

# GENERALIZED MULTI- PROTOCOL LABEL SWITCHING

THE DRAGON IMPLEMENTATION AT SARA

J U L Y   5 T H   2 0 0 6

M A R K   M E I J E R I N K  
R O B   P R I C K A E R T S





# OUTLINE



UNIVERSITEIT VAN AMSTERDAM

- ✻ Hybrid networks and SARA
- ✻ GMPLS in a nutshell
- ✻ The DRAGON Project
- ✻ GMPLS @ SARA
- ✻ Conclusion and Recommendations



# HYBRID NETWORKS AND SARA



# HYBRID NETWORKS AND SARA

## What is SARA?

- ✻ IT service centre
- ✻ More then 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



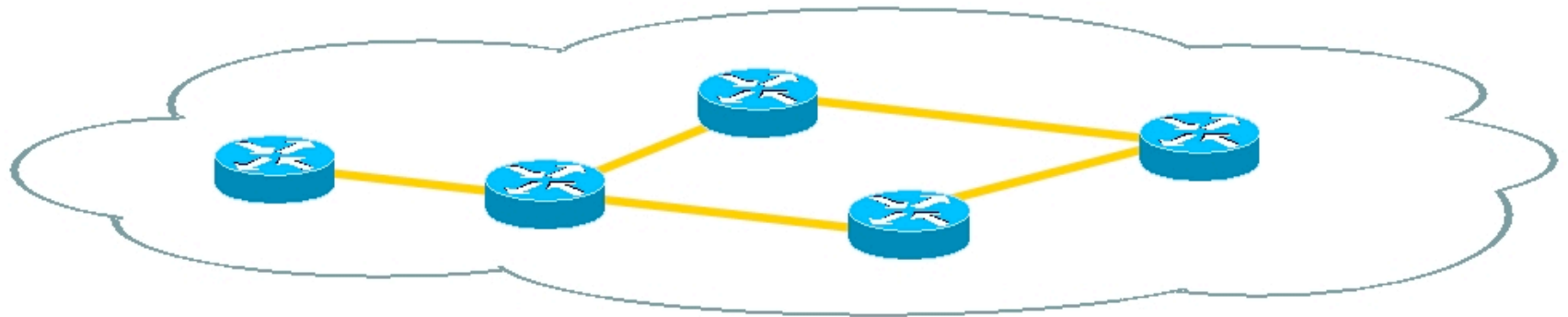
# GMPLS IN A NUTSHELL

## 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



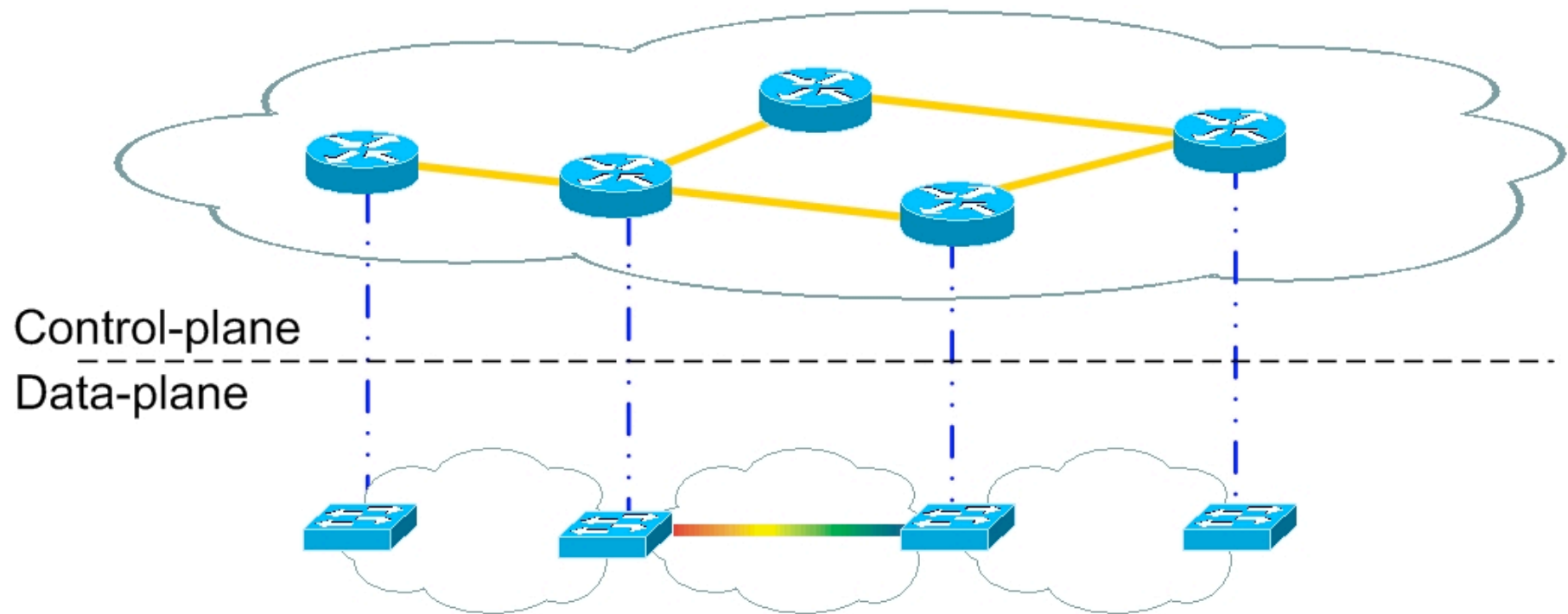
Control-plane

Data-plane



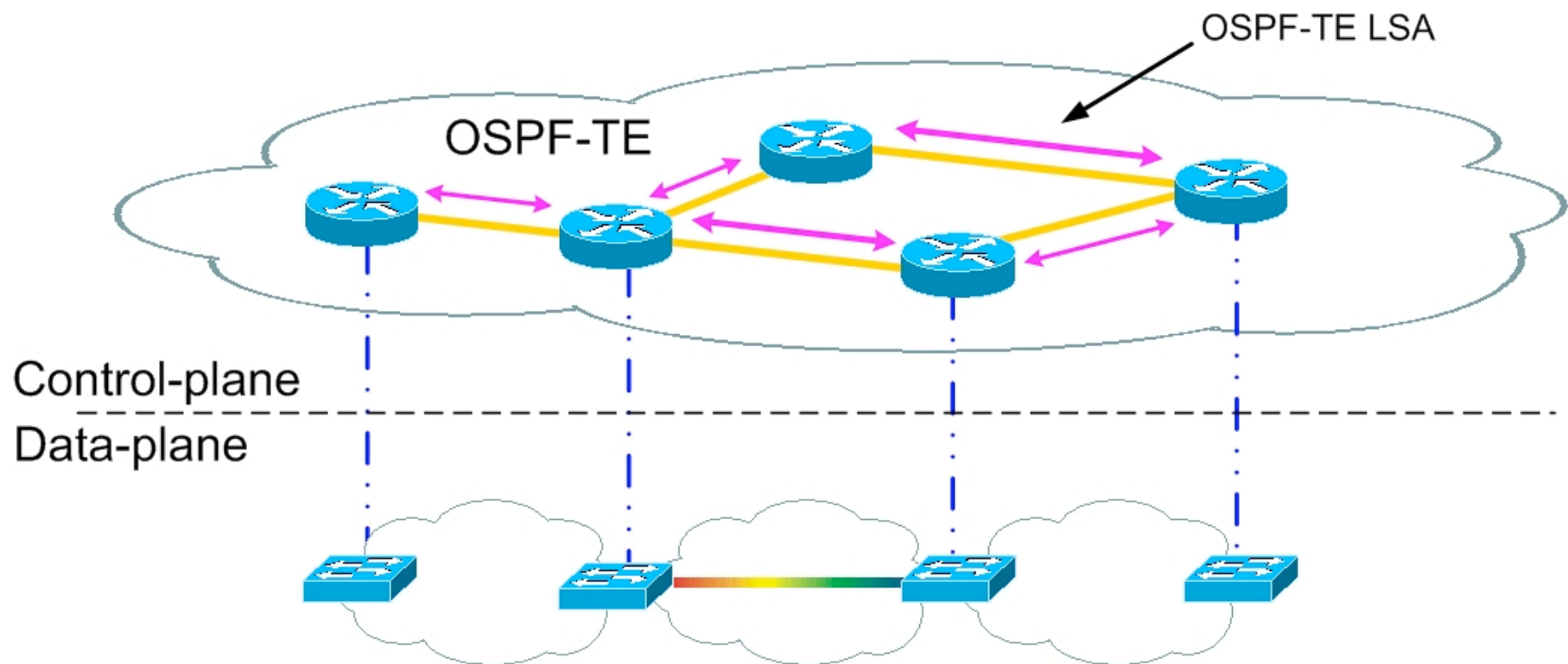


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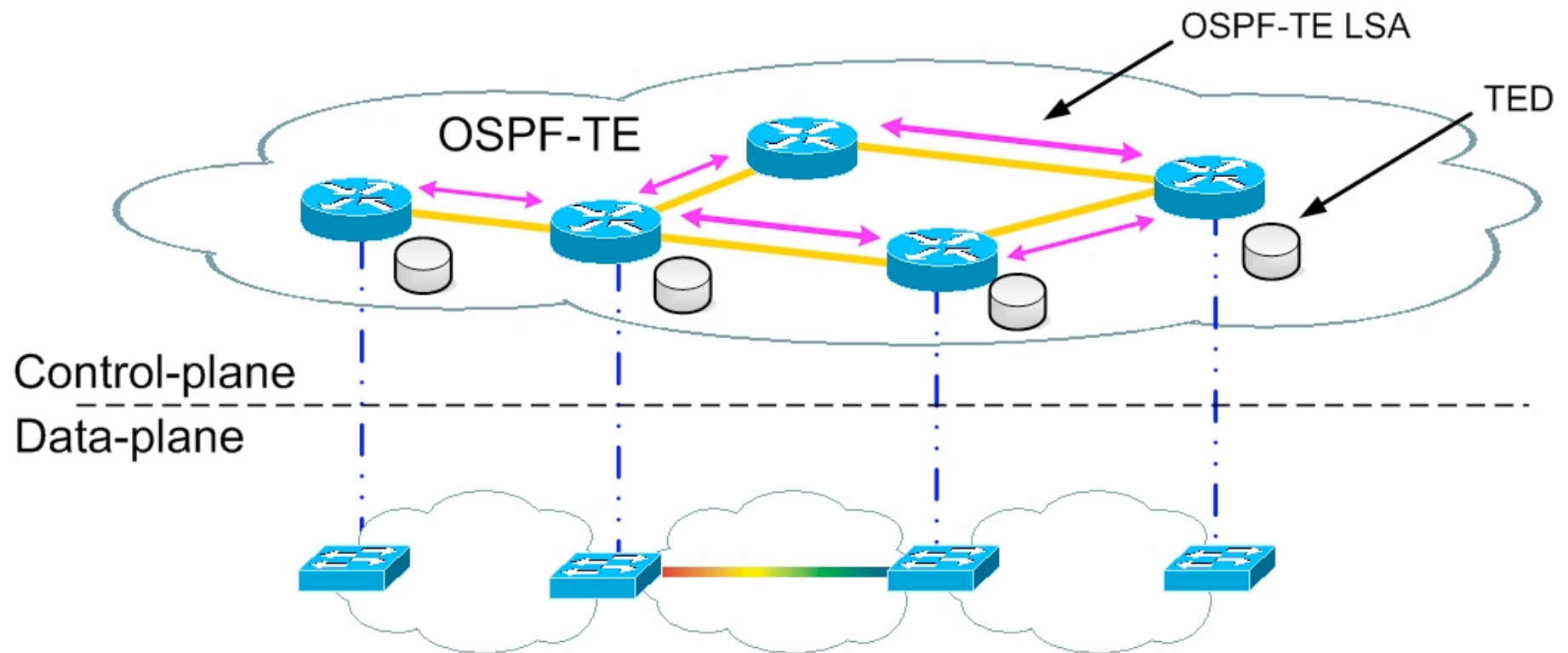


