Generalized Multi-Protocol Label Switching

The DRAGON implementation at SARA

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MARK MEIJERINK
ROB PRICKAERTS
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Hybrid networks and SARA
Hybrid Networks and SARA

What is SARA?

- IT service centre
- More than 30 years of experience!
- High performance networking, infrastructure services and high performance computing and visualization
Hybrid Networks and SARA

Background information

- National Research and Education Networks evolved into Hybrid Networks
- Routed IP and Light path or Optical sections
- Layer 1 or Layer 2 connections
- Dedicated Bandwidth and QoS
Hybrid Networks and SARA

The possible need for GMPLS

- Increased demand for Light path configuration
- Manual Light path configuration by NOC!!
- Time demanding and subject to Human Errors!!
- Need for automated Light path configuration
- Automated Light path Research in cooperation with the University of Amsterdam
Hybrid Networks and SARA

The GMPLS research goals

- Gain knowledge on Generalized MPLS
- Get familiar with the DRAGON Project
- Create a GMPLS capable network by using the DRAGON software
- Test the DRAGON Software
- Check RFC compliance of the DRAGON software
- Research the DRAGON softwares potential for SARA
GMPLS IN A NUTSHELL
GMPLS in a nutshell

Key features

- Support for Packet Switched Capable, Layer2 Switched Capable, Time-Division Multiplex Capable, Lambda Switched Capable and Fiber Switched Capable networks

- Control- and Data-plane *can* be physically separated

- Link Management Protocol

- Suggested Label

- Link Bundling
GMPLS IN A NUTSHELL

Control-plane

Data-plane
GMPLS IN A NUTSHELL

Control-plane
Data-plane
GMPLS IN A NUTSHELL

OSPF-TE

OSPF-TE LSA

TED

Control-plane

Data-plane
GMPLS in a nutshell

Control-plane
Data-plane

LSP Request
GMPLS IN A NUTSHELL
GMPLS in a Nutshell

OSPF-TE

Control-plane

Data-plane

PATH/label request
GMPLS IN A NUTSHELL

Control-plane
Data-plane

OSPF-TE

PATH/label request
PATH/label request for LSP-LSC
GMPLS in a nutshell

Control-plane
Data-plane

OSPF-TE

PATH/label request
PATH/label request for LSP-LSC
LSP-LSC RESV/label mapping
GMPLS in a nutshell
GMPLS in a nutshell

Control-plane
Data-plane

OSPTE

PATH/label request
Forward PATH/label request
Forward PATH/label request
LSP-PCS RESV/label mapping
GMPLS in a nutshell

LSP Hierarchy
The DRAGON Project
The DRAGON Project

Introduction

- Dynamic Resource Allocation via GMPLS Optical Networks
- Open Source GMPLS implementation
- Goal: Create dynamic, deterministic and manageable end-to-end network transport services for high-end E-Science applications
- Funded by the National Science Foundation (US)
The DRAGON Project

Building blocks

- Client System Agent CSA
- Network Aware Resource Broker NARB
- Application Specific Topology Builder ASTB
- Virtual Label Switch Router VLSR
The DRAGON Project

VLSR

- Enables non-GMPLS capable switches to be used in GMPLS networks
- Uses Open Source versions of OSPF-TE and RSVP-TE
- Runs on Unix-based servers
- Translates GMPLS messages into switch specific protocols such as CLI, SNMP, TL1 and XML
The DRAGON Project

VLSR
The DRAGON Project

Implementation

- HOPI testbed
- Hybrid Optical & Packet Infrastructure
- Deploy, test, evolve and evaluate new network technologies and architectures
- CHEETAH testbed
- Circuit-switched High-speed End-to-End Transport Architecture
The DRAGON Project

Extendability and developments

- Developed and GNU General Public License
- Write add-ons yourself
- Active development
- Nightly build
- Main contributors: University of Maryland UMD, Mid-Atlantic Crossroads MAX, University of Southern California Information Sciences Institute East USC/ISIS and George Mason University GMU
GMPLS @ SARA
Test

- Creating a LSP between the two CSA’s
- Break down a LSP
Creating a LSP between the two CSA’s

**Execution**

```bash
cln_host1-DRAGON> edit lsp test
cln_host1-DRAGON(edit-lsp-test)# set source ip-address A.B.C.39 lsp-id 1000 destination \ ip-address A.B.C.41 tunnel-id 2000
cln_host1-DRAGON(edit-lsp-test)# set bandwidth gige_f swcap l2sc encoding ethernet \ ethernet
cln_host1-DRAGON(edit-lsp-test)# set vtag any
cln_host1-DRAGON(edit-lsp-test)# exit
cln_host1-DRAGON> commit lsp test
```

- Test link by sending ping requests over the Data-plane
- Create and analyze packet dumps
Break down a LSP

- **Execution**
  
  `cln_host1-DRAGON> delete lsp test`

- Test if link fails by sending ping requests over data plane

- Create and analyze packet dumps

- Results
**CONCLUSION AND RECOMMENDATIONS**

**GMPLS**

- Can be a solution for Light path Automation
- Is a robust and divers Technology with good industry acceptance and development
- Has sufficient Hardware-Based solutions
- Has limited Software-Based solutions
- Has one serious OpenSource developer (DRAGON)
Conclusion and Recommendations

The DRAGON implementation

- Already capable of basic GMPLS functionality
- Sponsored Research with high potential, but still under development
- No support for LMP so far
- Link bundling expected in the (near) future
- Can help SARA and the University of Amsterdam get hands-on experience with GMPLS
QUESTIONS?