Network Planning for Dynamic Impairment Constraint Optical Networking:

The Activities of DICONET EU Project

OsUc – Planning Tools for Transparent Optical and Multilayer Networks

OFC/NFOEC 2008

Sunday, February 24, 16:30 – 19:30

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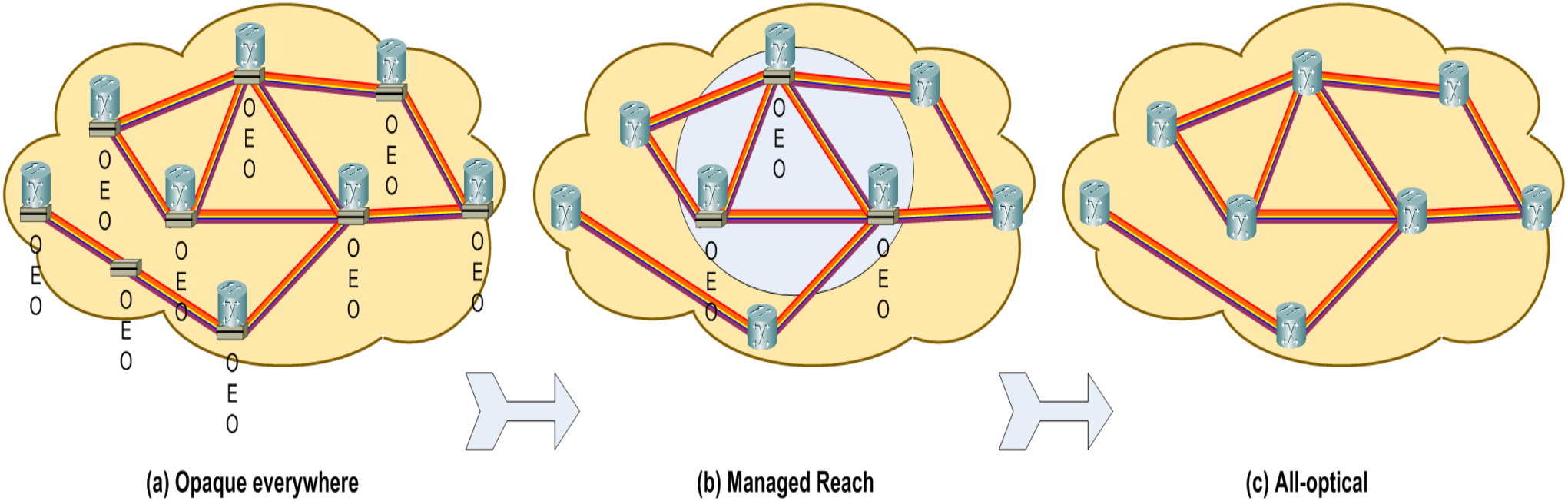
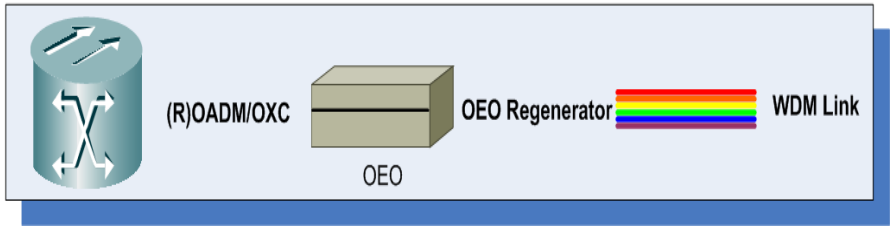
Outline

- Possible network architectures
- Challenges of Transparent Optical Networks
- DICONET Solution
- Key Building Blocks
- Question & Answers

Toward Future Core Nets (1/2)

- Evolution of Core optical networks





Toward Future Core Nets (2/2)

- **The network evolution aims at:**
  - Improved cost economics
  - Reduced Operations Efforts
  - Scalability
  - Suitability to Future services

- **The main drivers for network architecture migration:**
  - High bandwidth and end-to-end QoS guaranteed services
  - Dynamic (on demand) technology-independent service provisioning

Limitation of transparent networks

- **Physical Impairments accumulation**
  - Signal impairments accumulate along a transparent optical path, therefore limiting the system reach and the overall network performance

- **Failure localization**
  - Failure propagate in a transparent network environment and they can not be easily localized and isolated.

