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

3rd year	4	CIFRE / Orange	Benin	
		CNPQ	Brazil	
		MENRT	Brazil	
		BDE PACA/PME	Marocco	
2nd year	4	CORDI-S	Brazil	
		STREP EULER	France	
		CIFRE / Orange	France	
		BDO PACA/CNRS	Poland	UbiNet
1st year	4	BDO PACA/INRIA	China	
		CAPES	Brazil	
		MENRT	Vietnam	UbiNet
		BDE PACA/PME	Benin	UbiNet

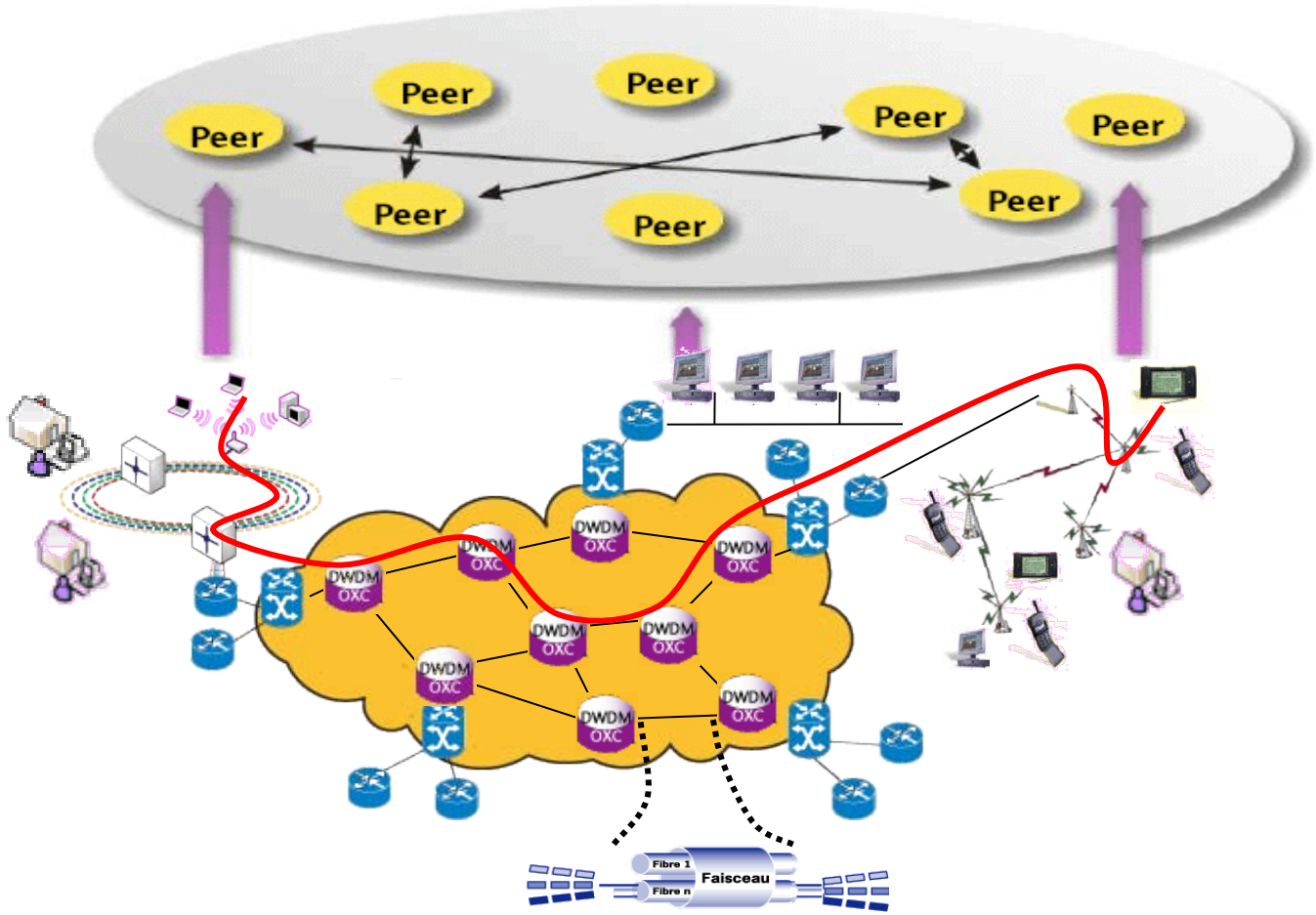
= 12

Former PhD students

Since 2006: 18

CR CNRS	**3**	**ENS, LIAFA, LIRMM**
MCF	**4**	**Brazil, Lille, Nice-Sophia, Santiago**
Engineer	**3**	**Brazil, Chile, France**
Post Doc	**9**	**Belgium, Brazil (2), Canada, Chile (2), Denmark, USA, Switzerland**

A multilayer networked world



Multilayer network design, provisioning

- Routing
- Traffic grooming
- Reconfiguration
- Connectivity
- Reliability (SRLG)