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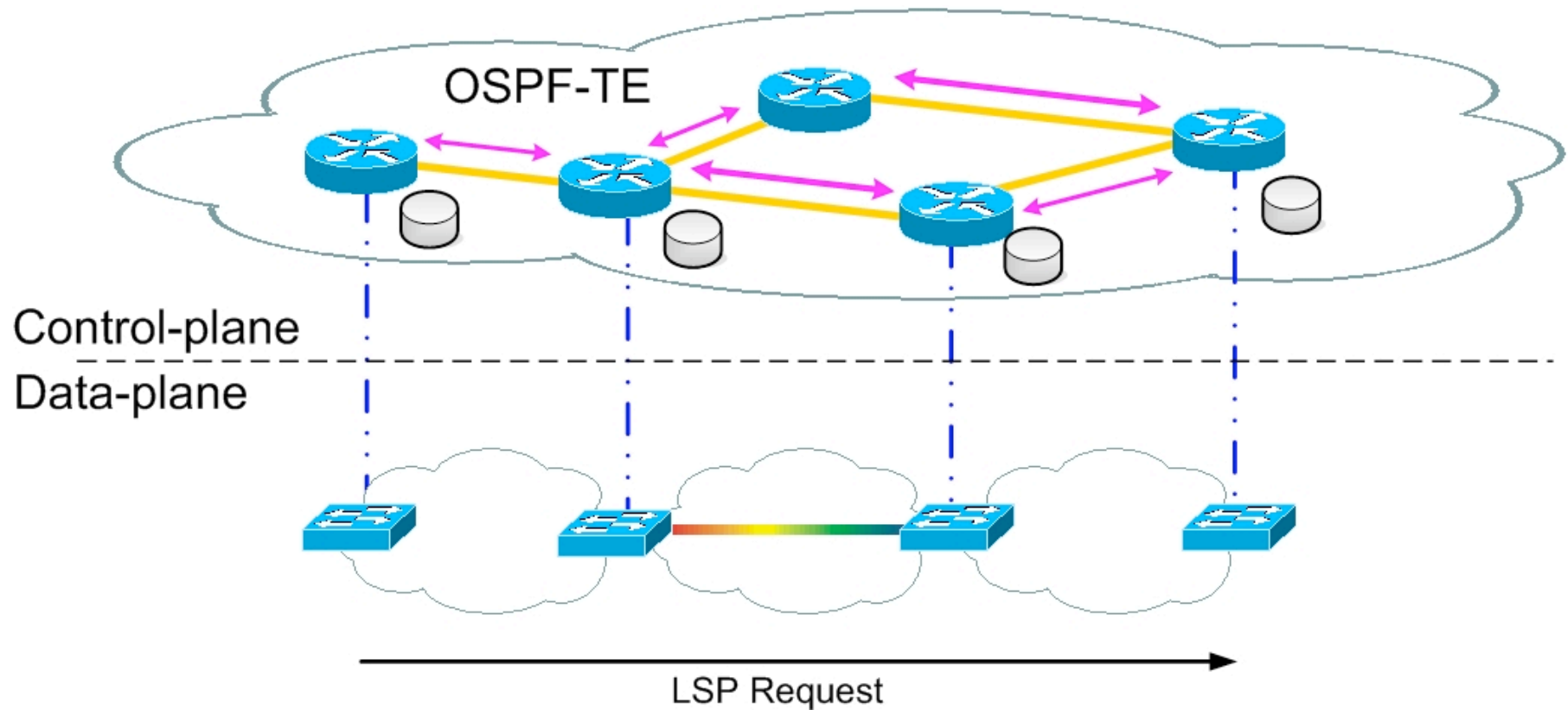


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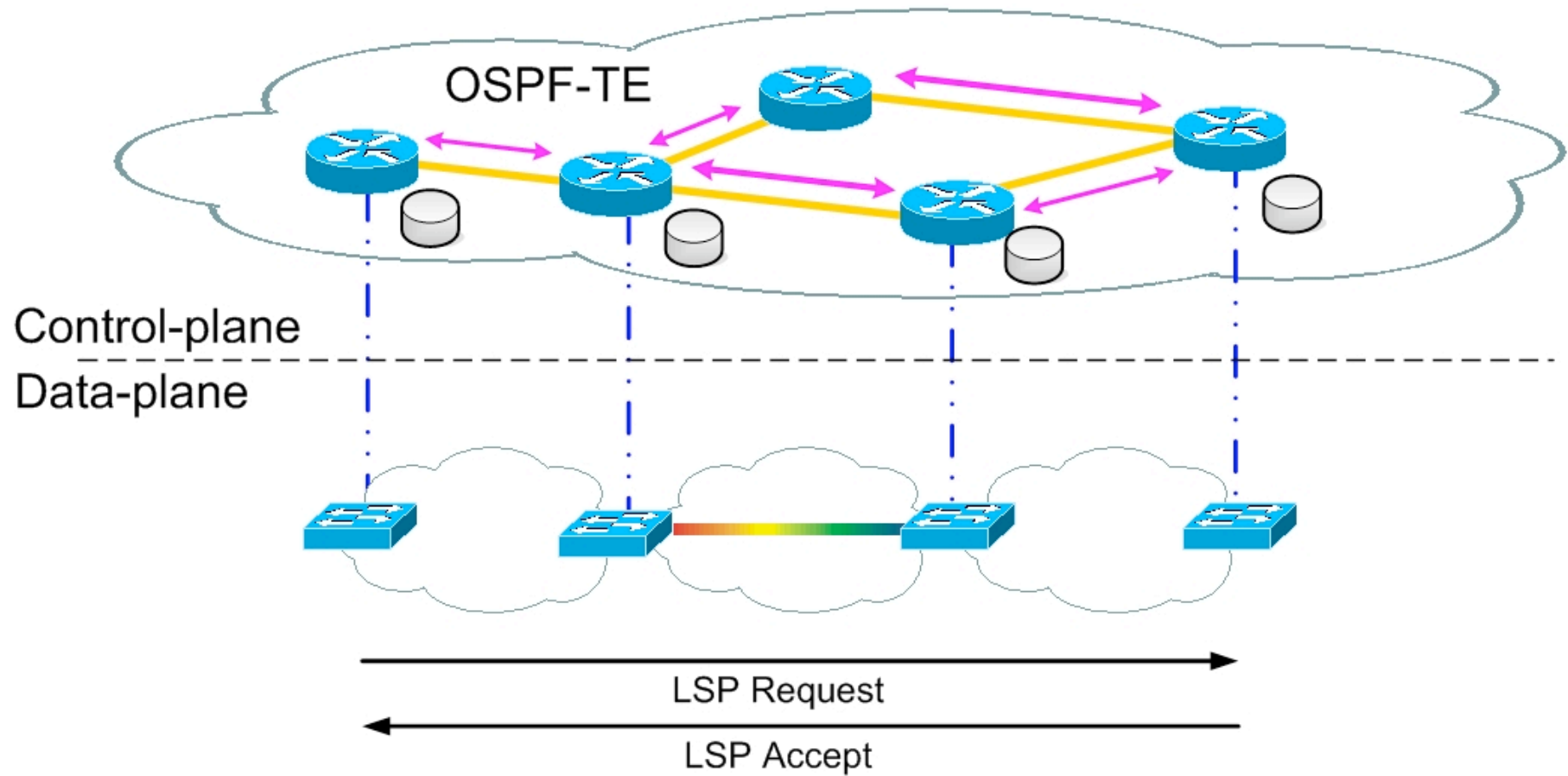


