

Path Computation Element in SURFnet6

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Introduction

Content

- Introduction
- Research Question
- Problem Description
- About PCE
 - Components
 - Features
- Usability in SURFnet6
- Future Work
- Conclusions

Introduction

- SURFnet is a ISP for universities and research institutes.
- SURFnet6 contains over 6000km Dark Fiber throughout The Netherlands.
- SURFnet6 is a Hybrid network.
 - Traditional IP – Packet Switched.
 - Lightpaths – Circuit Switched.
- SURFnet gives the ability to request a dedicated lightpath.
- SURFnet's NOC @ SARA is responsible for handling these requests.

Research Question

- Is the PCE-based architecture described in RFC4655 usable for SARA's planning tool?

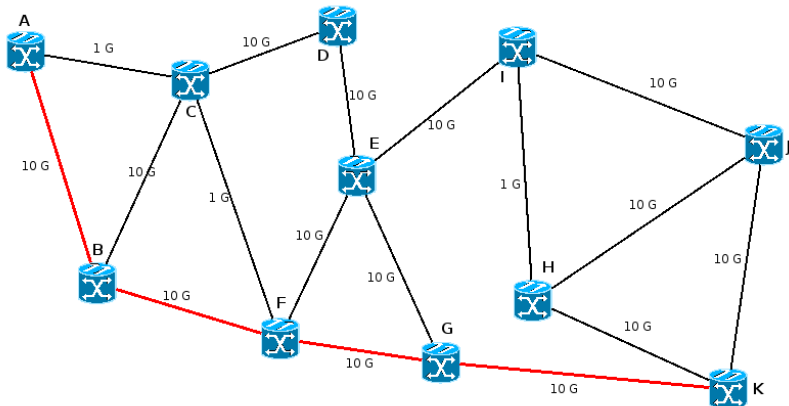
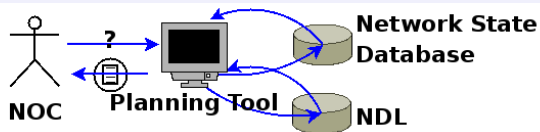
SARA's planning tool

- R. v.d. Pol and A. Toonk created a planning tool to find a lightpath in the SURFnet6 network.
- The tool is used by SURFnet's NOC @ SARA to set up the lightpaths.

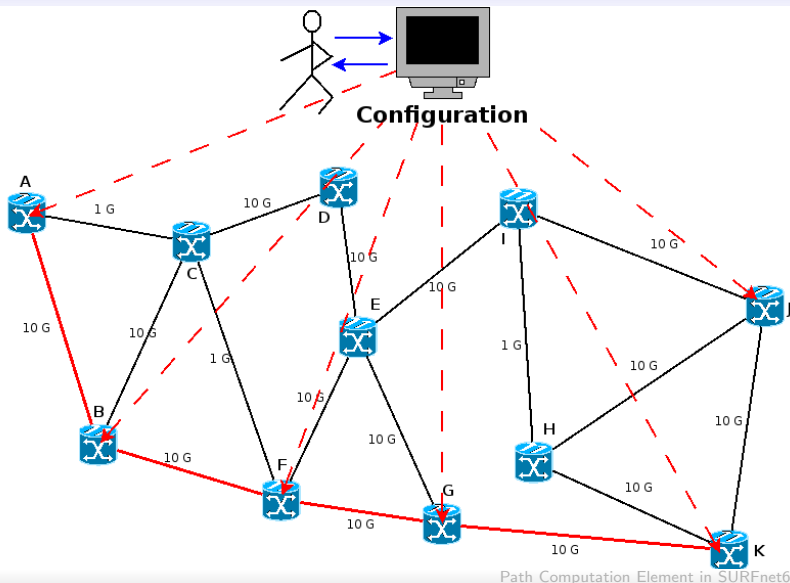
Properties of the Planning Tool:

- Topology data in NDL (Network Description Language).
- Allocated equipment in Network State Database.
- Applies constraints (bandwidth, type of path).
- Calculates shortest path on remaining topology.

SARA's planning tool – 1



SARA's planning tool – 2



About PCE

PCE Definition

RFC4566 states:

“A Path Computation Element (PCE) is an entity that is capable of computing a network path or route based on a network graph, and of applying computational constraints during the computation.”

