

Dynamic Resource Allocation over GMPLS Optical Networks

DRAGON

Project Overview

November 8th, 2004



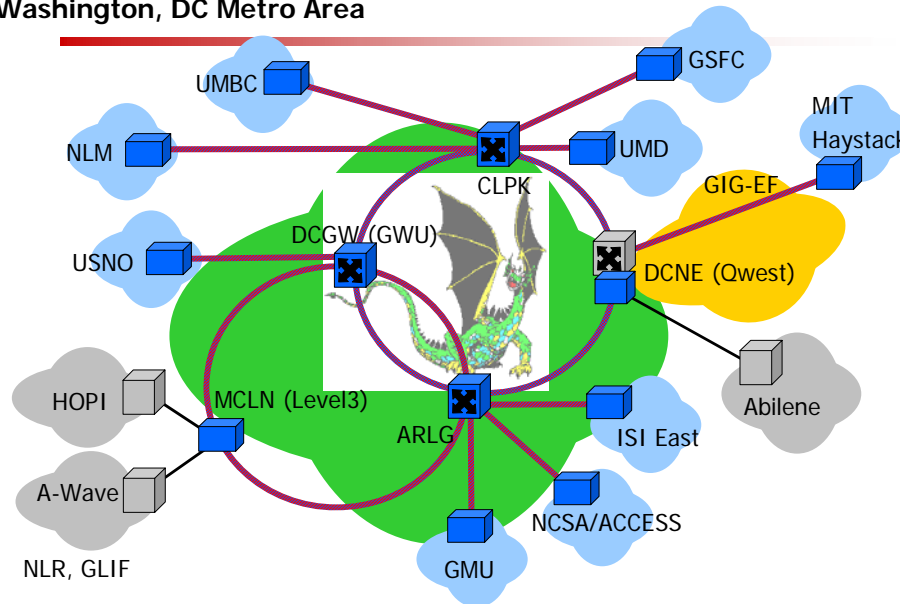
The DRAGON project is an experimental optical network funded by the National Science Foundation and deployed in the Washington DC metropolitan area. The DRAGON network incorporates a number of new network architectural design characteristics employing advanced optics, standardized and open-source control plane protocols and tools, and new application interface mechanisms.

The project is headed up by the Mid-Atlantic Crossroads/University of Maryland, University of Southern California / ISI-East, and George Mason University, commercial partner Movaz Networks, and includes key personnel from NASA Goddard Space Flight Center, MIT Haystack Observatory, NCSA ACCESS, and the US Naval Observatory.

The DRAGON network architecture begins with an all-optical, dynamically switched wavelength core. Current optical technologies and good network engineering practices allow DWDM waves to be delivered end-to-end all-photonicly within the metro/regional scale. This can dramatically reduce the cost of deploying extreme performance optical networks by reducing or eliminating the optical-to-electrical-to-optical (OEO) regeneration components within the core. New technologies such as wavelength selective switching and tunable transponders and filters are being deployed in the DRAGON core network support these capabilities.

DRAGON Network Topology thru 2006

Washington, DC Metro Area



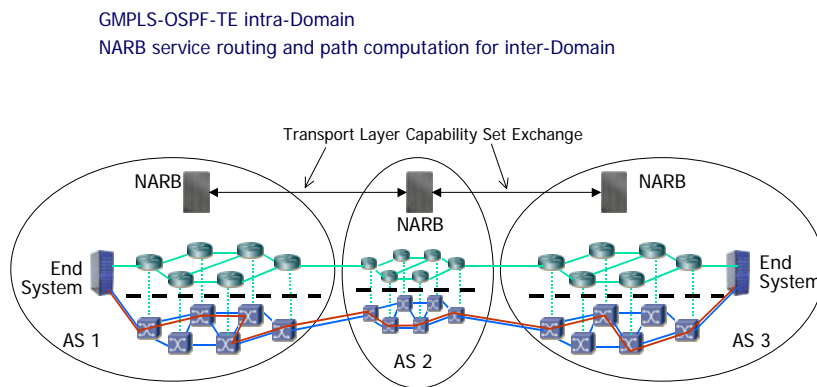
The DRAGON project is collaborating closely with e-science applications to develop both an intimate understanding of these particular science processes within the network engineering community, and to

insure that the science application is driving and benefits from the resulting network architecture and services.

DRAGON uses Generalized Multi-Protocol Label Swapping (GMPLS) protocols – specifically OSPF and RSVP, for dynamic provisioning of “light path” services within the core network. These protocols have been standardized by the IETF and early implementations are being delivered by vendors on their newer products. DRAGON has also developed open-source implementations of GMPLS OSPF and RSVP and has incorporated these into the “Virtual Label Swapping Router” (VLSR) tool. The VLSR enables dynamic light path services over common network elements that do not [currently] have native GMPLS compatibility. This allows network elements such as ethernet switches, fiber switches, and the like to be seamlessly integrated into a GMPLS environment.