Realistic Network Design

- Off-line network data
  - Topology, Demand matrix, Future growth of demands, link characteristics, …
- Physical Layer design and modeling
  - Impairment aware lightpath routing
  - Possible regeneration site selection
  - Impairment aware wavelength assignment
  - Monitoring equipment placement for failure localization
  - Impairment aware control plane (e.g. GMPLS) extensions
- Static network pre-planning
- Dynamic network planning based on online data and decisions

DICONET Overview

- Title: **Dynamic Impairment Constraint Networking for Transparent Mesh Optical Networks**
  - Instrument: STREP under EU-FP7
  - Activity: ICT-2007.1.1: The Network of the Future
  - Project start: 1 Jan. 2008
  - Project Duration: 30 Months
  - Project budget: 4,854,712 Euro (3,198,874 Euro EC contribution)
  - Project resources: 488.5 PM
  - URL: http://www.diconet.eu

The consortium

- 5 Industrial partners
  - ADVA, ALF, ECI, Huawei, DTAG/T-Systems
- 7 Academic and Research institutes
  - AIT, Create-NET, ENST, IBBT, RACTI, U of Essex, UPC
- 1 Project Management Company
  - JCP

DICONET Vision

- **DICONET Vision**
  - Cross-Layer optimization
    - Physical layer impairment management
    - Impairment Aware Routing and Wavelength Assignment (IA-RWA) algorithms

- The main idea:
  - The development of a ***dynamic network planning tool*** residing in the ***core network*** nodes that incorporates ***real-time measurements*** of optical layer performance into ***IA-RWA algorithms*** and is integrated into a unified control plane.

