

# StarPlane

**An application-controlled photonic  
network**

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System Network Engineering

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# Outline

- What's the problem?
- Overview
- Architecture
- Design & Approach
- Conclusion



# 'The Appetizer'



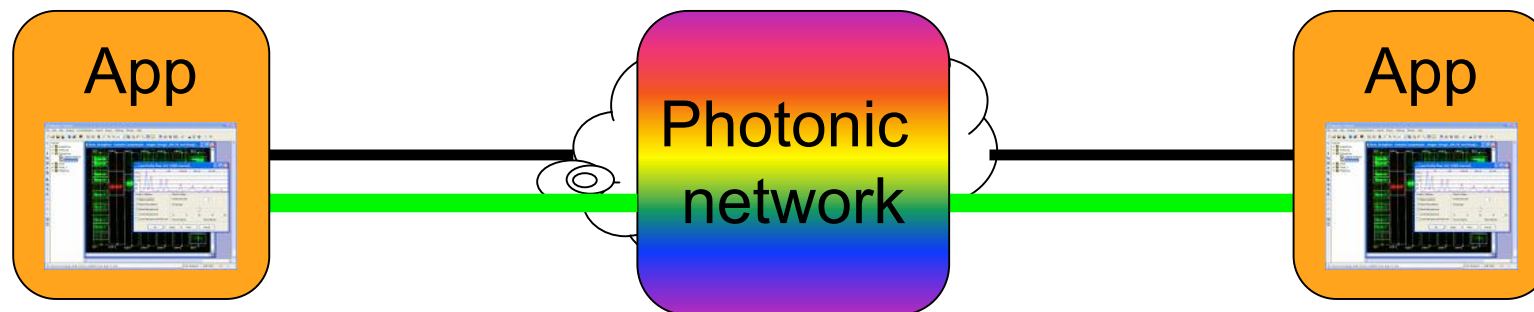
- Lambda( $\lambda$ ): the symbol of wavelength
- DWDM: Dense Wavelength Division Multiplexing
- Photonic network
- e-Science
- GMPLS: Generalized MultiProtocol Label Switching
- DRAC: Dynamic Resource Allocation Controller
- AAA: authentication, authorization, and accounting



# 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?
- ...



# StarPlane Overview



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



NORTEL

SURFnet

NWO



- 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:

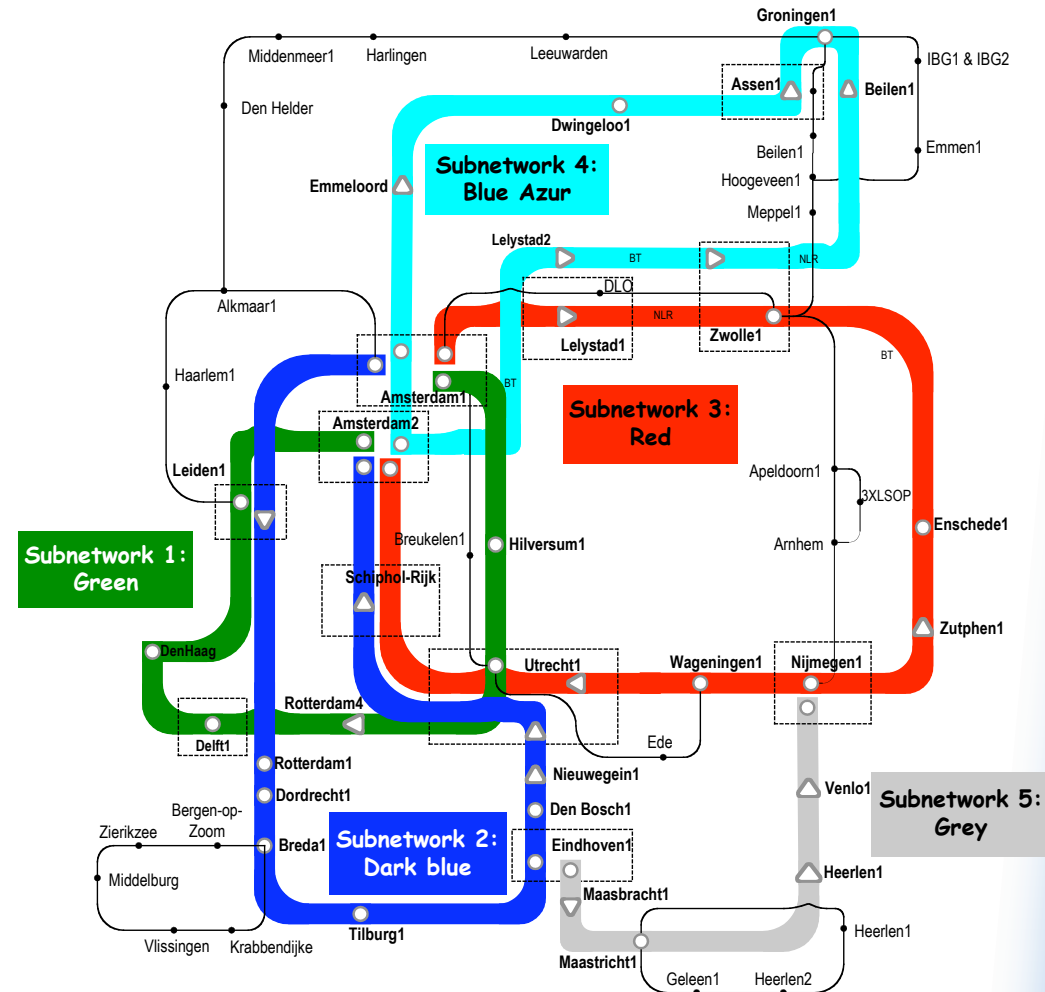
- Applications with dynamic bandwidth requirements
  - ◆ Remote data access for MEG modeling
  - ◆ SCARI