Green networking

- Energy awareness
- Network design

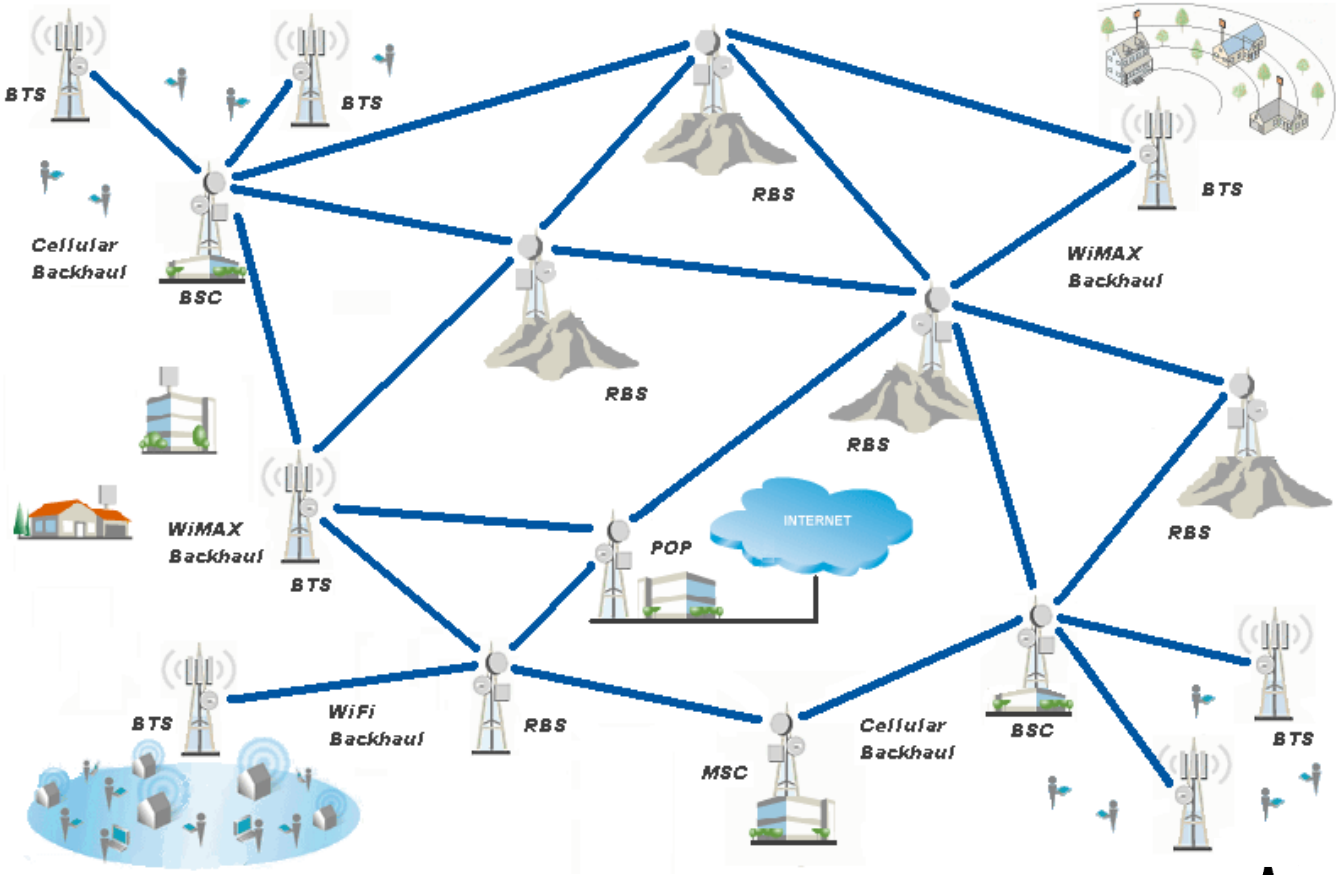
Overlay networks

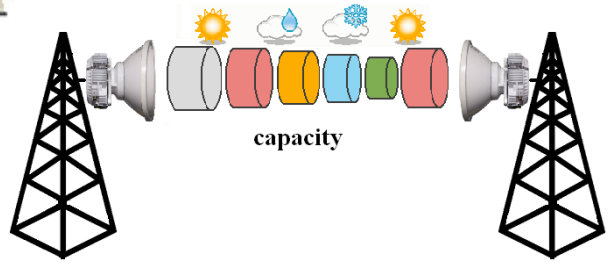
- Resource discovery
- Resource placement

Tools

- Discrete Maths
- Operational Research

Wireless backhaul networks





~ 50% of worldwide traffic

Wireless backhaul networks

Dynamic behavior of microwave links

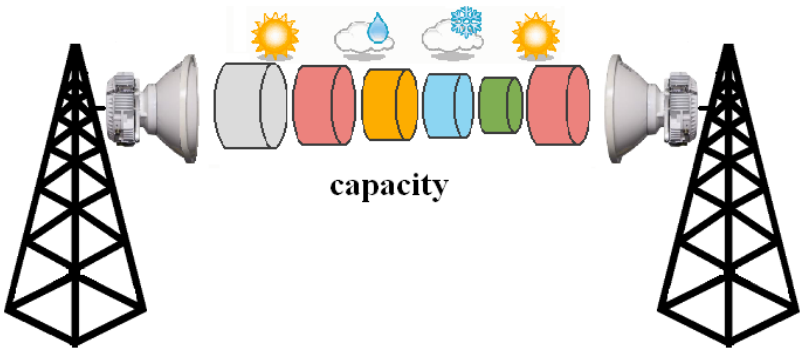