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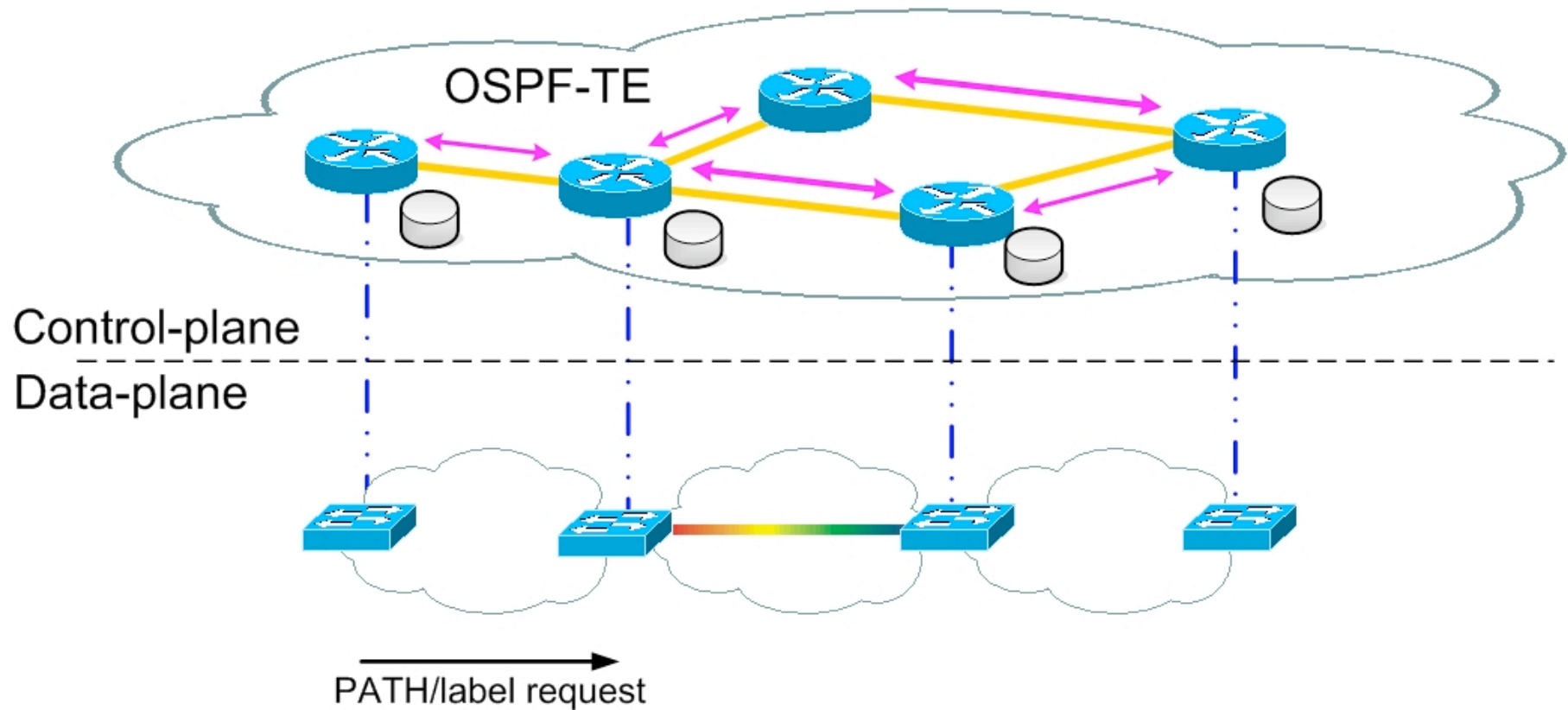


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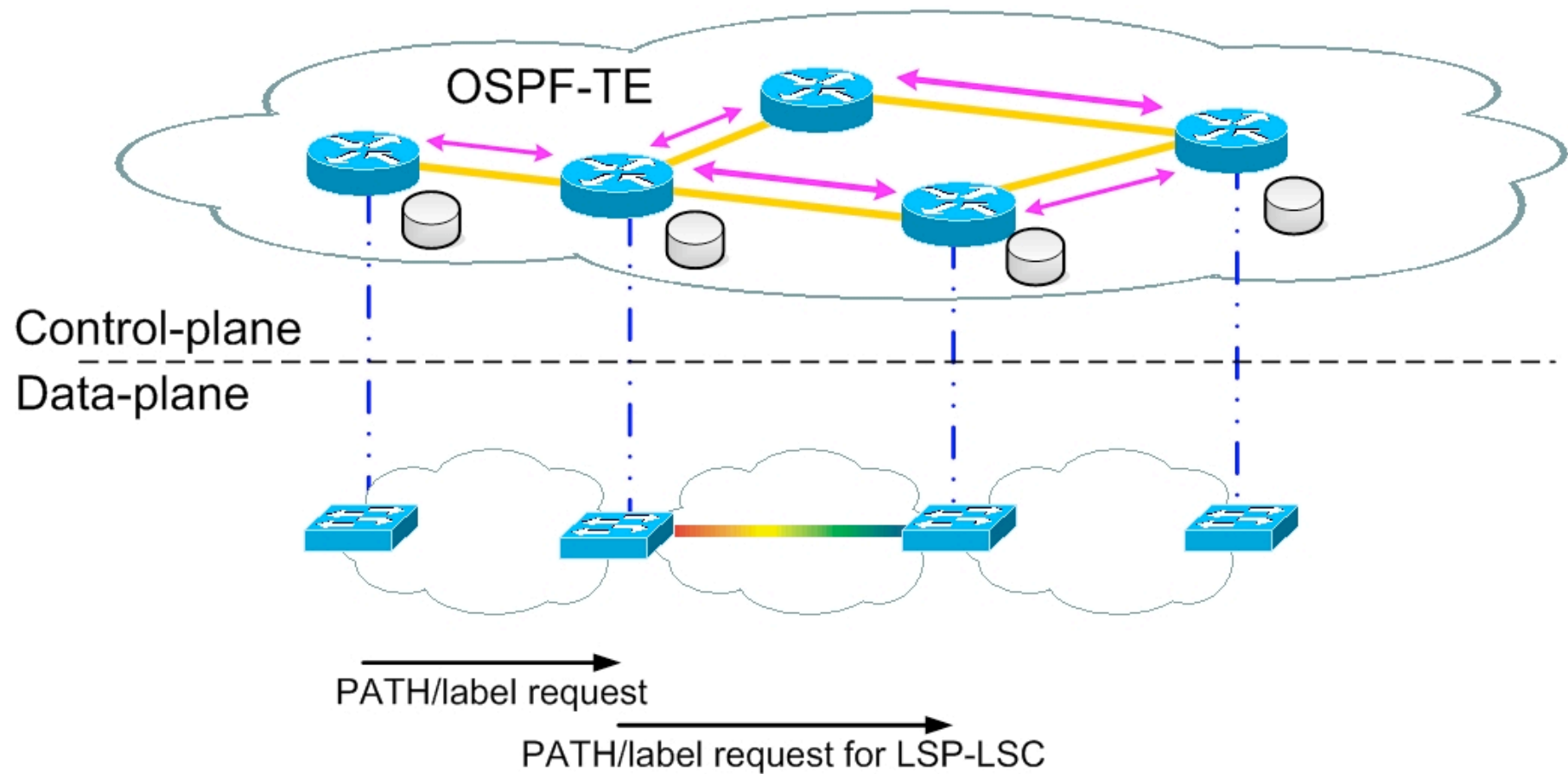