# SURFnet6 / CPL



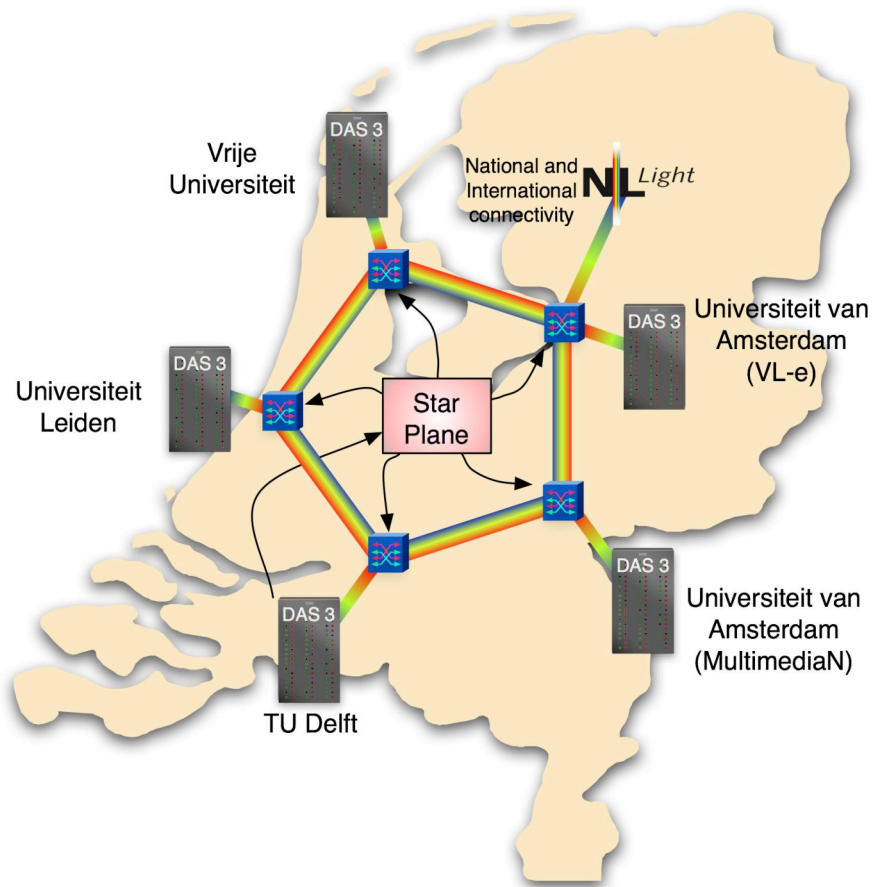
- SURFnet6 is a hybrid network which offers not only regular Internet services but also lightpaths with speeds up to 10Gbps in the Netherlands.
  - ◆ Officially launched on 23-01-2006
- Common Photonic Layer (CPL) is photonic portion for lightpaths:
  - ◆ 6000km dark fiber network with Nortel DWDM and 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



