Dynamic Circuit Network (DCN) / perfSONAR

Shared Infrastructure

Tom Lehman
USC/ISI
Network Cyberinfrastructure

Application Classes:

- Bulk Transport
- 2-Way Interactive Video
- Real-Time Communications
- others....

Applications call on Network Middleware:

- Phoebus
- Lambda Station
- Terapaths
- ....

Federated Trust

Performance Infrastructure / Tools

Control Plane

Information Services

Dynamic, Reactive, Visible, Service-rich Network
DCN Control Plane

- Architecture and Protocol which Enables Dynamic Provisioning "heterogeneous" network environments.
- "Heterogeneous" implies environments which may include the following:
  - Multi-domain
  - Multi-layer
  - Multi-control
  - Multi-technology
  - Multi-vendor
- Control plane protocol
  - InterDomain Controller (IDC) Protocol (IDCP)
Dynamic Network Services
IntraDomain

**Circuit Request**
- Source Address
- Destination Address
- Bandwidth
- VLAN TAG (untagged | any | tagged | tunnel)
- User Identification (certificate)
- Schedule

**Dynamically Provisioned Dedicated Resource Path (“Circuit”)**

**Internet2 IDC**

**Internet2 DCN Service**

**DRAGON Enabled Control Plane**

**Actual Network Path**

**User API**

- api can run on the client, or in a separate machine, or from a web browser
Dynamic Network Services

InterDomain

- No difference from a client (user) perspective for InterDomain vs IntraDomain

1. Client Service Request
2. Resource Scheduling
5. Service Instantiation (as a result of Signaling)
• Four Primary Web Services Areas:
  • Topology Exchange, Resource Scheduling, Signaling, User Request
I2 DCN Software Suite

- OSCARS
  - Web service layer, InterDomain messaging, AAA, Scheduling

- DRAGON
  - Control of domain network elements (Core Directors and/or Ethernet Switches)
  - Intra and Inter Domain Path Computation
  - RSVP based signaling

- Version 0.3.1 of DCNSS released April 2008
  - https://wiki.internet2.edu/confluence/display/DCNSS
InterDomain Controller (IDC) Protocol (IDCP)

- Developed via collaboration with multiple organizations
  - Internet2, ESnet, GEANT2 (DICE)
  - Nortel, University of Amsterdam, others

- The following organizations have implemented/deployed systems which are compatible with this IDCP
  - Internet2 Dynamic Circuit Network (DCN)
  - ESNet Science Data Network (SDN)
  - GÉANT2 AutoBahn System
  - Nortel (via a wrapper on top of their commercial DRAC System)
  - Surfnet (via use of above Nortel solution)
  - LHCNet (use of I2 DCN Software Suite)
  - Nysernet (use of I2 DCN Software Suite)
  - University of Amsterdam (use of I2 DCN Software Suite)
  - DRAGON Network

- The following "higher level service applications" have adapted their existing systems to communicate via the user request side of the IDCP:
  - LambdaStation (FermiLab)
  - TeraPaths (Brookhaven)
  - Phoebus
InterDomain Controller Protocol
Standardization Activities

• Standardization process and increasing community involvement continues
• Optical Grid Forum (OGF)
  • Network Markup Language (NML) Working Group
    • Standardizing topology schemas (perfsonar and control plane)
  • Network Services Interface (NIS-WG)
  • Grid High Performance Networking (GHPN) Research Group
  • Network Measurement (NM-WG)
  • Network Measurement Control (NMC-WG)
  • Information Services (IS-WG)
• GLIF
  • Control Plane Subgroup working on normalizing between various interdomain protocols (IDCP, G-Lambda GNS-WSI, Phosphorus API)
  • Also other GLIF subgroups in this and related space (global id format, PerfSonar)
Internet2 DCN Working Group

- DCN WG has been formed under NTAC
  - Chair: Linda Winkler (Argonne National Laboratory)
- DCN WG will drive directions and set agenda in this area
- Mailing list and Wiki available
  - dcn-wg@internet2.edu
  - https://spaces.internet2.edu/display/DCN/Home
- DCN WG Meeting on Monday, July 21, 12:30 PM 1:50 PM
perfSONAR allows autonomous measurement systems to be aggregated in analysis.
Elements of PS and IDC

