"Slice Around the World" Demonstrations – Global Clouds Closely Integrated With Highly Programmable Networks

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I. INTRODUCTION

A. Background

The 'Slice Around the World" demonstration initiative was established to demonstrate the powerful potential of designing and implementing world-wide environments consisting of Global computational and storage clouds closely integrated with highly programmable networks. The initiative has been established by network research centers/research labs that are participating in multiple next generation networking activities, including those developing large scale distributed experimental network research environment, such as those be implemented by such initiatives as the NSF Global Environment for Network Innovations (GENI), the EU Future Internet Research Environment (FIRE), the Japanese New Generation Internet, the Korean Future Internet initiatives, the German Future Internet Lab (G-Lab), the Brazilian future Internet initiative and others. These environments are being developed *by researchers for researchers.* An important goal for many of the current projects would be to have persistent global environments directly developed and managed by the research community to support their experimental research.

B. Motivation

Multiple considerations have led to the suggestion that the network research centers represented in this initiative create an international environment for multiple network science initiatives, experiments and demonstrations that could showcase innovations related to next generation communications services architecture and networking technologies at scale. Furthermore, these activities could be used in various locations to highlight topic areas of local importance.

C. Overall Design Considerations

Various aspects of design for this initiative design have been considered, including three primary components: a) showcasing one or more application capabilities, for example, some aspect of federated cloud based digital media transcoding and streaming as opposed to merely showing bit-flow graphs b) demonstrating the capabilities of programmable networks using OpenFlow, and c) designing a network architecture based on an international foundation infrastructure. Each of these components is further described

in a subsequent section of this description. Also, participants in this initiative are developing a number of innovative architectural and basic technology concepts.

D. Driver Application

Participants considered application and services parameters for these demonstrations. Listed here are the initial parameters for the first demonstrations: applications/service must:
1) Have Striking Visuals (i.e., Not Just Showing Performance Graphics Highlighting Bit Flows)
2) Reflect the Potentials of a Truly Global Environment
3) Closely Integrate Programmable Networking and Programmable Compute Clouds
4) Show Capabilities Not Possible to Accomplish With the General Internet or Standard R&E Networks
5) Highlight the Power of Programmable Networks, Especially Customization at the Network Edge.
6) Show a Potential for Resolving Real Current Issues vs Showing Advanced Technology, Although The Platform Is Oriented to Providing Suites Of Capabilities.

For Slice Around the World demonstrations, several techniques are being demonstrated. Finite Difference Time Domain(FDTD) is one of most commonly used computational electrodynamics modeling techniques for many research and industry simulations, such as LSI design electro verification. Under current HPC workflow techniques, researchers submit jobs, retrieve results, visualize those results and then resubmit the job with modifications, additional information, data, etc. Today this is a tedious, manual slow process, in part because of the limitations of today's networks.

An interactive real-time simulation/visualization instrument will include: a) distributed back-end MPI rendering clusters and storage, b) a web front end to setup control parameters for rendering and display the result, c) customized web server to pipe rendering results to users efficiently, d) a program to check the rendering result and submit jobs if the results were not produced.

For Slice Around the World demonstrations, these web interfaces will be used to dynamically identify the sites around the world, where the simulation images located, to convert the request and to send the request to the appropriate host over the private international network, and interactively visualize the simulation over the private network specifically designed for the "Slice Around the World" demonstration. In addition, the basic service will be extended using local public network.

Visualization is particularly important for nanotechnology science and engineering because those disciplines are focused on objects less than a nanometer wide. The science simulation/visualization examples that will be used are: a) Single/Double Slit Light Simulation at Nano-Macro Scale, b) Nano-Pattern Formation/Self Assembly, Photonic Band Gap, Optical Pulse incident on Nano-particles, etc. These topic areas are related to those that are designing materials that can use light to take the place of electric currents used for sub components in communications systems.

In sum, these demonstrations are showing how innovative new tools, services, and techniques can be created using programmable networks..

Different initiative participants are developing various techniques for virtualizing distributed environments and networks, for integration, for developing control frameworks, designing network middleware and for integrating resources. Clearly, federation among these capabilities will be a major theme. As a basic capability, this initiative will create a distributed, integrated OpenFlow environment interconnected through a customized international network, which is currently being implemented. A number of the existing centers currently have OpenFlow implemented. Others are in processes of implementing OpenFlow. All sites will provide servers capable of supporting addressable VMs. Among the sites there will be a blend of static and dynamic resources.

III. INTERNATIONAL FABRICS

As noted, a customized international network is currently being implemented to support this initiative. A number of the centers/labs participating in this initiative are already connected through existing testbeds supported by the Global Lambda Integrated Facity (GLIF) and GLORIAD, through a type of persistent international network research testbed facility. A process has been established to work on the connections for the others.

The international fabric was created for the demonstrations (Fig 1 below)

Figure 1. International Fabric Designed and Implemented