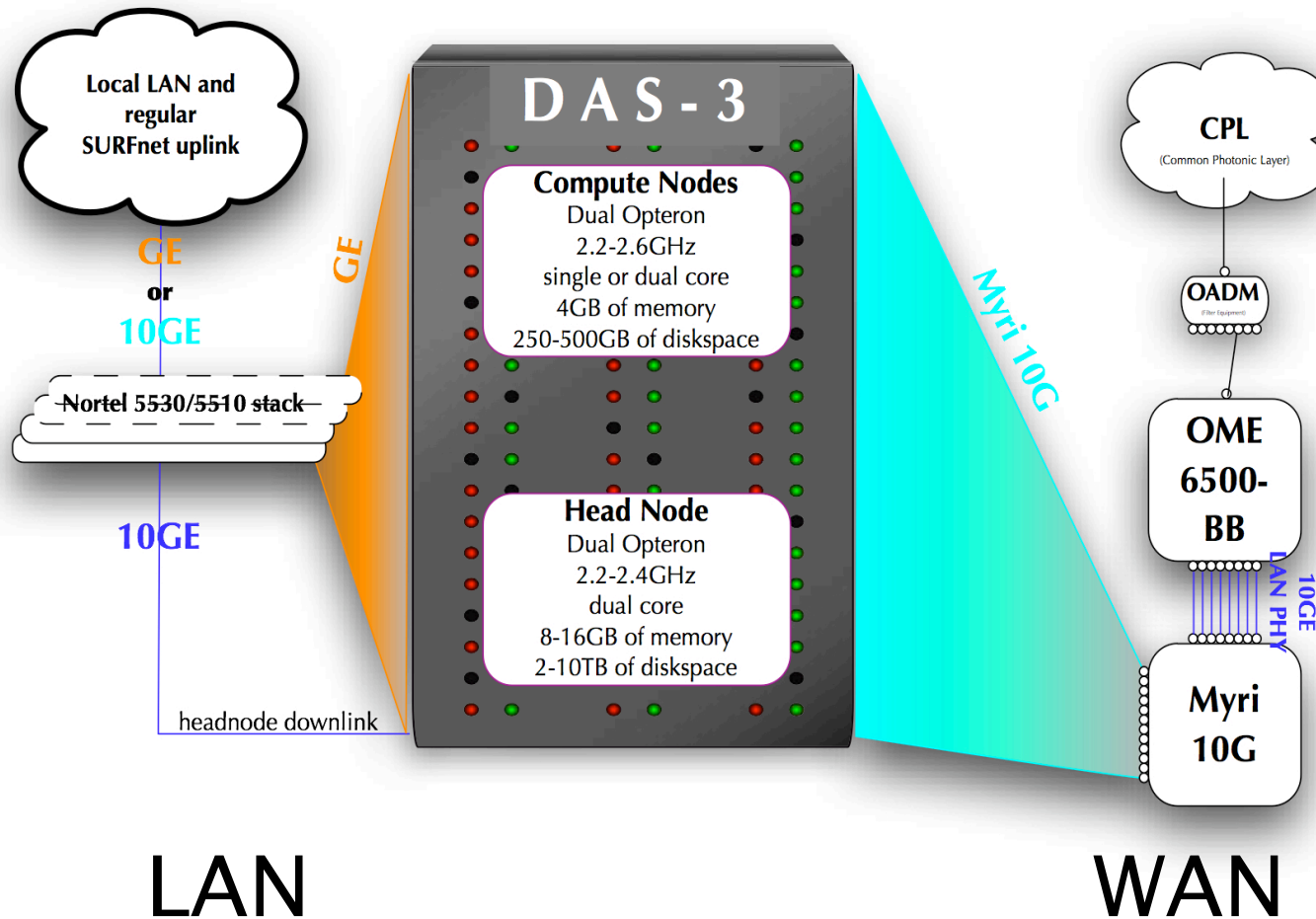
## DAS: Distributed ASCI Supercomputer

- 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.