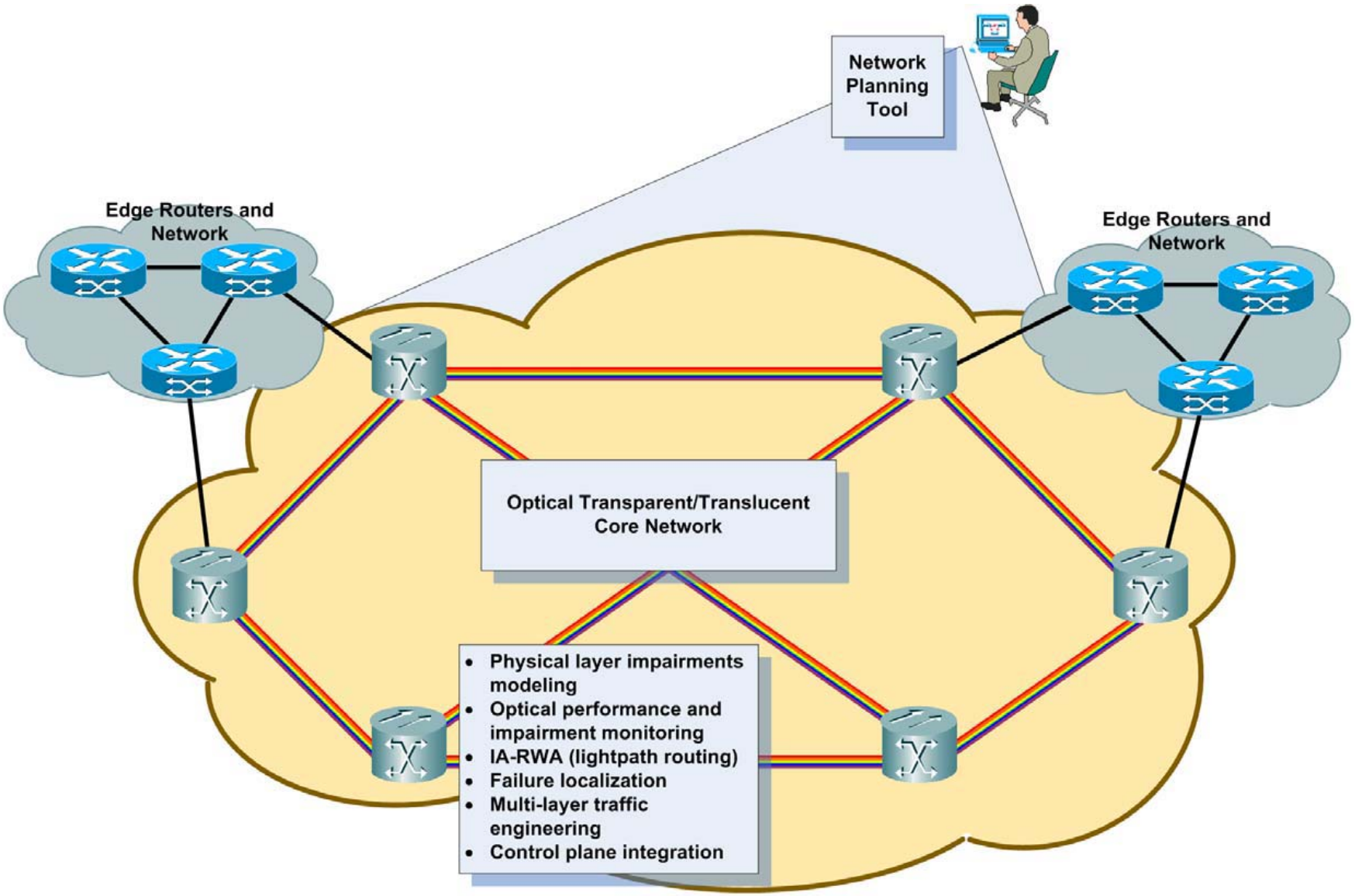
Challenges

- The challenges associated with the realization of the DICONET approach are as follows:
  - The availability of information on individual impairments from optical performance monitors to be used in order to guarantee SLAs
  - Accurate modeling of the variety of physical impairments and their interplay
  - An integrated framework that connects and associates the physical impairments and the networking aspects (e.g. traffic blocking, utilization of resources, end-to-end delay, throughput)
  - A mechanism that allows the impairment information to be exchanged between the network elements

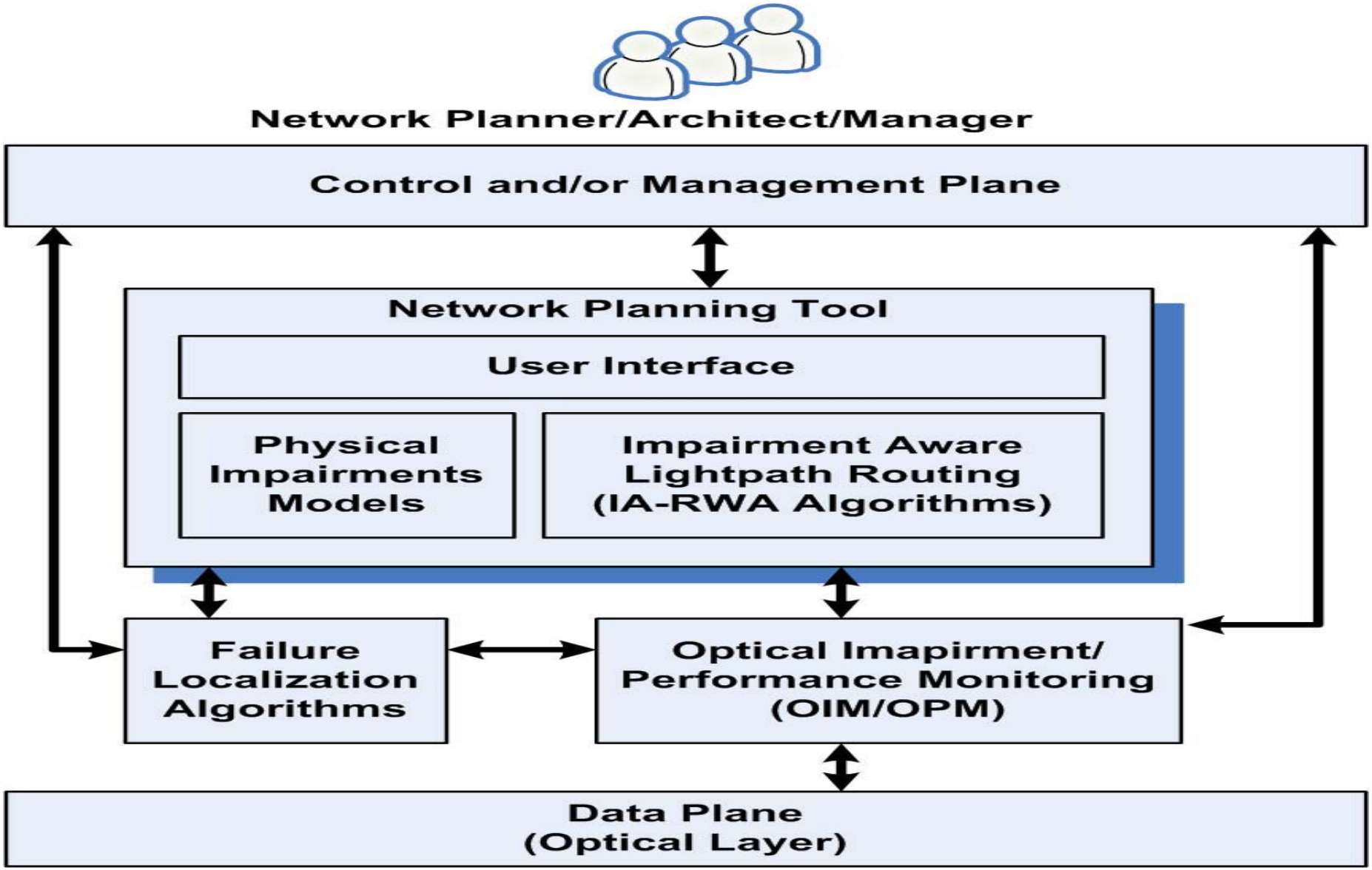
DICONET Solution (1/2)