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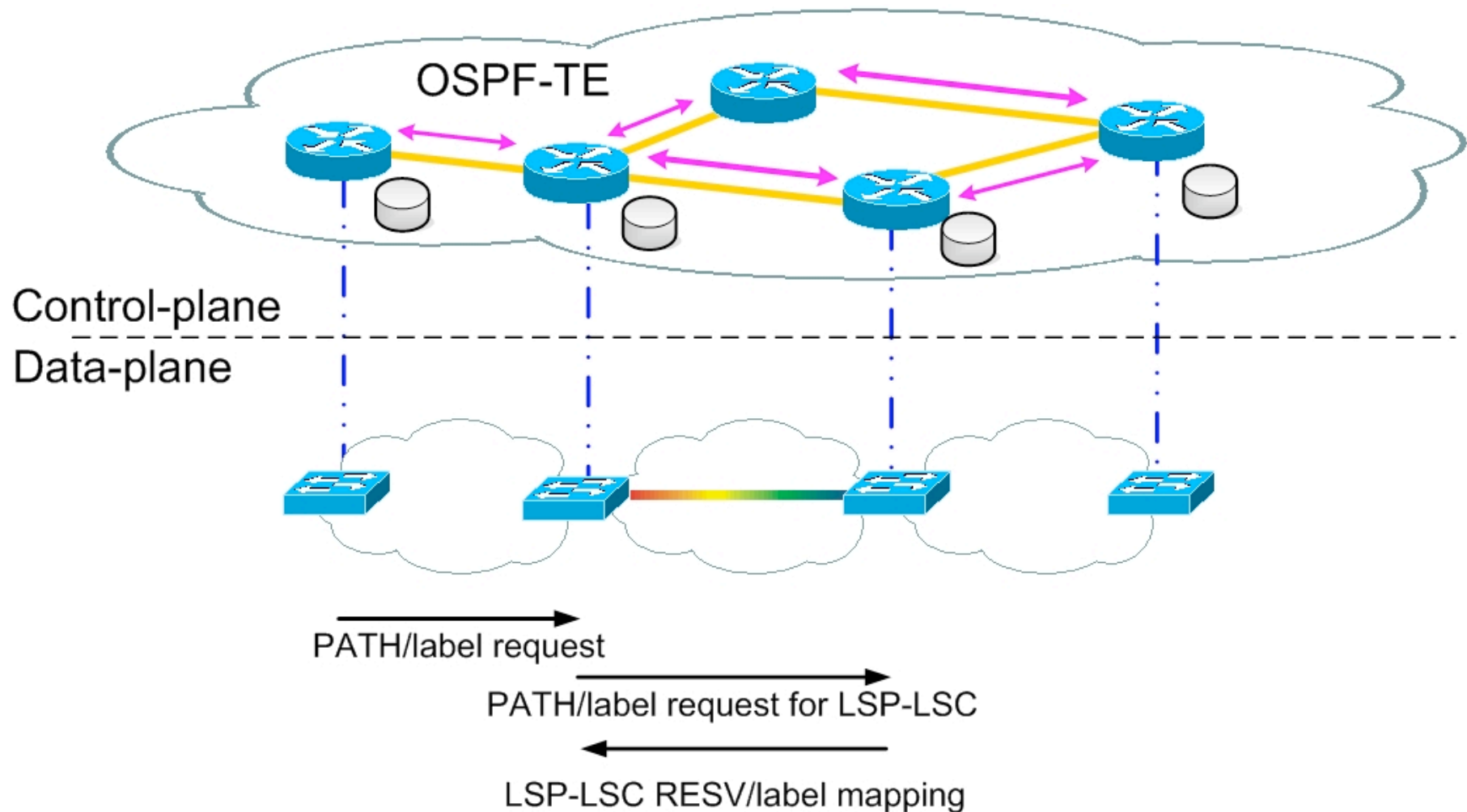


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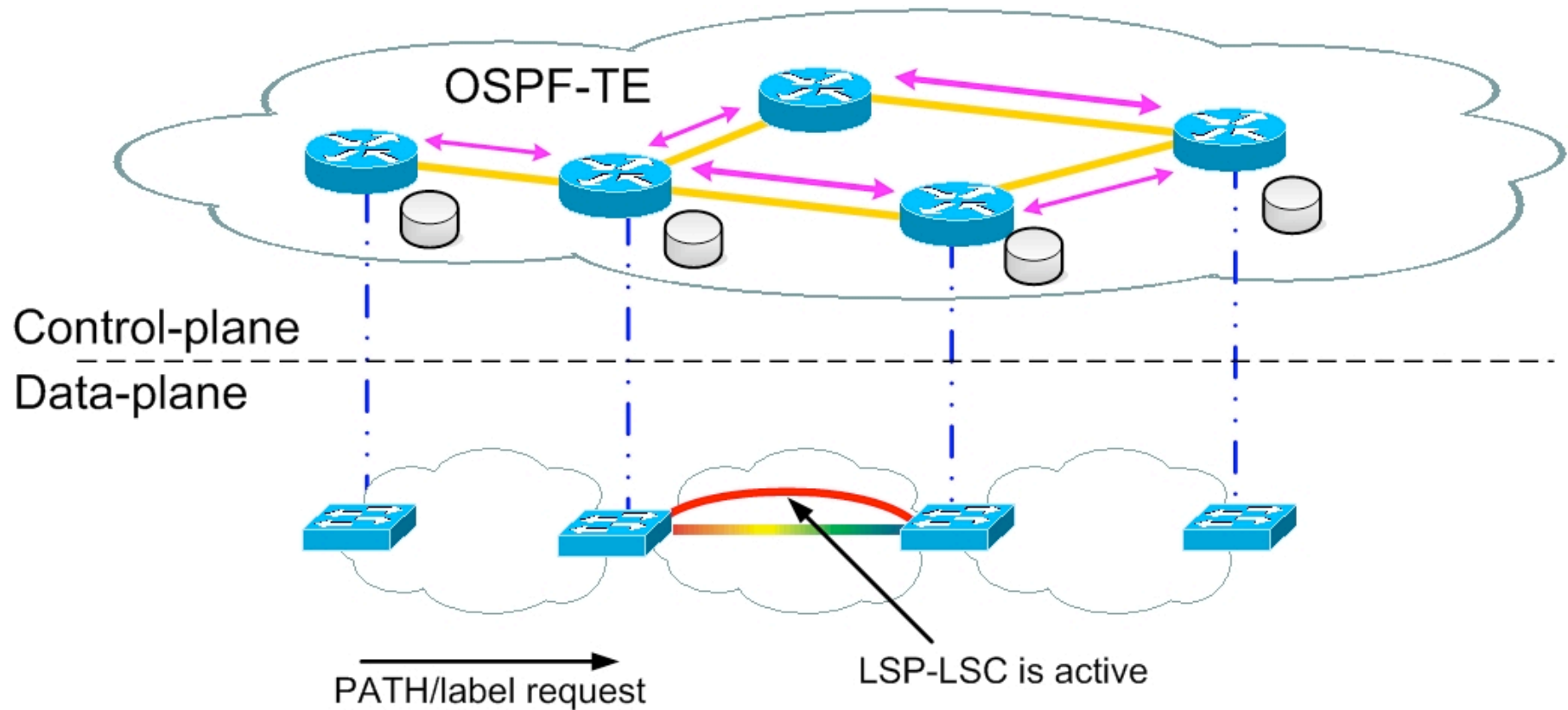