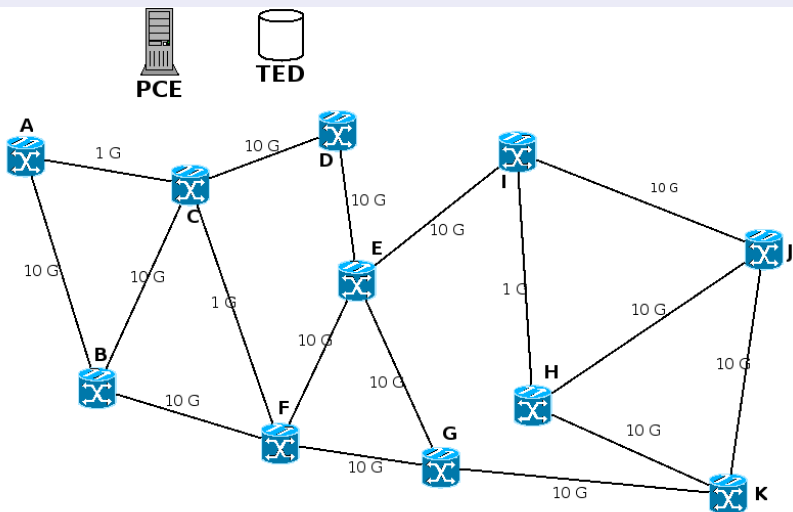
About PCE

PCE Properties

- One or more PCEs in a network.
- Application of constraints.
 - e.g. Bandwidth.
 - e.g. Type of path (Normal, Redundant, etc.).
- Application of policies.
- Communication with other PCEs.
- Computation of paths (using Traffic Engineering Database).
- Also possible to do inter-layer and inter-domain path computation.

