G E N I

Global Environment for Network Innovations

Milestone S2.d
Integrate UMF with BEN

Document ID: ERM_S2d_Aug10

August 31, 2010

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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 the work package Milestone S2.d of Project Nr. 1631, "Embedding real-time substrate measurements for cross-layer communications." This milestone document comprises the fourth deliverable of ERM in Spiral 2 and involves contributing to the cluster D effort by integrating the UMF subsystem with the Cluster D network substrate. More specifically, we integrated the developed hardware and software resources of UMF to the BEN infrastructure at the RENCI Point-Of-Presence (PoP).

In Section 2, we summarize our previous work in milestone S2.a, S2.b, and S2.c. In Section 3, we explain the software and hardware components of the UMF architecture. Section 4 presents the work that was done to integrate UMF into BEN at the RENCI PoP. Section 6 gives a summary and conclusion.

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
ERM_S2a_Dec09	Spiral 2 Milestone 2.a Technical Note
ERM_S2b_Mar10	Spiral 2 Milestone 2.b Technical Note
ERM_S2c_June10	Spiral 2 Milestone 2.c Technical Note

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	30 Aug 10	M. S. Wang	Initial draft

2 Previous Work (Summary of Milestones S2.a, S2.b, and S2.c)

The goal of milestone S2.a [erm_1] involved the design and development of UMF, which serves as a means for gathering physical-layer measurements and conveying the data to the GENI researcher in an aggregated, unified way. Design considerations were taken into account so that the UMF could be integrated within the ORCA cluster, initially, and then extended to other GENI control frameworks in the future. Further, we discussed an implementation of the UMF by means of a NetFPGA Cube [netfpga_1], which is an integrated system composed of a general purpose processor, in addition to the proprietary NetFPGA hardware [netfpga_2]. The UMF comprises of both a software component (implemented on the general purpose processor), as well as a hardware component (implemented on NetFPGA card). Each component has a defined role in facilitating the UMF to access the networking elements and its measurement data.

Further, the goal of milestone S2.b [erm_2] involved implementing and demonstrating a working software interface between the UMF and at least one subsystem that is capable of embedded physical layer measurements, such as bit-error rate measurement or optical power monitoring. The specific subsystem we chose is a set of four Polatis switches within the ORCA-BEN [orca_1] network, from which we retrieved the optical power. In doing so, we have merged our UMF design with the integrated measurement framework (IMF) [imf_1] project implementation. By realizing the measurement handler (MH) for the Polatis switch and testing the functionality of the XMPP server and pubsub module (PSM), we demonstrated the ability of IMF to obtain real-time optical power measurements from any of the four Polatis switches in the ORCA-BEN network [orca_1].

Then, the goal of milestone S2.c [erm_3] involved demonstrating a working UMF prototype by implementing an experimental use-case at the Lightwave Research Laboratory at Columbia University [lrl_1]. We set up a protected lightpath that switches the input signal into a path containing an SOA if the input optical power is below a predefined threshold, and bypasses the SOA otherwise. We compared the eye diagrams and BER curves for the unprotected and protected paths while changing the attenuation of the input signal. For the same attenuation, we examine a more open eye diagram and lower BER for the protected path versus the unprotected path.

3 UMF Architecture

The UMF is implemented on a NetFPGA Cube system [netfpga_1], [netfpga_2]. It comprises of both a software component (using the general purpose processor), as well as a hardware component (using the NetFPGA card) [erm_1]. Fig 3.1 shows the architectural block diagram of the UMF.

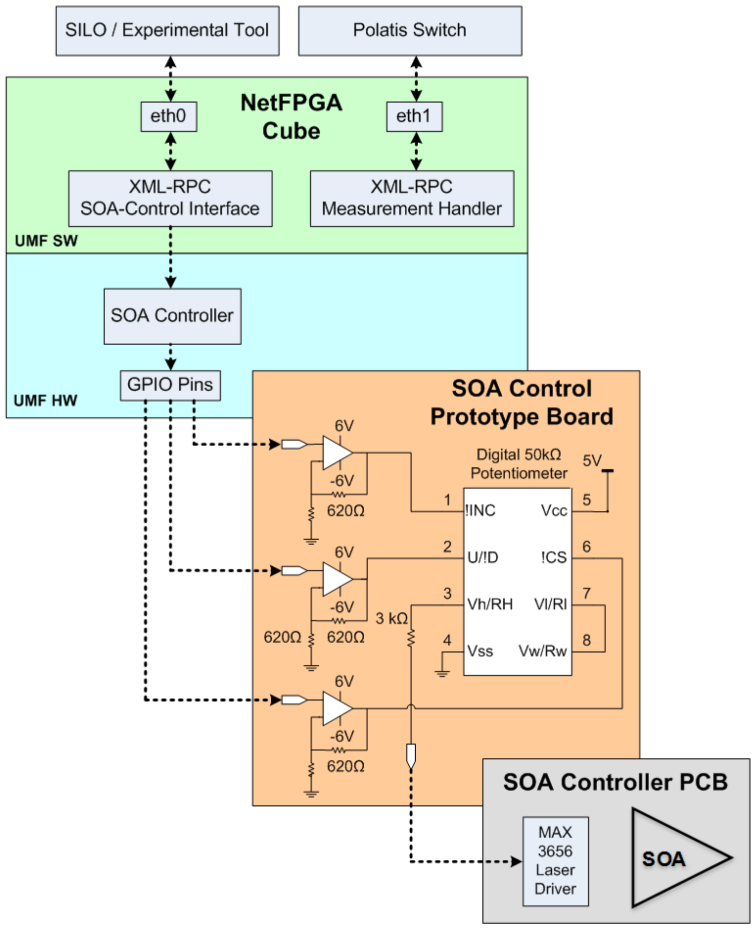

Fig 3.1 UMF Architecture

The UMF SW consists of the XML-RPC-based code, including the measurement handler (MH) and the SOA-control interface. The MH provides a unified interface to obtain real-time optical power measurements from Polatis switches [polatis_1]. The SOA-control interface is used to communicate with SILO or other experimental tools to enable cross-layer communication and control.