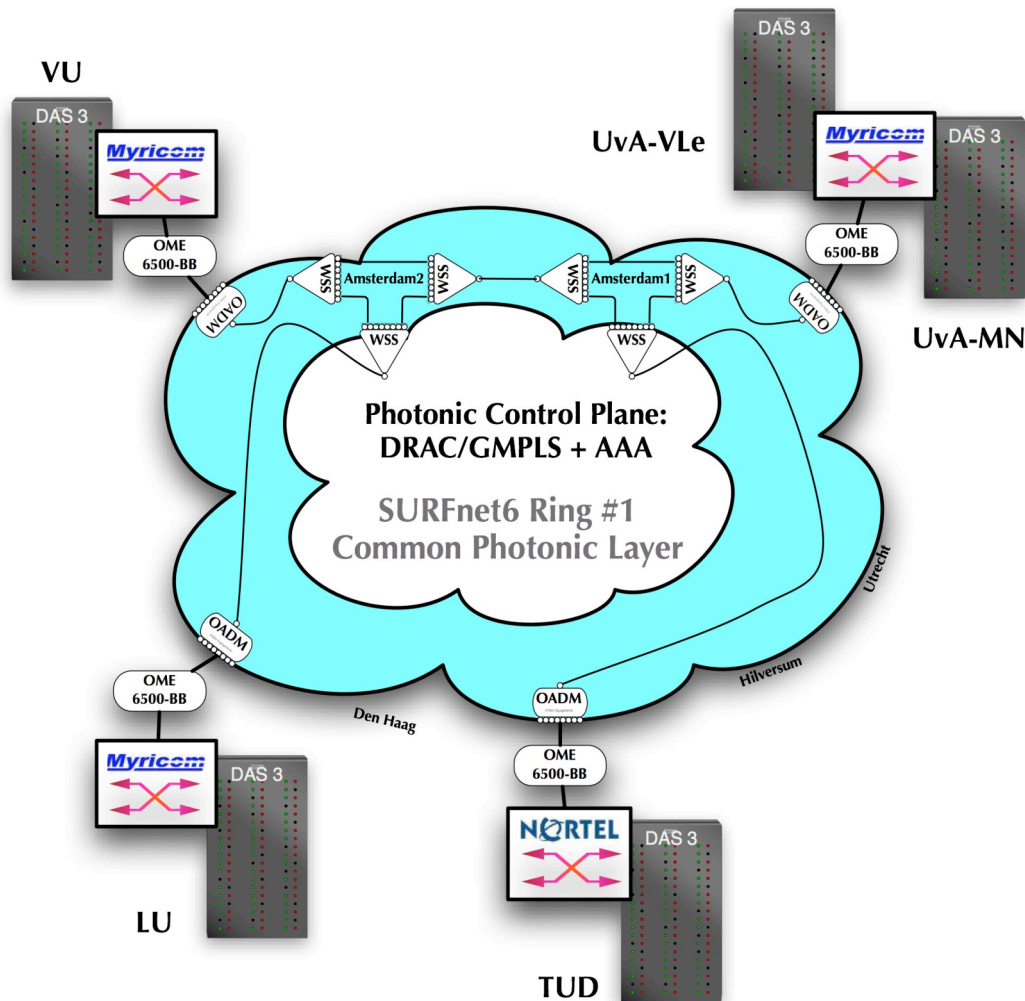


# DAS-3 Cluster Connectivity





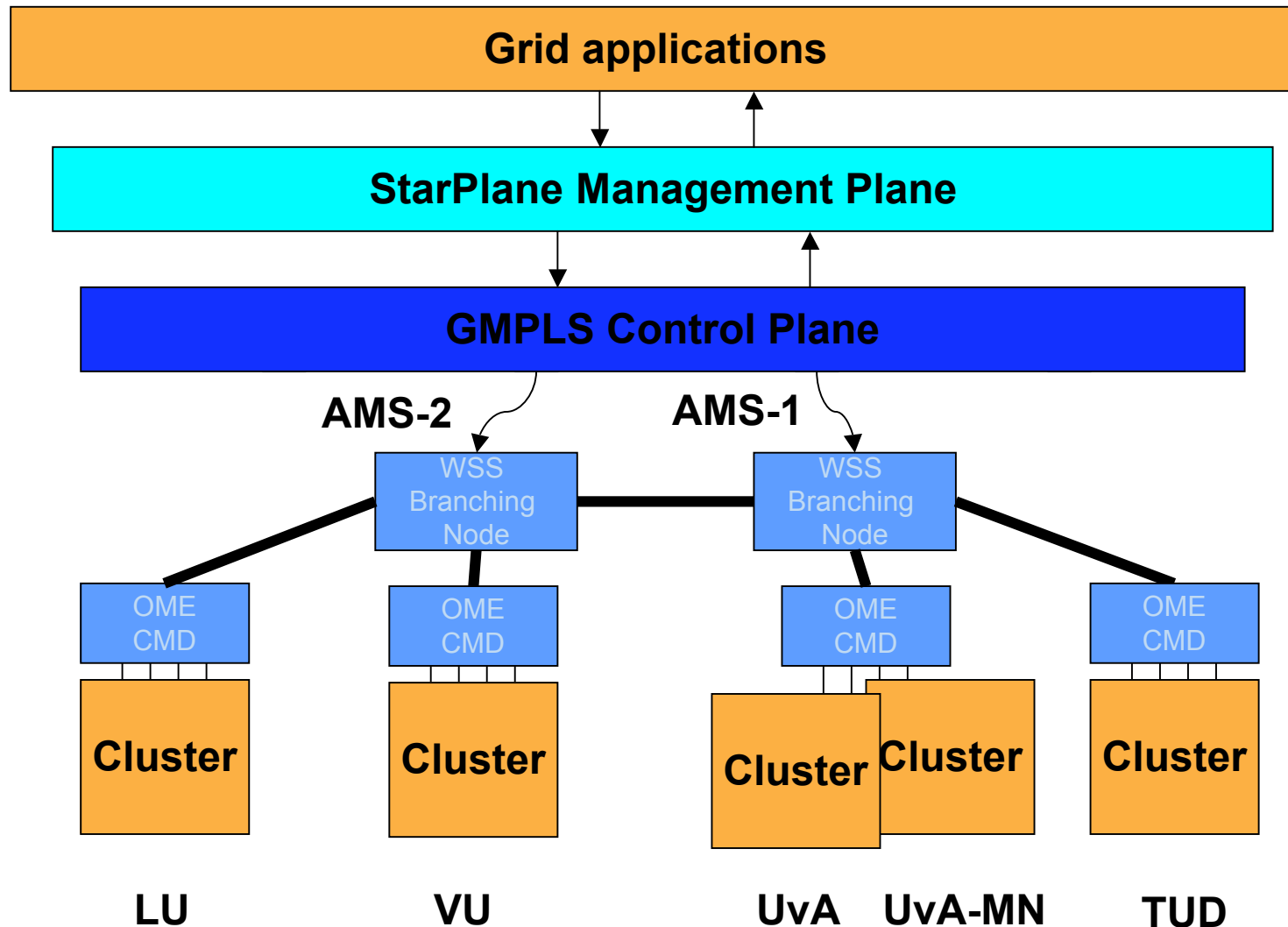
# StarPlane Architecture



- 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





- 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

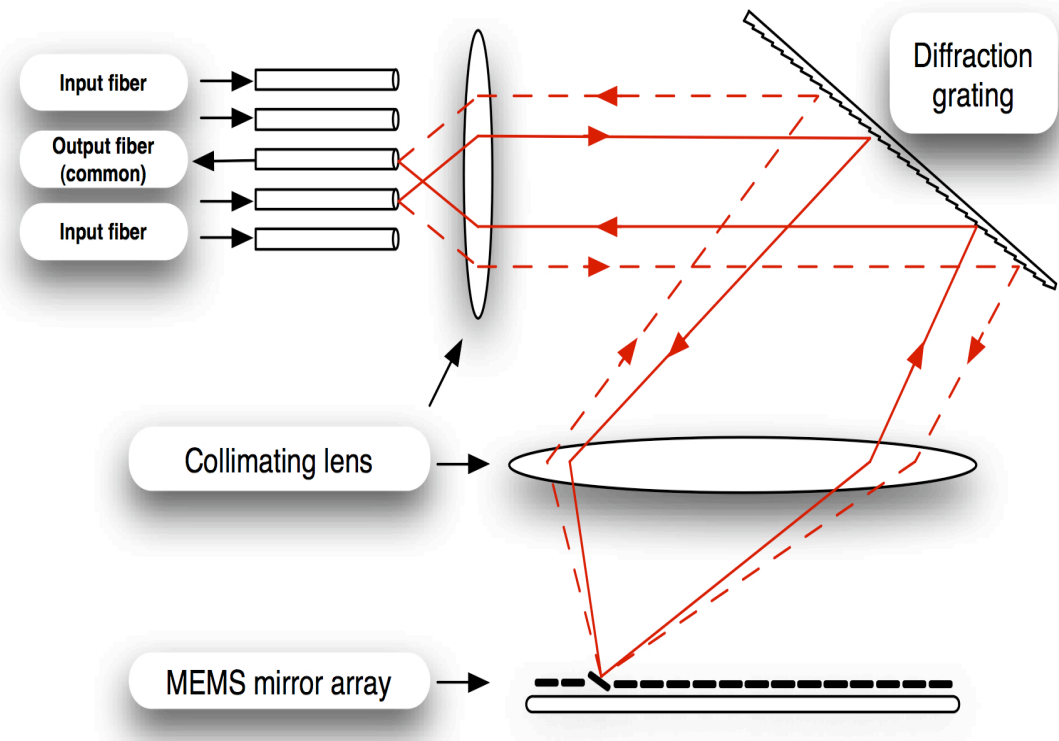


- Development of the M/C Plane
- WSS and other devices (e.g. OME, Myrinet switch)
- Traffic engineering
- Network interaction
  - ◆ Application-engaged
  - ◆ Workflow-engaged
- Integration from other researches within SNE group
  - ◆ Network Description Language (NDL)
  - ◆ AAA