In order for DRAGON capabilities to be adopted in other networks, the architecture must address the inter-domain routing problem. DRAGON is working in two areas on this issue:

Network Aware Resource Broker (NARB) – Inter-Domain Service Advertising and Routing



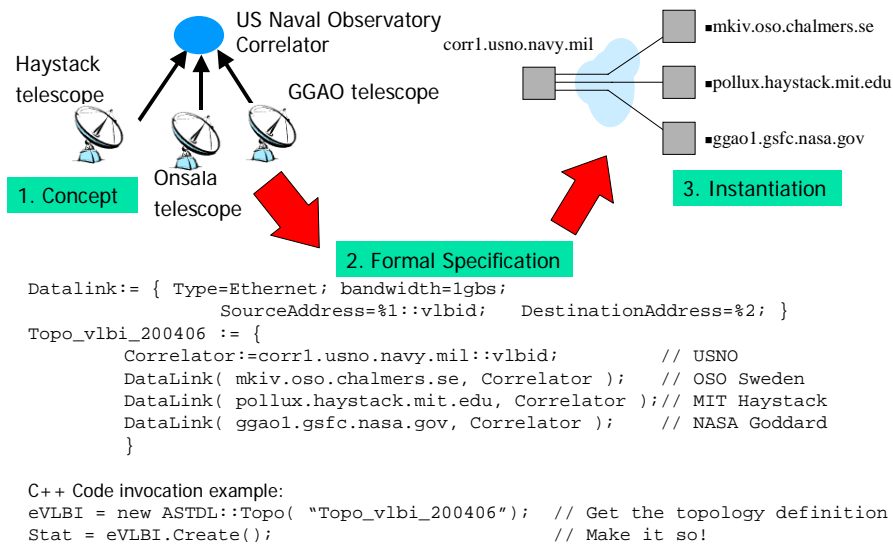
First, the project has developed the “Network Aware Resource Broker” (NARB). The NARB is a resource agent that represents a domain, learning and monitoring the internal resources status from internal routing protocols, and expressing the domain’s service capabilities to it’s external neighbors. The NARB is responsible for exchanging a substantially broader set of service information than simply network layer reachability (ala BGP). The NARB depends upon good IP routing to do these things.

Secondly, DRAGON is developing initial models for Common Service Definitions. The CSDs allow light paths to be provisioned across multiple domains in a consistent fashion. The network community has realized that while we share similar ideas about what light path services should provide, the actual implementations of a particular type of light path may exhibit dramatically different performance characteristics in different domains. The CSD allows the community to define basic service offerings such they can be provisioned predictably and deterministically across multiple domains, end-to-end.

One of the requirements for dynamic light path services is that they be reserved in advance of their actual instantiation.. The applications incorporate many types of resources – computational clusters, storage arrays, sensors or other instruments. The network itself is an application resource that must be scheduled in advance as well, and it must be available in conjunction with all of the other application’s resources. Further, these other resources may reside in many separate locations – often on different

contents. The applications need a means of describing the necessary topologies. The DRAGON Application Specific Topology Description Language (ASTDL) allows the application to describe in a formal manner the network resources that it needs in order to run. ASTDL will provide the API for accessing the generalized schedulers and resource managers.

Application Specific Topology Description Language - ASTDL



The true measure of success for DRAGON will be evident in how the applications are able to leverage the new network capabilities to perform better science. To this end, the DRAGON project is working closely with the MIT Haystack Observatory to integrate these services into the Electronic Very Long Baseline Interferometry (e-VLBI) application. e-VLBI requires dedicated and deterministic network resources/performance in order to stream multi-gigabit data from radio telescopes to the VLBI correlator facilities. These instruments and facilities are distributed all around the world. Projections of e-VLBI network requirements by 2007 range from 1 Gbs to 4 Gbs at each telescope, and 10 Gbs to 40 Gbs for each correlator site – every time the application is run. Dynamically provisioning light paths for these types of emerging globally distributed applications allows the network to satisfy the application requirements most cost effectively.

DRAGON is also developing the High Definition – Collaborative Video Area Networking environment (HD-CVAN). The HD-CVAN incorporates DRAGON resource allocation techniques to deliver high definition video and graphics to possibly many distributed displays. It uses the UltraGrid HD capture and multicasting capability.

The DRAGON project is exploring new network architectures for building very high performance optical networks, and for delivering dynamic yet deterministic and predictable network resources to advanced applications. The project website is <http://dragon.maxgigapop.net>. Please visit this site. Organizations wishing to participate or to develop similar regional capabilities are invited to contact the Principle Investigators.