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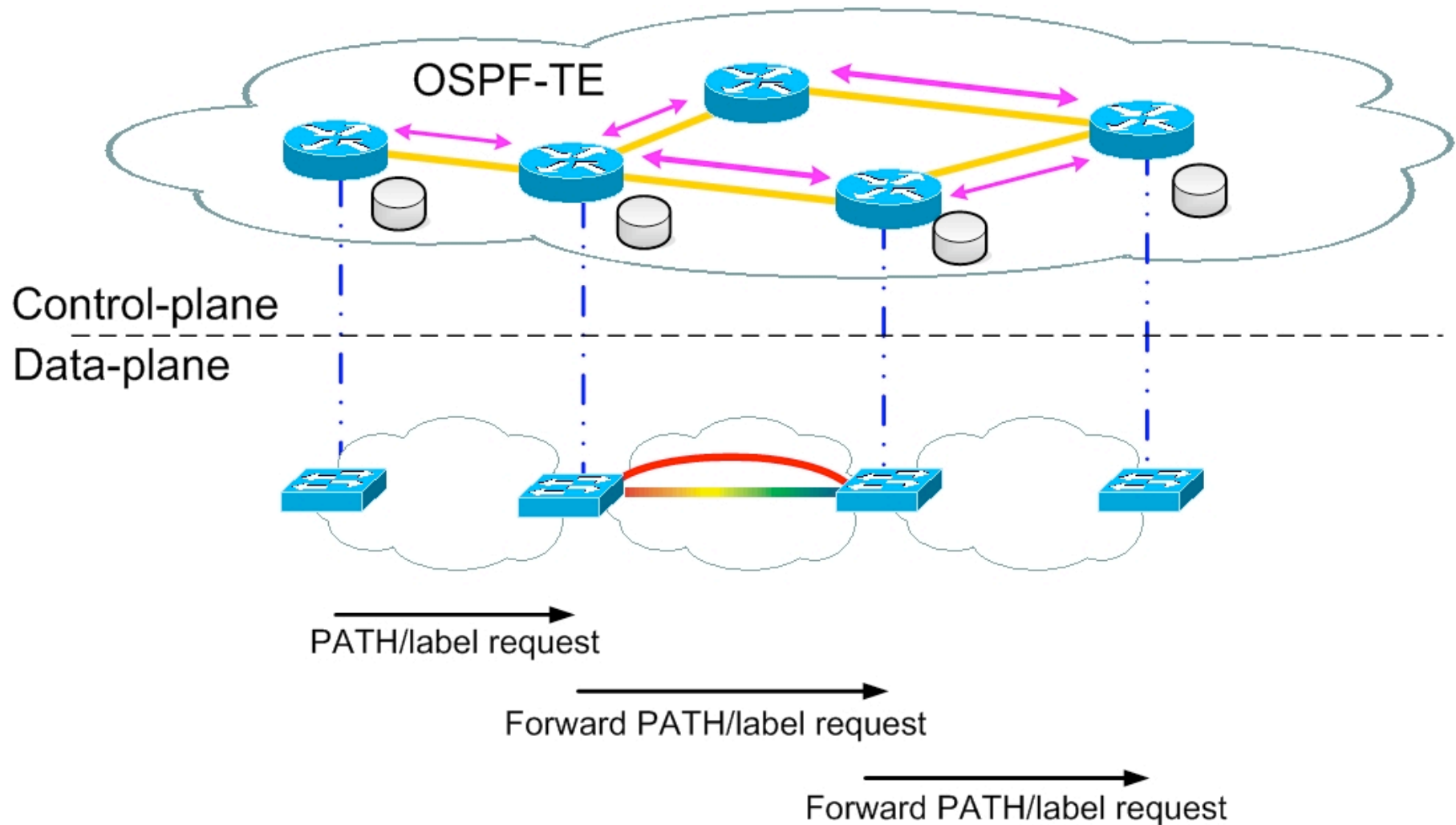


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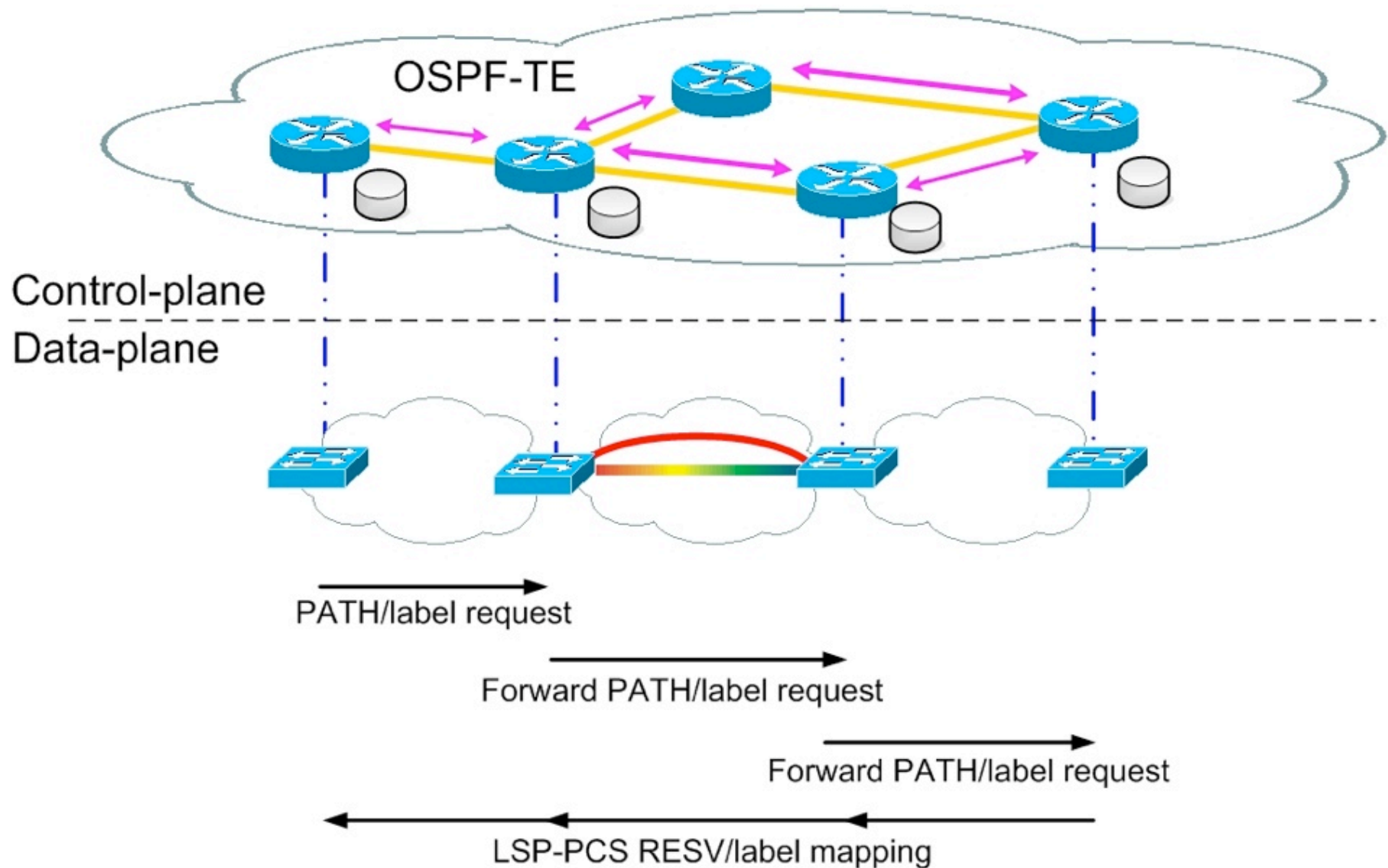