• Common Elements
  • Topology
    • Topology Exchange
    • Domain Abstraction
  • Lookup Services

• Different Elements, but with Strong Parallels
  • Resource Scheduling and Path Computation
    • Multi-Domain path computation techniques
    • Resource identification, reservation, confirmation
  • Signaling
    • Path setup, service instantiation

• Ideally AAI models and infrastructure would be compatible and/or common
DCN/perfSonar Shared Infrastructure

- Lookup Service
- Topology Service
  - Topology Exchange
  - Domain Abstraction
- AAI
  - Authentication Authorization Infrastructure
Information Services
Topology Service and LookUp Service

• Control Plane uses Information Services
  Topology Service and LookUp Service

• LookUp Service
  • Provides a mapping from circuit end points to user friendly names

• Topology Service
  • Provides an infrastructure from which to retrieve topologies from other domains
  • Will be utilized for global path computation
InterDomain Controller
Web Service Based

• Utilizes OGF Network Measurement Working Group (NMWG) for Topology Definition Schemas (control plane namespace added)
  • nmtopo-ctrlp.xsd

• Web Services definition also for the Resource Scheduling, Signaling, and User Request
DCN Control Plane uses NMWG OGF Topology Schema
DCN Control Plane uses NMWG OGF Topology Schema
## Connection Mappings

<table>
<thead>
<tr>
<th>Hostname</th>
<th>LinkID</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>eutobehn.grnet.gr</td>
<td>urn:ogf:network:domain=sv2.lon.uk.geant2.netnode=10.10.0.3:port=10.10.32.15:link=*</td>
<td>Delete</td>
</tr>
<tr>
<td>test-newy.dcn.internet2.edu</td>
<td>urn:ogf:network:domain=dcn.internet2.edu:node=NEWY:port=S26367:link=10.100</td>
<td>Delete</td>
</tr>
</tbody>
</table>

Click "Query LS", "Reset", or "Insert".
Lookup Service

- Also XML based configuration/protocol
  - Native storage/query mechanisms [XPath/XQuery]
  - Message format to exchange the data
- Targeted at single domain deployment
  - Single instance to manage multiple services
- Client components and applications use the LS to find services
  - perfSONAR-UI
  - perfAdmin
  - DCN Control Plane
Distributed Lookup Service

- Federation of individual IS instances into a global system
- “Meta”-lookup phase allows a query to find the specific IS that has relevant information
  - Or perhaps the relevant ISes that have said info
- The specific query is sent directly to the IS in question
- Recent active design and development
Topology Service

- Provides a queryable repository for obtaining topology information about a domain
  - Can obtain the entire network
  - XQuery interface allows the construction of complex queries about the network
- Topology is specified according to the schema in development in the OGF
- Current work to merge this with NDL in the NML OGF WG
Information Services
Topology Service
Topology Service and Path Computation

• Topology Distribution is a critical service for future advanced dynamic network operations
• Initially we want to be able to automate the determination of available paths based on basic network parameters such as technologies, bandwidth, vlans available, etc
• Eventually we would like to make path decisions based multiple constraints including administrative and policy criteria.
• Have an infrastructure which makes topology information available will be key to that capability
DCN Control Plane
AAA and Security

- OSCARS AAA
- SSL Encryption
- Authentication
  - X.509 Certificates
    - User to Domain
    - Domain to Domain
  - Web Service Security by OASIS
  - SAML assertions about end-user (future)
- Authorization
  - OSCARS attribute based system
• Four Primary Web Services Areas:
  • Topology Exchange, Resource Scheduling, Signaling, User Request
DCN and perfSONAR AAI

- This is an area where we hope to converge over time.
- perfSONAR currently SAML assertions for various attribute-based user authentication and authorization use cases.
- DCN use case is more of a network to network "service level agreement" type of model.
  - authorization, authentication is based on trust relationships with directly connected users and peering networks.
  - this is a very useful model which is anticipated to remain.
- However it is desired to also be able to make use of the AAI infrastructure that perfSONAR will put in place.
  - for AAA associated with DCN service provision.
- There is also work to evolve the current perfSONAR AAI to incorporate additional capabilities associated with Federated Models and Virtual Organizations.
• Thank You