# 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.

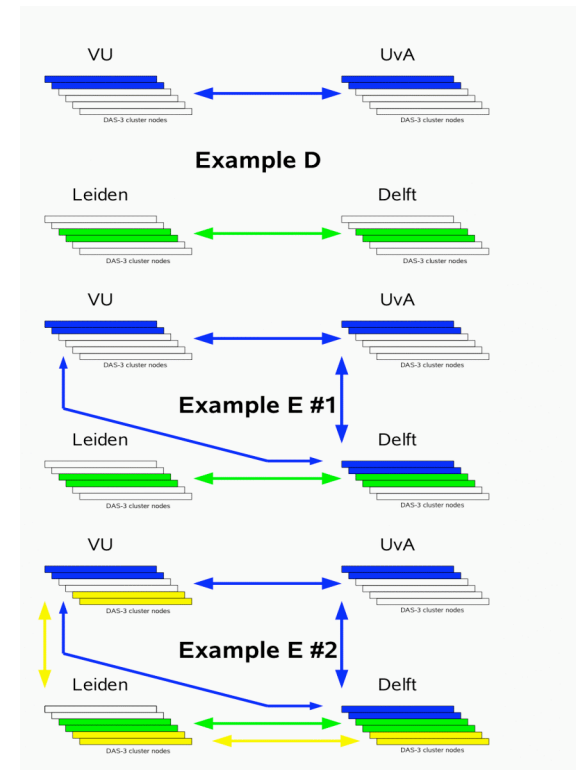
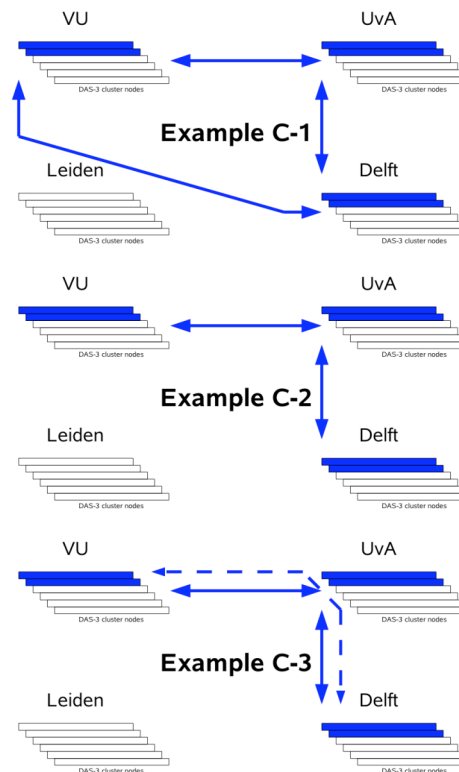
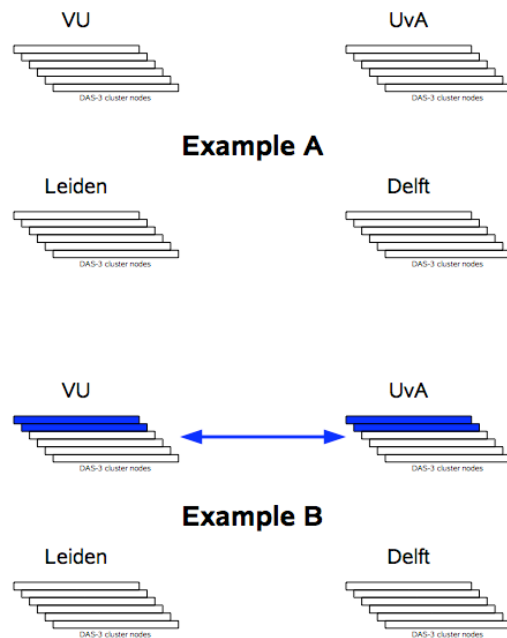