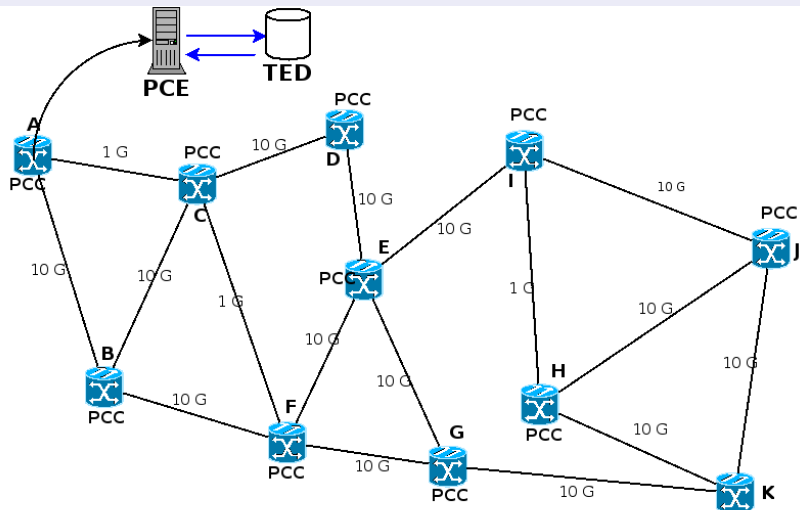
Components

PCE



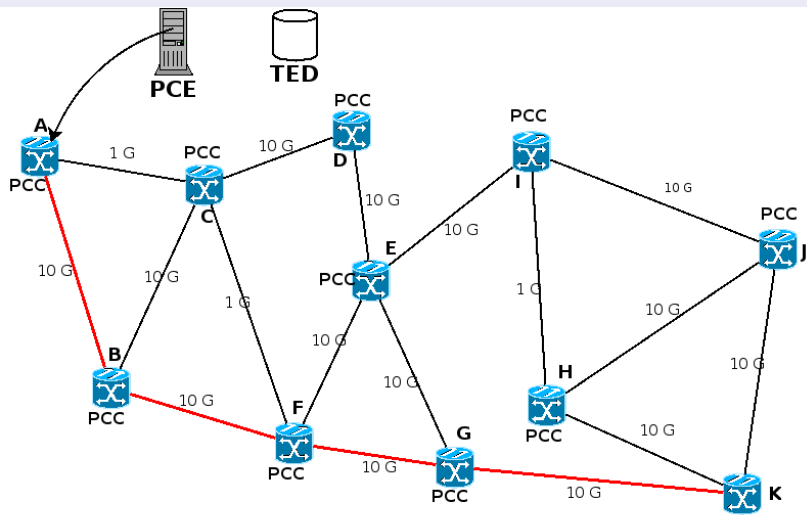
Components

Path request



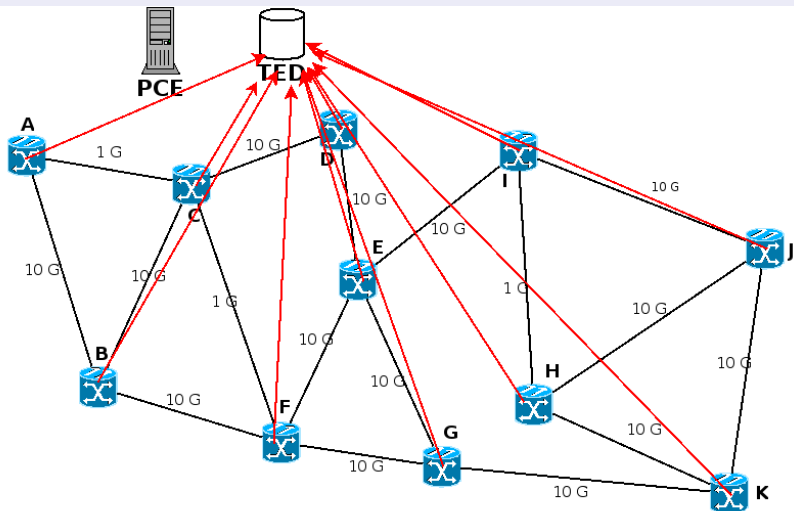
Components

Path Creation



Components

TED update



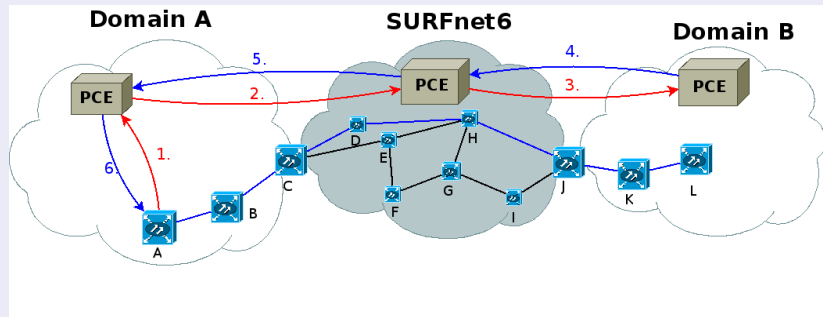
Features

Inter-domain and inter-layer path computation

- PCE is also able to do inter-domain and inter-layer path computations.
- The 'downside' is that these features is that they require an Interior Gateway Protocol with Traffic Engineering extensions like OSPF-TE and IS-IS-TE.
- Extra security is needed in these situations.

Features

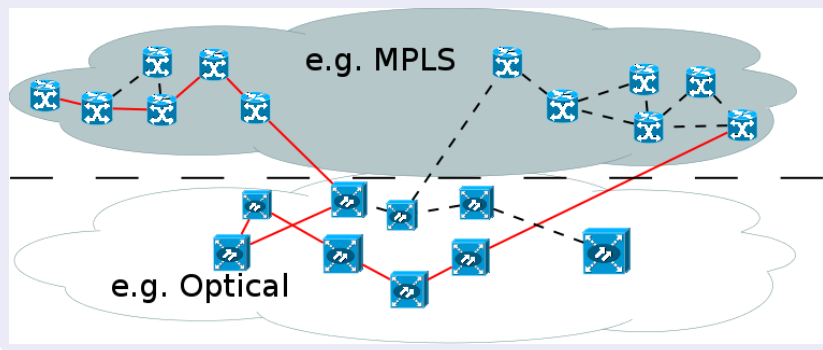
Inter-domain path computation



1. Path request from A to L.
2. Path request from C to L.
3. Path request from J to L.
4. The path is: "J - K - L".
5. The path is: "C - D - H - J - K - L".
6. The path is: "B - C - D - H - J - K - L".

Features

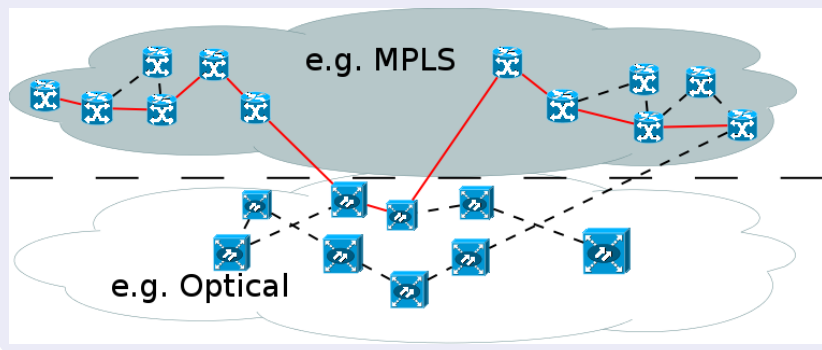
Inter-layer path computation



Without multi-layer PCE, SPF is done on each layer separately. The MPLS considers the optical layer as a single hop and counts 6 hops. Overall this results in a suboptimal path of 11 hops.

Features

Inter-layer path computation



With multi-layer PCE, SPF is done on all layers together. The PCE can now also see the Optical layer. It results in an optimal overall path of 10 hops.

Usability in SURFnet6

- No support for future reservations
 - Normal reservation: needed next week; set up instantly;
 - Future reservation: needed next week; set up when needed;
- Mandatory implementations
 - The Path Computation Client
 - The PCEP protocol
 - The constraints
 - The policies (e.g. Restricting information for certain clients)

Future Work

- How can Inter-domain and inter-layer PCE be implemented in SURFnet6?
- Some research could be done on algorithms the PCE should use.
- Research has to be done on proper policies.

Conclusions

- PCE can certainly be an interesting extension for SARA's planning tool:
 - The dynamic approach of PCE adds significant complexity to the protocol.
 - A IETF standard will be used.
- PCE's inter-domain and inter-layer are certainly of interest for SURFnet6:
 - Standardized PCE protocol facilitates better communication between SURFnet6 and other research networks.
 - Less bureaucracy and formality.
 - For this feature, an IGP with TE extensions has to be implemented in SURFnet6 first.

Questions?