- Physical layer monitoring
  - Performance monitoring (BER, Q-factor)
  - Impairment monitoring (OSNR, CD, PMD, …)
- Physical layer modeling
  - Analytical Q-factor estimations
  - Semi-analytical phenomenological models to estimate the Quality of Transmission (QoT) based on experimental measurements
- Physical layer aware RWA
  - Off-line
  - On-line
- Algorithms for optimum equipment placement
  - Regenerators
  - Monitors
- Failure localization algorithms
- Physical layer aware GMPLS
  - OSPF based
  - RSVP based
  - PCE based

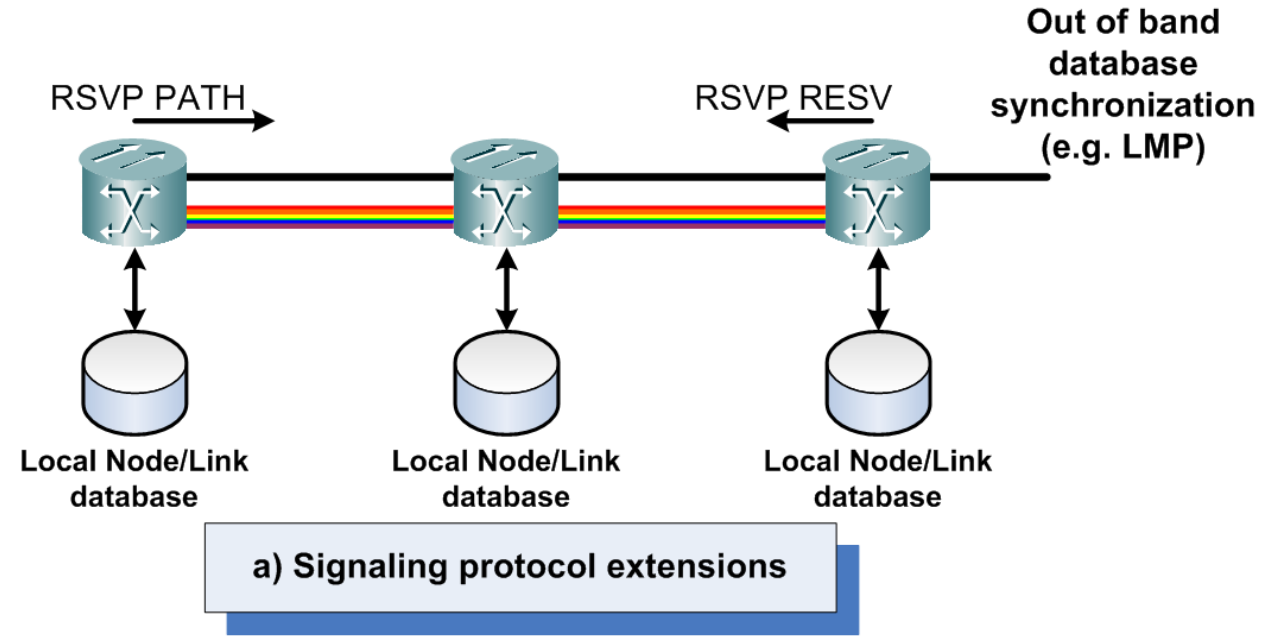
DICONET Solution (2/2)