MEMS: micro electro mechanical system





- Change the logical topology by provisioning different lightpaths

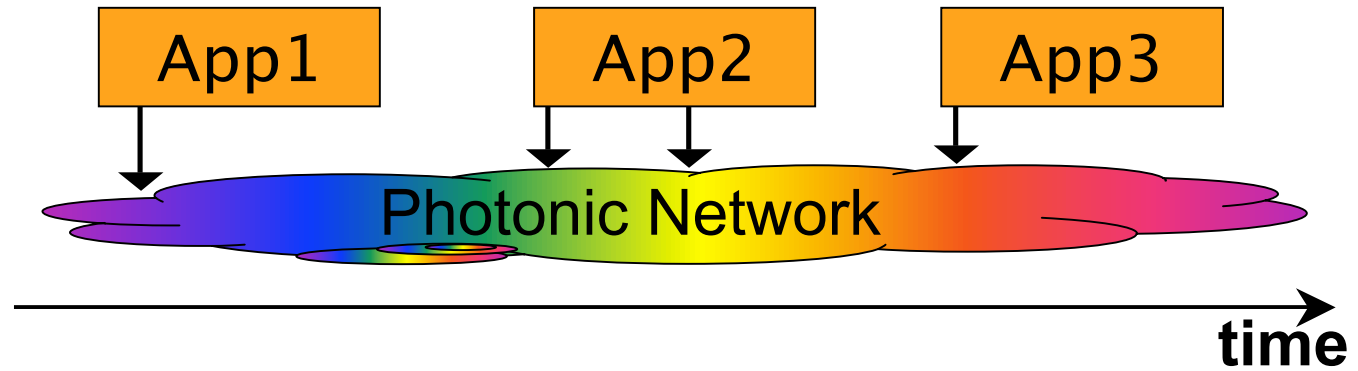




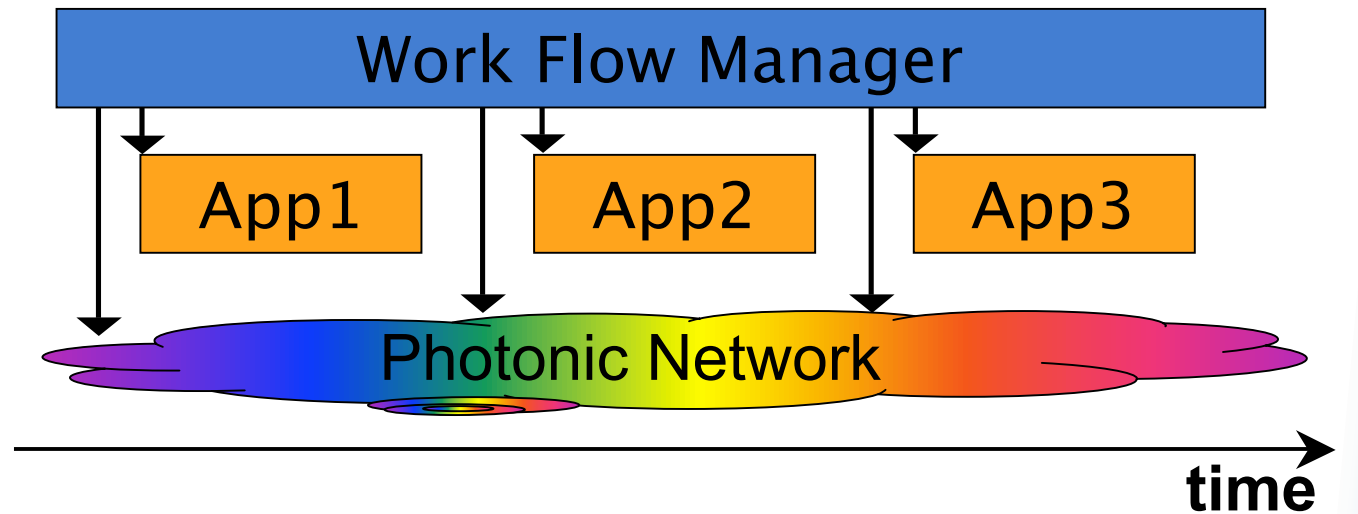
# Network Interaction



Application-  
engaged  
Network  
Configuration



Workflow-  
engaged  
Network  
Configuration



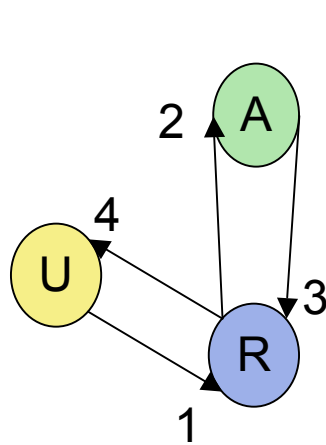


- **Application–engaged networks**
  - ◆ The application makes itself known to the network
  - ◆ The network recognizes its footprints (via tokens, deep packet inspection)
  - ◆ e.g., storage management applications
- **Workflow–engaged networks**
  - ◆ Through workflow languages, the network is aware 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

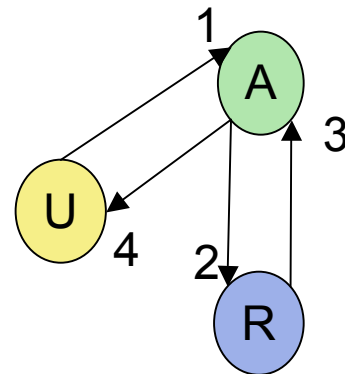


# Authorization issue

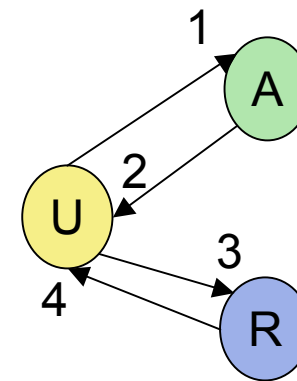
- Authorization questions
  - ◆ Who is authorized to make requests to the StarPlane mgmt/control plane?
  - ◆ How will we handle the authorization sequences?
- 3 models – Which is suitable for StarPlane?
- Research in:
  - ◆ Integrating AAA with the control plane
  - ◆ Usage of tokens within the network