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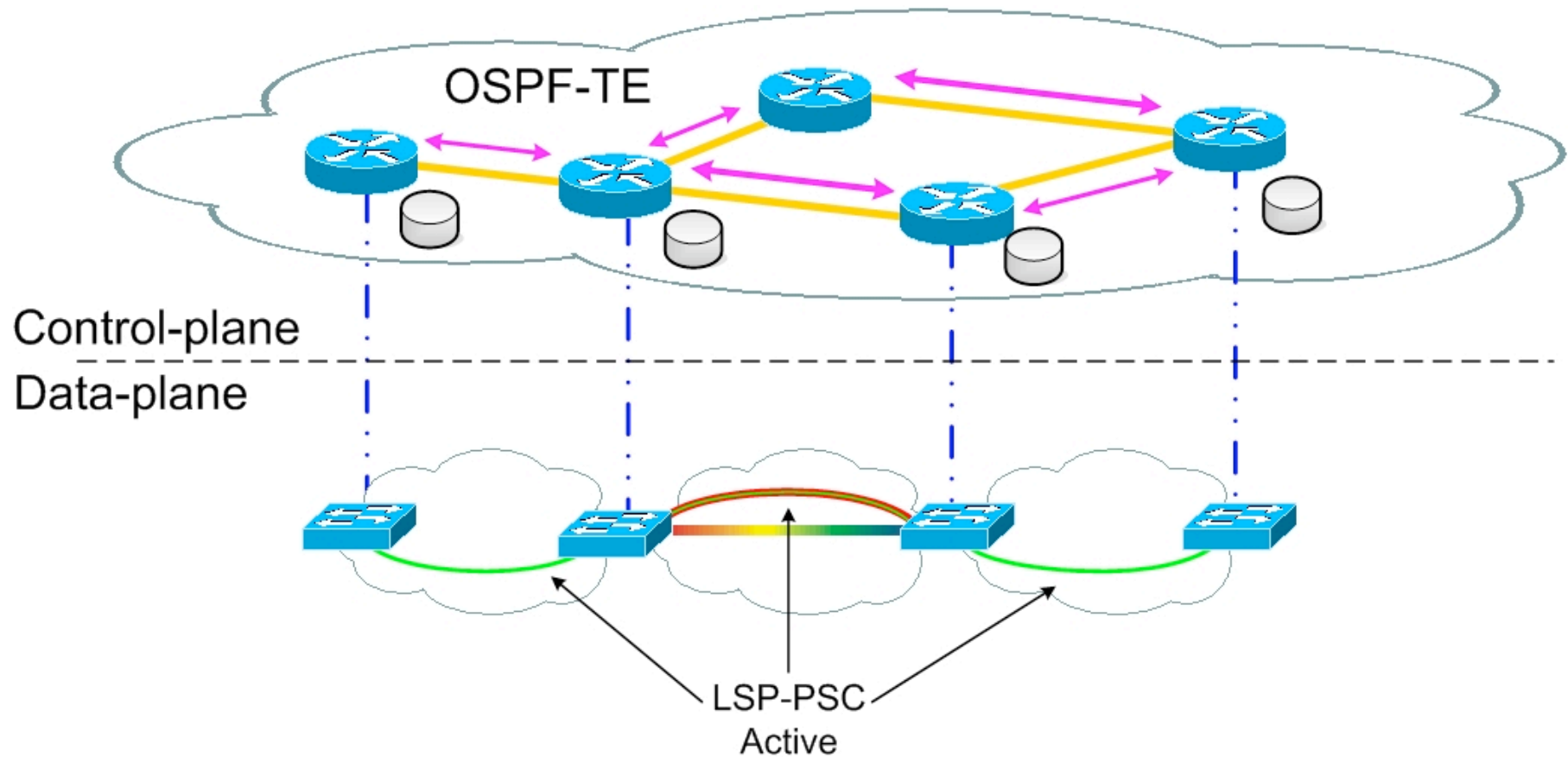




