Dynamic Impairment Constraint Networking for Transparent Mesh Optical Networks

ICT-2007.1.1: The Network of the Future
Grant agreement n° 216338
Project Duration: 30 months
Project Budget: 4.83ME
EC contribution: 3.2ME
Why DICONET?

- Evolution of Core optical networks

<table>
<thead>
<tr>
<th>Network Regeneration</th>
<th>All-optical Nowhere</th>
<th>Managed Reach Where needed</th>
<th>Sub-networks Only at edges</th>
<th>Opaque Everywhere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Limitation</td>
<td>Simple Transport</td>
<td>Complex Management</td>
<td>Modest Reach length</td>
<td>Simple Fabric size</td>
</tr>
<tr>
<td>Pro</td>
<td>Flexibility Impairments</td>
<td>Fewest regenerators Interworking</td>
<td>Manageable Limited scalability</td>
<td>Evolutionary Highest cost</td>
</tr>
</tbody>
</table>

Most relevant FP6 EU project: NOBEL (no continuation in FP7, although desirable by the partners) DICONET is the only FP7 call 1 EU project focusing on core optical networks
Main limitations of transparent networks:
- Physical Impairments
  - 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 isolate

DICONE Vision
- Cross-Layer optimization
  - The physical layer performance is considered in the optimization process of the network layer performance
- 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
  - Integration (through proper extensions) into a unified control plane based on the GMPLS protocol suite
  - The real-time measurements of optical layer performance will enable more accurate failure localization
Key objectives

- Development of IA-RWA algorithms
  - Success criteria: QoS aware, IA-RWA for static/dynamic traffic/network conditions.
- Optimum regenerators and monitors placement
  - Success criteria: Algorithms for optimum regenerators and monitors.
- Efficient failure localization algorithms
  - Success criteria: Failure localization algorithms.
- Development of Optical Performance and Impairment Monitoring (OPM/OIM) techniques.
  - Success criteria: Capabilities and requirements of OIM/OPM and feedback to standardization bodies.
- Development of modeling tools
  - Success criteria: Models for deleterious effects involved in high speed networks.
- Experimental verification and realization of dynamic network planning tool.
- Extensions to existing protocols
  - Success criteria: Proposed extensions to G-MPLS and feedback to standardization bodies.
- Verification of the DICONET tools, algorithms, and protocols
  - Success criteria: Development of a test-bed to DICONET.
WP1  Project Management

WP2  Network architecture and support studies

WP3  Development of a network planning tool for dynamic traffic/impairments
- Task 3.1: Efficient optical layer impairment monitoring and dissemination of information
- Task 3.2: Network modelling studies to evaluate the efficiency of monitoring schemes
- Task 3.3 Development and evaluation of the network planning tool

WP4  Development of algorithms
- Task 4.1 Impairment aware, multi-constrain RWA for QoS routing
- Task 4.2 Impairment aware offline RWA routing
- Task 4.3 Optimization Algorithms for component placement

WP5  Network Management and Control Protocols
- Task 5.1: Definition of the interface between monitors and the control plane
- Task 5.2.1: Modifications/extensions of G-MPLS control protocols
- Task 5.2.2: Implement the proposed G-MPLS control protocols extensions

WP6  Lab Experimentation, evaluation and testbed implementation
- Task 6.1: Experimental assessment of DICONET concepts
- Task 6.2: Implementation on FPGA hardware
- Task 6.3: Network planning tools evaluation and experimentation

WP7  Exploitation & Dissemination
- Task 7.1: Dissemination
- Task 7.2: Control Plane Extensions and Standardization
- Task 7.3: Techno-economic Issues
The consortium

- Project Coordinator:
  - JCP

- 7 Academic and Research institutes
  - AIT, Create-NET, ENST, IBBT, RACTI, UEssex, UPC

- 5 Industrial partners
  - ADVA, Bell-Labs, ECI, Huawei
  - DT/T-Systems
Cluster activities/collaboration with other projects

• Collaboration with BONE and Sardana
  – Common events/sessions/workshops
  – Standardisation activity

• Participation in future Internet activity if relevant.

• Contact persons for clustering:
  – Ioannis Tomkos (itom@ait.edu.gr)
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Thank You! - Questions

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# Key innovations

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<th>Technical Area</th>
<th>Current State of the Art</th>
<th>DICONET progress beyond the state of the Art</th>
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<td>Dynamic network planning tool</td>
<td>• Network planning tools for static network conditions that optimize network designs and provide optimum traffic routing</td>
<td>• Development of a dynamic network planning tool that incorporates real-time measurements of optical layer performance into IA-RWA algorithms and provides automated rapid network reconfiguration for dynamic traffic and dynamic network conditions</td>
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<td>Routing and Wavelength Assignment Algorithms</td>
<td>• Static and dynamic RWA approaches separating or treating the two problems simultaneously</td>
<td>• Novel static and dynamic RWA algorithms enhanced with optimum regenerator placement approaches that consider all key physical impairments and their interplay in combination with networking aspects (IA-RWA) in a feasible and efficient manner capable for integration in a dynamic network planning tool</td>
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### Key innovations (cont.)

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<td>Failure localization Algorithms</td>
<td>• Computational intensive failure localization and attack detection algorithms</td>
<td>• Innovative failure localization algorithms with reduced complexity in fully transparent optical networks, able to be deployed in the control or management plane of future networks and provide high resiliency and fast restoration.</td>
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| Control Plane protocols             | • GMPLS provides an efficient solution for fast and automated provisioning of connections across multi-layer networks. It enables advanced network functionalities for traffic engineering, traffic resiliency, automatic resource discovery and management. | • Propose and implement extensions and enhancements to the GMPLS protocol suite to realize an impairment aware Control Plane  
• Implement to the control plane certain functionalities like dynamic connection provisioning, performance monitoring, path computation and restoration in a distributed fashion without the intervention of the MP to enable simple and efficient network management  
• Provide feedback to related standardization bodies |