Pull model



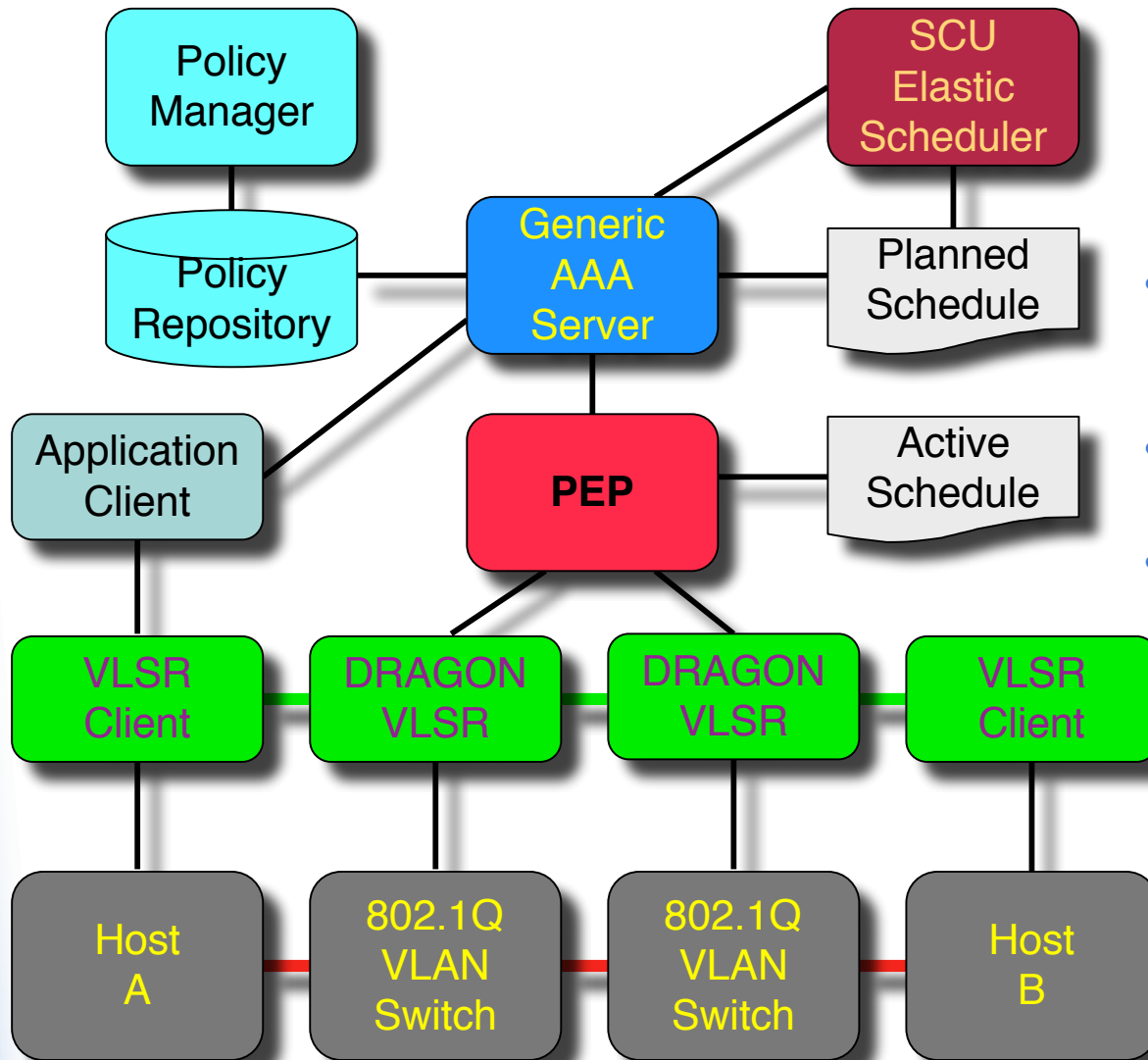
Agent model



Push/token model



# Token-based GMPLS



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



- 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.



# Question?

StarPlane

- Link: [www.starplane.org](http://www.starplane.org)
- Contact: Li Xu -- [lixu\\_at\\_science.uva.nl](mailto:lixu_at_science.uva.nl)

Thanks for your  
attendance!

Have a nice weekend :-)