Optimizing Next-Generation Elastic Core Network Infrastructure

The increasing demand for transmission capacity in optical networks led to the Flexgrid concept, which allows a flexible aggregation of basic channels according to the demand. With the Flexgrid approach it is necessary to rethink many aspects of optical networks implementation: node architectures, planning procedures, protection and resilience options. These aspects were studied in ONECI.

**PROJECT WEBSITE URL**
https://www.in.pt/Projects/Project/1859

---

**GENERAL MOTIVATION AND OBJECTIVES**

Present communication networks have two complementing aspects: optical and mobile networks. The latter have the advantage of portability, making possible the realization of the ‘anywhere communications’ concept. Due to their popularity, mobile networks generate huge amounts of traffic, which must be delivered to the appropriate destination. However, mobile networks themselves cannot transport large amounts of traffic; possibly exceeding rates of 1000 gigabits per second. Here, fixed line networks based on optical fibers play a fundamental role, by transporting the huge amounts of data generated not only by wireless networks but also by all types of communication networks. In this context, the key objective of the ONECI project was to research in detail a cost and power efficient, optical transport network, based on the Flexgrid concept. The optimised optical network will be able to carry a wide range of signal bandwidths, varying in real time, direction and magnitude, some of which will have extremely large rates (greater than 400 gigabits/sec in the near future).

**CHALLENGE**

To achieve the goals of ONECI, it was necessary to carry out interdisciplinary studies involving researchers with backgrounds in networking and physical aspects of optical communications, as well as mathematics. To perform an integrated rethink of optical networks, the following interrelated aspects were considered: (i) design of Flexgrid node architectures; (ii) integrate the designed Flexgrid architectures into network planning procedures; (iii) design and evaluation of protection and resilience options using Flexgrid. It must be emphasized that the resilience aspect of optical networks is of paramount importance when compared with other network types, due to the huge amounts of data they transport.

**WORK DESCRIPTION AND ACHIEVEMENTS**

ONECI involved various interrelated aspects of optical networks: physical layer characterization and optimization, control plane optimization, and techno-economic studies. A brief description of each one of these aspects follows.

---

**Fig. 1** Dimensional network corresponding to a feasible solution for the survivable topological design problem.

**Fig. 2** Topologies obtained using the Integer Linear Programming model and the genetic algorithm for the node location of (a) German network and (b) Brazilian RNP network.

---

**Table**

<table>
<thead>
<tr>
<th>Main Project Team</th>
<th>OCP-Ao</th>
</tr>
</thead>
<tbody>
<tr>
<td>José Rodrigues Ferreira da Rocha</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Paulo Miguel Nascimento Pereira Montanaro</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Armando Humberto Monteiro Nascimento Pinto</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Amaro Fernandes de Souza Araújo</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Doria da Silva Santos</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Rita Manuel Dias Moreira</td>
<td>ContiTelleget</td>
</tr>
<tr>
<td>Gozde Sohmen</td>
<td>OCP-Ao</td>
</tr>
</tbody>
</table>

**Funding Agencies**

<table>
<thead>
<tr>
<th>FCT</th>
<th>151,843 €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>01/05/2013</td>
</tr>
<tr>
<td>Ending Date</td>
<td>31/07/2015</td>
</tr>
</tbody>
</table>

**Publications**

1. *International Journal (6 in IEEE Journals)*
2. *Conferences Papers (17 International Co.)*
3. *Concluded PhD Theses (2)*
4. *Concluded MSc Theses (4)*

**Summary**

ONECI involved various interrelated aspects of optical networks: physical layer characterization and optimization, control plane optimization, and techno-economic studies. A brief description of each one of these aspects follows.

---

**Fig. 1** Dimensional network corresponding to a feasible solution for the survivable topological design problem.

**Fig. 2** Topologies obtained using the Integer Linear Programming model and the genetic algorithm for the node location of (a) German network and (b) Brazilian RNP network.

---

**Table**

<table>
<thead>
<tr>
<th>Main Project Team</th>
<th>OCP-Ao</th>
</tr>
</thead>
<tbody>
<tr>
<td>José Rodrigues Ferreira da Rocha</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Paulo Miguel Nascimento Pereira Montanaro</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Armando Humberto Monteiro Nascimento Pinto</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Amaro Fernandes de Souza Araújo</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Doria da Silva Santos</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Rita Manuel Dias Moreira</td>
<td>ContiTelleget</td>
</tr>
<tr>
<td>Gozde Sohmen</td>
<td>OCP-Ao</td>
</tr>
</tbody>
</table>

**Funding Agencies**

<table>
<thead>
<tr>
<th>FCT</th>
<th>151,843 €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>01/05/2013</td>
</tr>
<tr>
<td>Ending Date</td>
<td>31/07/2015</td>
</tr>
</tbody>
</table>

**Publications**

1. *International Journal (6 in IEEE Journals)*
2. *Conferences Papers (17 International Co.)*
3. *Concluded PhD Theses (2)*
4. *Concluded MSc Theses (4)*

**Summary**

ONECI involved various interrelated aspects of optical networks: physical layer characterization and optimization, control plane optimization, and techno-economic studies. A brief description of each one of these aspects follows.

---

**Fig. 1** Dimensional network corresponding to a feasible solution for the survivable topological design problem.

**Fig. 2** Topologies obtained using the Integer Linear Programming model and the genetic algorithm for the node location of (a) German network and (b) Brazilian RNP network.

---

**Table**

<table>
<thead>
<tr>
<th>Main Project Team</th>
<th>OCP-Ao</th>
</tr>
</thead>
<tbody>
<tr>
<td>José Rodrigues Ferreira da Rocha</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Paulo Miguel Nascimento Pereira Montanaro</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Armando Humberto Monteiro Nascimento Pinto</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Amaro Fernandes de Souza Araújo</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Doria da Silva Santos</td>
<td>OCP-Ao</td>
</tr>
<tr>
<td>Rita Manuel Dias Moreira</td>
<td>ContiTelleget</td>
</tr>
<tr>
<td>Gozde Sohmen</td>
<td>OCP-Ao</td>
</tr>
</tbody>
</table>

**Funding Agencies**

<table>
<thead>
<tr>
<th>FCT</th>
<th>151,843 €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>01/05/2013</td>
</tr>
<tr>
<td>Ending Date</td>
<td>31/07/2015</td>
</tr>
</tbody>
</table>

**Publications**

1. *International Journal (6 in IEEE Journals)*
2. *Conferences Papers (17 International Co.)*
3. *Concluded PhD Theses (2)*
4. *Concluded MSc Theses (4)*

**Summary**

ONECI involved various interrelated aspects of optical networks: physical layer characterization and optimization, control plane optimization, and techno-economic studies. A brief description of each one of these aspects follows.