StarPlane

An application-controlled photonic network

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Outline

• What’s the problem?
• Overview
• Architecture
• Design & Approach
• Conclusion
• **Lambda** ($\lambda$): the symbol of wavelength
• **DWDM**: Dense Wavelength Division Multiplexing
• **Photonic network**
• **e-Science**
• **GMPLS**: Generalized MultiProtocol Label Switching
• **DRAC**: Dynamic Resource Allocation Controller
• **AAA**: authentication, authorization, and accounting
The increasing demands

- Higher bandwidth and lower latency
- Network partitioning and topology changing
- Photonic network
  - Lightpath: A lightpath is an optical end-to-end connection that avoids the routed Internet and that offers a guaranteed capacity and a predictable latency
The missing middlebox

- How to let applications exploit the suitable network topology?
- How to enable applications to drive the topology changing?
- How to provision the network resource on-demand in real-time scale?
- ...

Photonic network

Mgmt/Control Plane

App
StarPlane Overview

- NWO funded research project, carried out by UvA (PhD, Scientific programmer) and VU (postdoc), with major contributions from SURFnet and NORTEL

- Use the SURFnet6 CPL infrastructure to interconnect the DAS-3 sites

- Vision: give flexibility directly to the applications by allowing them to choose the logical topology of the photonic network and allocating the requested resources in real time

- Ultimately configure within sub-seconds
StarPlane Applications

Class 1:
- Large ‘stand-alone’ file transfers
  - User-driven file transfers
  - Nightly backups
  - Transfer of medical data files (MRI)
- Large file (speedier) Stage-in/Stage-out
  - MEG modeling
  - Analysis of video data
- Application with static bandwidth requirements
  - Distributed game-tree search
  - Remote data access for analysis of video data
  - Remote visualization

Class 2:
- Applications with dynamic bandwidth requirements
  - Remote data access for MEG modeling
  - SCARI
SURFnet6 / CPL

- SURFnet6 is a hybrid network which offers not only regular Internet services but also lightpaths with speeds up to 10Gbps in the Netherlands.
  - Officially launched on 23–01–2006
- Common Photonic Layer (CPL) is photonic portion for lightpaths:
  - 6000km dark fiber network with Nortel DWDM and TDM equipments
  - 5 rings
  - 36 → 72 lambdas each with up to 10Gbps possible throughput
StarPlane Setup

- Interconnect 5 DAS–3 clusters at 4 sites
- Band of 4 to 8 \( \lambda \)'s on SURFnet6 CPL Ring #1 (green)
- Star shaped logical infrastructure
- Starts out with 4 \( \lambda \)'s and static configuration
- External connections to other photonic network via NetherLight
DAS: Distributed ASCI Supercomputer

- an experimental testbed for research on wide-area distributed and parallel applications.
- 5 clusters with about 270 dual-cpu nodes supercomputers
- integrated into a large-scale distributed system using the multi-color optical networking capabilities from SURFnet.
DAS-3 Cluster Connectivity

LAN

WAN

Local LAN and regular SURFnet uplink

- Nortel 5530/5510 stack -

10GE

headnode downlink

D S - 3

Compute Nodes
Dual Opteron
2.2-2.6GHz
single or dual core
4GB of memory
250-500GB of disk space

Head Node
Dual Opteron
2.2-2.4GHz
dual core
8-16GB of memory
2-10TB of disk space

CPL
(Common Phyical Layer)

OADM

OME 6500-BB

Myri 10G

10GE

LAN PHY

10GE
StarPlane Architecture

- 3 Wavelength Selective Switches (WSS) per SURFnet6 CORE site (6 total)
- fixed OADM (Optical Add Drop Multiplexer) per DAS–3 site (4 total)
- NORTEL OME–6500BB per DAS–3 site (4 total)
- Control/Management Plane
Mgmt/Ctrl Plane Architecture

Grid applications

StarPlane Management Plane

GMPLS Control Plane

AMS-2

AMS-1

WSS Branching Node

WSS Branching Node

OME CMD

Cluster

LU

VU

Grid applications

StarPlane Management Plane

GMPLS Control Plane

AMS-2

AMS-1

WSS Branching Node

WSS Branching Node

OME CMD

Cluster

Cluster

Cluster

Cluster

Cluster

Cluster

LU

VU

UvA

UvA-MN

TUD
Management/Control Plane

- **Management Plane**
  - Accessible for any nodes
  - Interfacing to both application side & control plane
  - Extendable
  - Web Services, Job scheduler, Network description..

- **Control Plane**
  - GMPLS/DRAC + AAA
What makes StarPlane fly

- Development of the M/C Plane
- WSS and other devices (e.g. OME, Myrinet switch)
- Traffic engineering
- Network interaction
  - Application-engaged
  - Workflow-engaged
- Integration from other researches within SNE group
  - Network Description Language (NDL)
  - AAA
WSS Module Operation

- WSS will allow us to redirect a selected input color to the output fiber.
- This allows us to flexibly reconfigure the network according to the application demands.
- The key issue of StarPlane is sub-second switching, and topology reconfiguration.

MEMS: micro electro mechanical system
• Change the logical topology by provisioning different lightpaths
Network Interaction

Application-engaged Network Configuration

Workflow-engaged Network Configuration

App1  App2  App3

Photonic Network

Work Flow Manager

App1  App2  App3

Photonic Network
Network Interaction

- Application-engaged networks
  - The application makes itself known to the network
  - The network recognizes its footprints (via tokens, deep packet inspection)
  - e.g., storage management applications

- Workflow-engaged networks
  - Through workflow languages, the network is aware of the overall “flight-plan”
  - Failure-handling is the same
  - Network services can anticipate the next step, or what-if's
  - e.g., healthcare workflows over a distributed hospital enterprise
Authorization issue

- **Authorization questions**
  - Who is authorized to make requests to the StarPlane mgmt/control plane?
  - How will we handle the authorization sequences?

- **3 models – Which is suitable for StarPlane?**

- **Research in:**
  - Integrating AAA with the control plane
  - Usage of tokens within the network

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Pull model

Agent model

Push/token model
Token-based GMPLS

- **DRAGON**: Dynamic Resource Allocation via GMPLS Optical Networks
- **VLSR**: Virtual Label Switch Router
- **PEP**: Policy Enforcement Point
Conclusion

- StarPlane allows applications to control the photonic network (lightpath provisioning, topology changing)
- We aim at sub-second lambda switching.
- Several components (WSS, Mgmt Plane, TE, Workflow, and AAA) are essential to StarPlane.
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Thanks for your attendance!
Have a nice weekend :-}