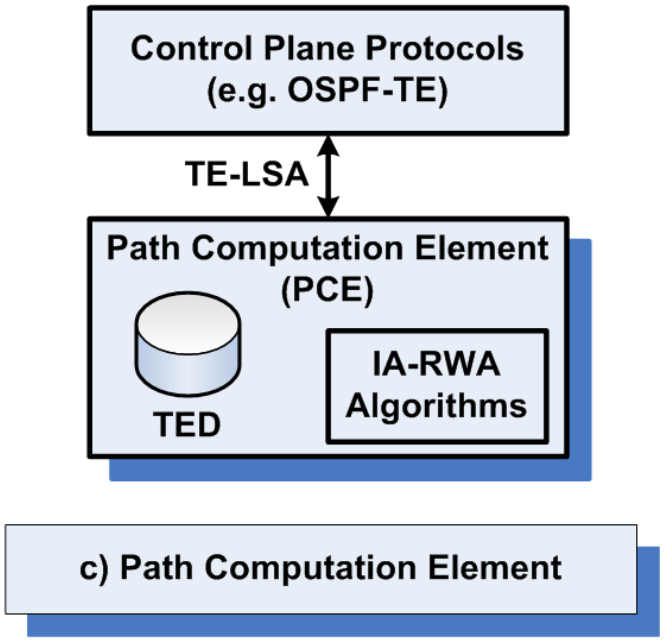


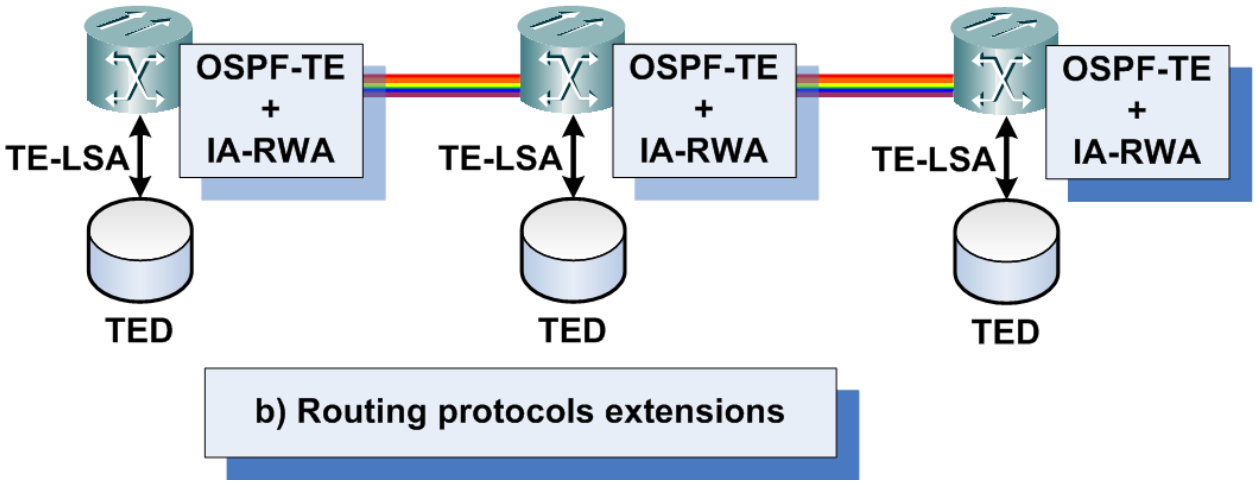
Building Blocks



Control Plane (IA-GMPLS)







DICONET through its industrial partners participate actively in standards bodies

Expected outcomes

- Identification of the network impairments and appropriate monitoring techniques
- Techniques for physical impairment information dissemination across the network
- Development of an advanced physical layer modeling tool
- Design of IA, multi-constraint routing and wavelength assignment algorithms
- Optimized algorithms for component (regenerators, monitors) placement
- Development of failure localization algorithms
- Define interface between monitors and the control plane
- Propose extensions to GMPLS protocols (RSVP, OSPF, LMP) for impairment aware networking
- Techno-economic studies results to quantify the benefits
- Tools for network planning based on the status of the network and the information received by network monitors

Conclusions

- Dynamic network planning with IA-RWA, integrated into a unified control plane is a key enabler for rapid network configuration

- DICONET represents a new network concept, which will have major impact on the network design and operation

The topic is gaining momentum

- Over 10 presentations on relevant topics at OFC 2008
  - Including an invited presentation by Prof. Maurice Gagnaire of ENST, DICONET partner
- Special issue at IEEE Network on “cross-layer issues”
  - CFP will be circulated end of February
- ICTON 2008 special industry session on “Impairment constraint networking”