decision and highlight some of the work we have planned to implement with Cluster D. Specifically, ERM's first step is to integrate our concept of a unified measurement framework within the ORCA/BEN aggregate, enabling real-time measurements using the networking equipment embedded in BEN.

1.2 Related Documents

The following documents are related to this document, and provide background information, requirements, etc., that are important for this document.

1.2.1 GENI Documents

Document ID	Document Title and Issue Date
GENI_QR_ERM_Apr09	1Q09 Status Report
GENI_QR_ERM_Jul09	2Q09 Status Report
GENI-INF-PRO-S1-CAT-01.3	GENI Infrastructure Substrate Catalogue
GENI-MS1-ERM-March09-v1.1	Technical Note 1, Milestone 1
GENI-MS2-ERM-March09-v1.0	Technical Note 2, Milestone 2
GENI_MS3_ERM_March09_v1-0	Technical Note 3, Milestone 3
GENI_MS4_ERM_June09_v1-0	Technical Note 4, Milestone 4
GENI_MS5_ERM_Sept09_v1-0	Technical Note 5, Milestone 5

1.3 Document Revision History

The following table provides the revision history for this document, summarizing the date at which it was revised, who revised it, and a brief summary of the changes. This list is maintained in chronological order so the earliest version comes first in the list.

Revision	Date	Revised By	Summary of Changes
1.0	01 Sept 09	C.P. Lai	Initial draft

2 Candidate control framework

2.1 Overview

In our previous milestones, we assessed the capabilities of the GENI infrastructure with respect to real-time measurement [erm09_1] and discussed the issue of interfacing the available embedded performance monitors (PMONs) to the GENI control framework and to the access point of the GENI researcher. Rather than interfacing every performance monitoring device within the substrate directly with the control framework, we recommended the design and implementation of a unified measurement framework (UMF) [erm09_2]. The UMF represents a universal, integrated measurement platform that abstracts the measurement capabilities within the network substrate and makes them accessible/sliceable to the control framework. A software architecture that can support the UMF within the GENI infrastructure was outlined in [erm09_3]. We also provided an example of how to realize the hardware implementation of the UMF using NetFPGAs [netfpga09_1].

2.2 ORCA Cluster D

Following the Spiral 1 development stage, our goal was then to identify an appropriate candidate control framework and GENI cluster for the integration of our real-time measurement subsystem. Within this direction, we evaluated the various control frameworks in order to assess which control framework fits best with our vision of a unified measurement framework.

We made significant strides in this direction by recently joining the ORCA Cluster D team [orca09_1]. This move was based on our continuing discussions with other GENI teams, specifically RENCI, Duke University, and North Carolina State University. We also evaluated the feasibility of joining the ProtoGENI Cluster through interactions with the University of Wisconsin (MeasurementSystem project [barford06_1]) and also the ORBIT Cluster [erm09_3]. Further, we had continuous interactions with the University of Houston [gurkan08_1].

Ultimately, our decision to join the ORCA team was based on which cluster's infrastructure was most aligned with our vision of integrating the UMF. Specifically, we plan to work closely with the BEN substrate [orcaben08_1] as a means of creating real-time physical layer measurements. Taking into account the ERM team's current knowledge base in optical networking, the following points highlight the rationale for joining the Cluster D team efforts.

1. First, BEN is a dark optical fiber network whose networking equipment already enables some embedded measurement capabilities. BEN nodes use both Polatis fiber switches that are capable of optical power monitoring, as well as Infinera DTN ROADMs that allow for forward error correction (FEC) and bit-error count functionalities; these were previously assessed in [erm09_1]. The real-time measurement subsystem can then leverage these performance monitoring capabilities to extract physical layer information and transmit them to the UMF.
2. Furthermore, the ORCA team has close links with the SILO project and envisions possible future implementation of the SILO architecture [silo09_1]. As was determined in [erm09_3], the real-time measurement capabilities provided by the BEN substrate could then be interfaced and accessible as a collection of API calls within the aforementioned SILO architecture. This would represent a new component to the SILO framework, that is specific to the operating environment and allows (physical) measurement information to be gathered within SILO. The API may be fronted by specific "measurement" SILO services with control interfaces (knobs)

to adjust the measurement accuracy or time-scale. Additional ordering constraints would define where to fit the measurement service(s) into the SILO stack.

3. The networking equipment within the BEN substrate, as well as the cluster control framework structure, support the network management protocols and data exchange formats that we envision compliable with the UMF. As compared to other clusters' infrastructure, Cluster D's architecture can straightforwardly lend itself to using some of the protocols and formats that we outline in [erm09_3]. We will require real-time exchange of measurement and control information between the substrate's performance monitors and the UMF via SNMP or TL1, as well as an NDL resource description data format exchange between the UMF and the GENI control framework. The ORCA team supports NDL between the substrate aggregates and the control framework, which we can then leverage in implementing the UMF.
4. The ORCA team, in conjunction with RENCI/BEN, has previously envisioned their architecture as being able to support cross-layer design [baldine07_1] and support ERM's notions of enabling cross-layer communications via real-time measurements. RENCI agrees with our overall project vision of creating a cross-layer communications infrastructure so that the optical substrate can deliver functionalities that will enable GENI networking [stevenson07_1].

This collaboration with the ORCA cluster, and specifically with RENCI and BEN, provides a feasible means for implementing our vision of enabling real-time physical layer measurements within GENI. In future Spiral 2 work, we plan to proceed with the development of the UMF with a NetFPGA and pursue our collaborations with ORCA by integrating the UMF into the BEN substrate. In this way, we can enable real-time measurements within a GENI test-bed with the potential to realize cross-layer communications in the future GENI infrastructure.

3 Summary and Conclusions

In this report, we discuss our latest Spiral 1 milestone of identifying a candidate control framework in which to integrate our vision of enabling real-time physical layer measurements. We highlight our rationale for joining the Cluster D ORCA team and provide an overview of the work we have planned within these integration efforts. The collaboration with the ORCA cluster provides a feasible means for implementing real-time measurements within GENI.

4 Bibliography

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