# GMPLS IN A NUTSHELL



# GMPLS IN A NUTSHELL





# 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

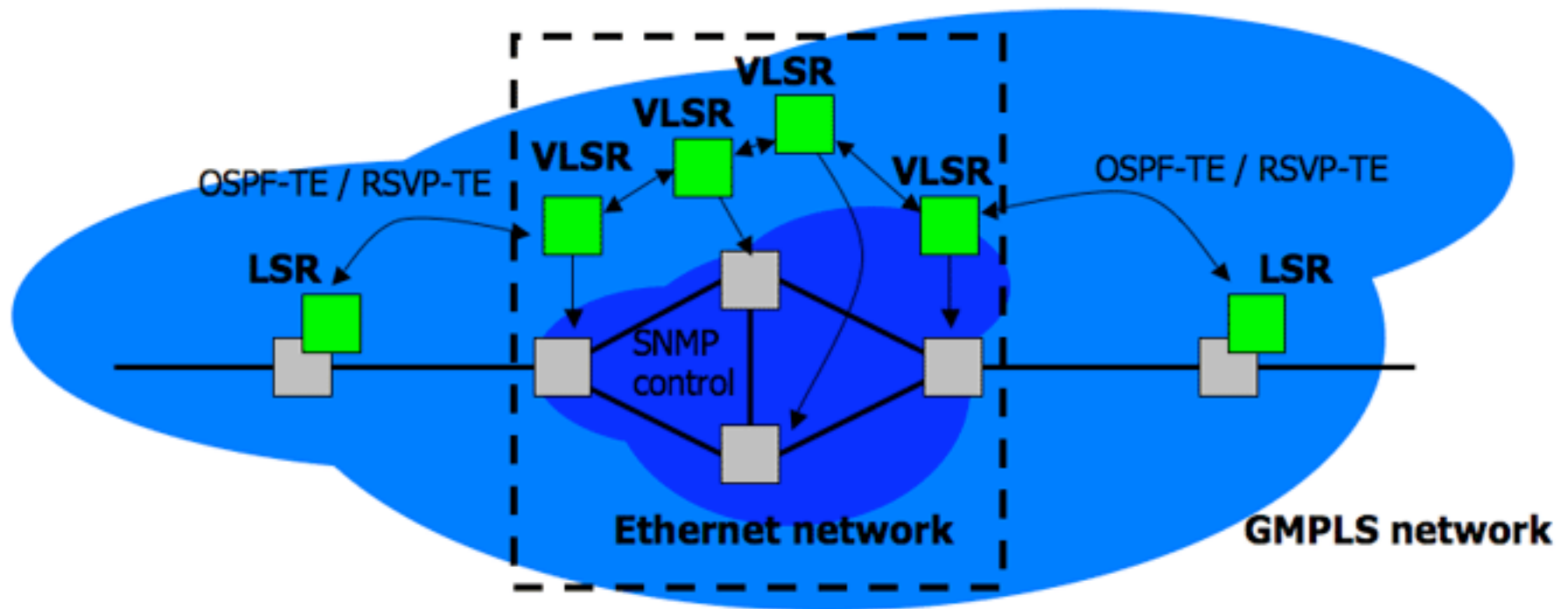
## VLSR

- ✻ 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

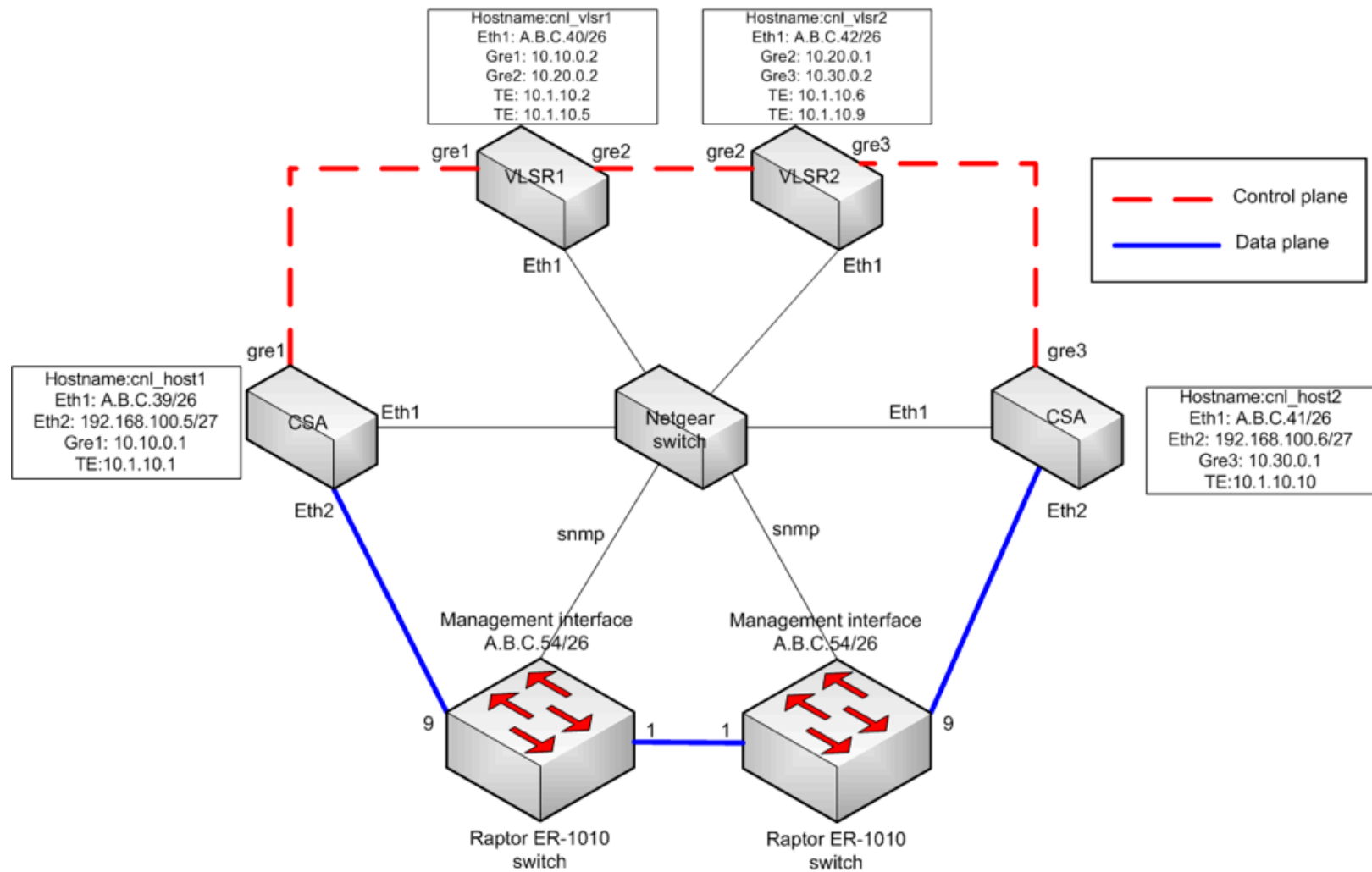
- ✻ Developed and GNU General Public License
- ✻ Write add-ons yourself
- ✻ Active development
- ✻ Nightly build
- ✻ Main contributors: University of Maryland UMD, Mid-Atlantic Crossroads MAX, University of Southern California Information Sciences Institute East USC/ISIS and George Mason University GMU



GMPLS @ SARA



# Infrastructure



“GMPLS Tutorial and R&E Network Implementation” by Chris Tracy at the University of Amsterdam April 19th 2006



# GMPLS @ SARA

## Test

- ✻ Creating a LSP between the two CSA's
- ✻ Break down a LSP



# GMPLS @ SARA

## Creating a LSP between the two CSA's

### ☼ Execution

```
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



# GMPLS @ SARA

## 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



# 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?