Project Team MASCOTTE

Common Project
I3S (CNRS/Université Nice Sophia-Antipolis)
INRIA Sophia-Antipolis Méditerranée

02/2012
MEMBERS 02/2012

- J-C. Bermond CNRS
- C. Caillouet Univ. Nice-Sophia
- D. Coudert INRIA (head)
- O. Dalle Univ. Nice-Sophia
- F. Giroire CNRS
- F. Havet CNRS
- J. Moulierac Univ. Nice-Sophia
- P. Mussi INRIA KIC ICT labs
- N. Nisse INRIA
- S. Pérennes CNRS
- M. Syska Univ. Nice-Sophia

Ex-Collaborators
A. Ferreira CNRS (on leave @ FET Open)
B. Reed CNRS / McGill Montréal (on leave)
H. Rivano CNRS / CITI Lyon => INRIA

12 PhD
3 Post-Doc
2 Expert Engineer
2 secretaries, part time
Visitors
# Current PhD students

<table>
<thead>
<tr>
<th>Year</th>
<th>Students</th>
<th>Institution / Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd year</td>
<td>4</td>
<td>CIFRE / Orange, Benin</td>
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<tr>
<td></td>
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<td>CNPQ, Brazil</td>
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<td>MENRT, Brazil</td>
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<td></td>
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<td>BDE PACA/PME, Marocco</td>
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<tr>
<td>2nd year</td>
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<td>CORDI-S, Brazil</td>
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<td>STREP EULER, France</td>
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<td>CIFRE / Orange, France</td>
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<td>BDO PACA/CNRS, Poland</td>
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<td>UbiNet</td>
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<tr>
<td>1st year</td>
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<td>BDO PACA/INRIA, China</td>
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<td></td>
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<td>CAPES, Brazil</td>
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<td>MENRT, Vietnam</td>
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<td>BDE PACA/PME, Benin</td>
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<tr>
<td></td>
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<td>UbiNet</td>
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</tbody>
</table>

= 12
## Former PhD students

Since 2006: 18

<table>
<thead>
<tr>
<th>Role</th>
<th>Count</th>
<th>Locations</th>
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<tbody>
<tr>
<td>CR CNRS</td>
<td>3</td>
<td>ENS, LIAFA, LIrMM</td>
</tr>
<tr>
<td>MCF</td>
<td>4</td>
<td>Brazil, Lille, Nice-Sophia, Santiago</td>
</tr>
<tr>
<td>Engineer</td>
<td>3</td>
<td>Brazil, Chile, France</td>
</tr>
<tr>
<td>Post Doc</td>
<td>9</td>
<td>Belgium, Brazil (2), Canada, Chile (2), Denmark, USA, Switzerland</td>
</tr>
</tbody>
</table>
A multilayer networked world

**Multilayer network design, provisioning**
- Routing
- Traffic grooming
- Reconfiguration
- Connectivity
- Reliability (SRLG)

**Green networking**
- Energy awareness
- Network design

**Overlay networks**
- Resource discovery
- Resource placement

**Tools**
- Discrete Maths
- Operational Research
Wireless backhaul networks

~ 50% of worldwide traffic
Wireless backhaul networks

Dynamic behavior of microwave links

Environmental conditions

Impact on signal propagation

Variation of the capacity

Problems

• Robust design to handle both traffic and link capacity variations
  • Bandwidth and frequency reservation
• Optimization of the power consumption (switch on/off devices, routing,…)

Mathematical models and approach

• Linear and stochastic programming
• Relaxation, heuristics
Routing reconfiguration

Rerouting

- **Modeling**: cops-and-robber game on the digraph modeling dependencies
  - 1 cop on a vertex = 1 interruption
- **Goal**: minimize total/simultaneous traffic disruptions, SLA, ...
- **Approach**: digraph decomposition + contraction + ... exact (exp.) algorithms
- **Other constraints**: physical layer impairment
Other topics

Green networking
• ANR DIMAGREEN, Orange labs
• Measurement campaign of network equipment \textit{wrt.} traffic load
  • Realistic power consumption models
• Energy aware designs/routing \textit{wrt.} QoS, fault tolerance, …
• Tradeoff reduction of the power-consumption \textit{vs} increase of CAPEX-OPEX

Data storage in peer-to-peer networks
• ANR SPREADS with UbiStorage…
• Data placement, reliability, replication, coding
• Performance analysis: new stochastic models based on \textit{fluid} approximation

Simulation methodology and tools (O. Dalle)
• ANR USS-SimGrids, EA DISSIMINET Canada
• OSA: Open Simulation Architecture
Algorithmic and discrete mathematics

Graph theory
- **Graph coloring**: models for various frequency allocation problems
- **Decomposition** (treewidth, pathwidth,…): Structural results, duality, …
- **Directed graphs**

Algorithmic
- **Cops-and-robber games**: algorithmic counterpart to graph decomposition
- **Exact algorithms for hard problems**
  - Moderately exponential $O(c^n)$
  - Fixed parameterized algorithms $O(f(k).poly(n))$
- **Distributed & localized algorithms**
- **Large static and dynamic graphs**

Funding
- ANR AGAPE, GRATEL Taiwan, PICS Prague, PHC Aachen, EA EWIN Brazil, FIRE STREP EULER
Industrial collaborations

Orange labs
- CRC CORSO 2004-2009 + CRE + CIFRE (10, 11)
- Radio networks (Wimax): data gathering, capacity of mesh networks
- Optical networks: Reliability, survivability, traffic grooming

Alcatel-Lucent Bell labs
- Participation to ADR HiMa of the joint lab (since 2009)
- Network morphing, routing reconfiguration
- Belgium: Bilateral contract (08-10) + STREP EULER (10-13)
- Dynamic compact routing

3Roam
- APRF RAISOM (+ AVISTO) (09-12) + 2 BDE (08, 11) + ANR ECOSCELLS (09-12)
- Design and management of backhaul networks
Software development

On-going

- Optimization:
  - MASCOPT: backbone networks design & management
  - Grph: graph optimization library
  - Sage: contribution to graph and LP modules

- Simulation:
  - OSA: Open Simulation Architecture
  - DRMSim: Dynamic Routing Model Simulator

Goals

- To provide experimental tools
  - Validation and verification of theoretical results
  - Experiment on virtual/future configurations

- To address important but seldom considered issues
  - Enforce/ensure reproducibility
  - Support experimental methodology
Collaboration with Greece

- **Univ. Patras & CTI**
  - C. Kaklamanis, P. Spirakis, I. Caragiannis, S. Nikoletseas
  - Graph algorithms, resource sharing, routing schemes
  - WDM & sensor networks, AS network of the Internet
  - IST FET CRESCCO 2002-2005 lead: Patras
  - IST FET AEOLUS 2005-2010 lead: Patras
  - FIRE STREP EULER 2010-2013 lead: Alcatel-Lucent

- **Athens:**
  - D. Thilikos: Graph algorithms, cops-and-robber games, FPT
  - E. Koutsoupias: within CRESCCO and AEOLUS

- Regular visits: ex: D. Coudert 3 months in Patras in 2011
- Post-docs: Dimitrios Michail (2008), Orestis Telelis (2010)
Merci

David Coudert

• David.coudert@inria.fr  
• http://www-sop.inria.fr/members/David.Coudert

Project-team MASCOTTE

• Algorithmic, combinatorial optimization, simulation  
• Telecommunication networks  
• http://www-sop.inria.fr/mascotte