Further, the UMF HW consists of an SOA controller that can control the gain of an SOA. The SOA resides on a printed circuit board (PCB) that contains a current driver. The gain of an SOA is controlled by the amount of current driven across it. This current driver is connected to a digital potentiometer, which is housed on the SOA Control Prototype Board. This potentiometer is used to vary the current in the current driver. The UMF SW can control the UMF HW to vary the gain of the SOA, based on the power measurement from the Polatis switch, thereby enabling cross-layer communication and control.

4 Integrating UMF with BEN

The UMF, described in Section 3, is integrated into the BEN network. Figure 4.1 shows the physical connections made in the integration process.

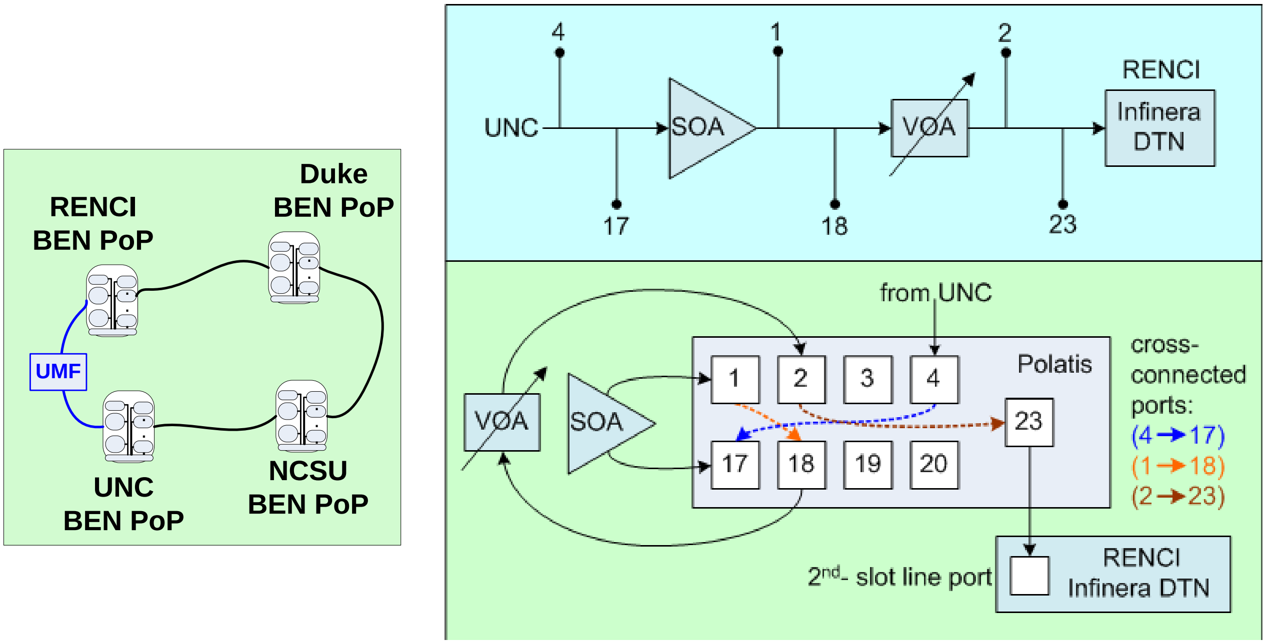

Fig 4.1 Physical Connections in BEN

BEN consists of four PoPs located in North Carolina. The UMF is integrated into the link connecting the UNC PoP and the RENCI PoP. Note that we also connected a variable optical attenuator (VOA) into the path. The VOA is programmable and is used to alter power on the lightpath. This VOA is not controlled by the UMF, but is instead controlled by an external MatLab script. The UMF is then used to adjust for the power fluctuation through cross-layer optimization and control. Figure 4.2 shows the physical connection of the hardware into the RENCI PoP.

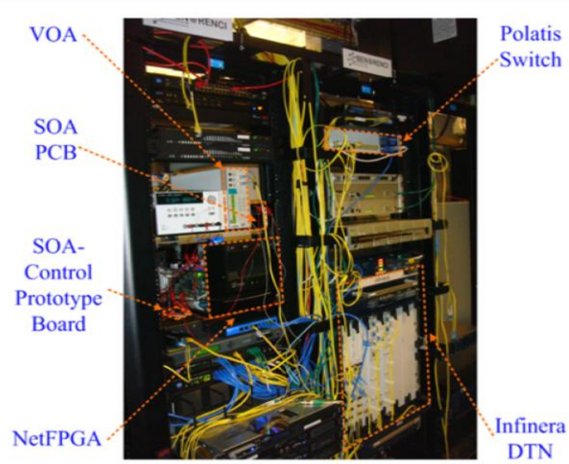

Fig 4.3 Physical Connection at RENCI PoP

5 Summary and Conclusion

In this report, we discuss our latest Spiral 2 milestone of contributing to the cluster D effort by integrating the UMF subsystem with the Cluster D network substrate. We integrated the developed hardware and software resources of UMF to the BEN infrastructure at the RENCI (PoP).

6 Bibliography

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