

ISOGA – Integrated Services Optical Grid Architecture for Emerging Scientific Collaborative Applications

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Summary

Built over optical wavelength switched networks, Lambda Grid systems have emerged to support scientific applications with deterministic multi-gigabit rate bandwidth via lambdas or wavelengths of light. The goal of the ISOGA project is to develop intelligent control services to enable an Integrated Services Lambda Grid system to provide heterogeneous network services to emerging scientific applications with diverse bandwidth requirement of deterministic and variable bit rates, and communication requirements including collaborative multicast. Furthermore, intelligent application control signaling middleware is developed to enable applications to select the appropriate network service and to establish explicit lightpaths on demand under an application-empowered Lambda Grid paradigm.

Existing Grid systems are primarily built over IP packet switched networks. To support deterministic multi-gigabit rate transport, Lambda Grid systems are being built over optical wavelength or lambda switched networks with lightpaths that link schedulable computation resources.

Besides deterministic multi-gigabit rate point-to-point transport, emerging scientific applications will have other transport requirements. For example, collaborative visualization applications would require efficient multicast transport. A composite multimedia application may have both streaming and bursty media components that would be efficiently transported respectively by deterministic and variable bit rate modes. We focus on the *Integrated Services Optical Network (ISON)* control plane services to enable an optical wavelength switched network to provide heterogeneous network services that support the diverse bandwidth and communication requirements of emerging scientific applications.

There is an increasing trend for scientific institutions to acquire their own strands of fibers and optical switches, which become valuable commodities and are deemed to be

schedulable just like the computation resources. We focus on the *Dynamic Application-centric Intelligent Signaling Interface (DAISI)* middleware to enable applications with network-awareness to select and establish explicit lightpaths that link schedulable computation resources, and to select the appropriate network service to transport data over established lightpaths.

Independent institutions or administrative domains may employ different Lambda Grid control planes with incompatible routing and signaling protocols to support lightpath provisioning. As deployment of independent Lambda Grid networks gain momentum, there are increasing demands to interconnect them via a multi-domain control plane. We focus on the *Secure Photonic Inter-domain Negotiator (SPIN)* as an open secure multi-domain control plane to enable dynamic end-to-end lightpath provisioning over incompatible domains.

Accomplishment

In the University of Illinois at Chicago (UIC), we have developed and successfully deployed DAISI version-1 over an all-optical local area network (LAN) testbed, with Calient and Glimmerglass all-optical

switches maintained in the Electronic Visualization Laboratory (EVL).

University of Amsterdam has adopted and integrated DAISI version-1 with their policy-based authorization, authentication and accounting (AAA) control software, and successfully deployed the integrated DAISI/AAA middleware over their own all-optical network testbed.

We have successfully launched collaborative visualization and tele-immersive applications over gigabit clusters linked by our DAISI-based all-optical network testbed. EVL develops these collaborative applications, which include:

- TeraScope - a massive set of information visualization tools for visual data mining;
- TeraVision - a gigabit network appliance to allow scientists to share their computer screens during a collaborative session;
- GeoWall2 - a geo-science tele-immersive system for large remote sensing, image rendering and seismic interpretation.

We have developed SPIN version-1, and successfully deployed it in Supercomputing 2003 through collaboration with University of Amsterdam to demonstrate dynamic multi-domain lightpath provisioning over a Chicago-Amsterdam optical wavelength switched network testbed (Fig. 1) via the StarLight (Chicago) and NetherLight (Amsterdam) optical peering exchanges.

We are working on the initial system design of ISON version-1, which would enable an optical wavelength switched network to provide an emulated optical burst switched network service that supports applications with variable bit rate or burst traffic.

Future Plan

Northwestern University iCAIR group is managing the OMNInet in Chicago, which

is an all-optical metropolitan area network with Nortel all-optical switches, and employs the Generalized MultiProtocol Label Switching (GMPLS) control plane. There is a collaboration plan to deploy SPIN to interconnect the OMNInet with the all-optical LAN in UIC and University of Amsterdam.

We will discuss with Argonne National Laboratory / I-WIRE group to explore the possibility of deploying SPIN to interconnect the Illinois I-WIRE lambda network with the UIC all-optical LAN. We will explore the possibility of adapting the Globus Security Infrastructure to enable inter-domain security support for future SPIN version.

We will finish the design of ISON version-1 and start its development. For future SPIN and DAISI versions, we will focus on optical multicast routing and wavelength assignment support. We will explore the possibility of enabling these future versions to be compatible with the Open Grid Services Architecture (OGSA) or the Web Services Reference Framework (WSRF).

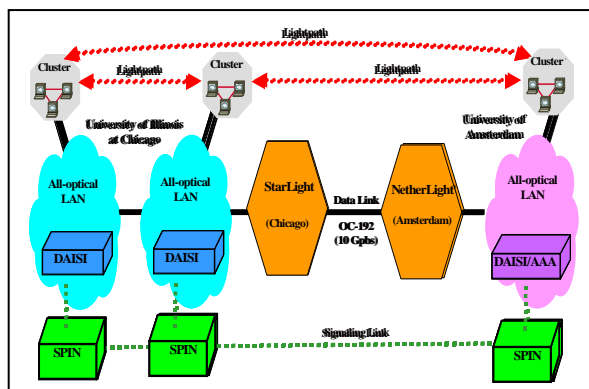


Figure 1. ISOGA Testbed (year 1)

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