Environmental conditions

↓

Impact on signal propagation

↓

Variation of the capacity



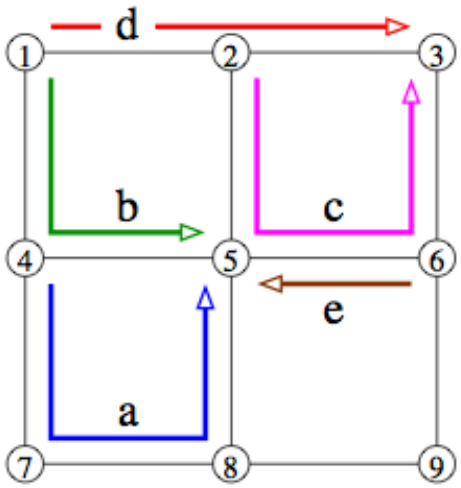
Problems

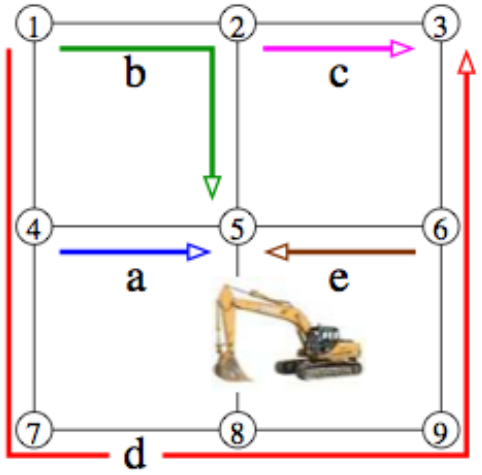
- ***Robust* design** to handle both traffic and link capacity variations
  - Bandwidth and frequency reservation
- Optimization of the **power consumption** (switch on/off devices, routing,…)

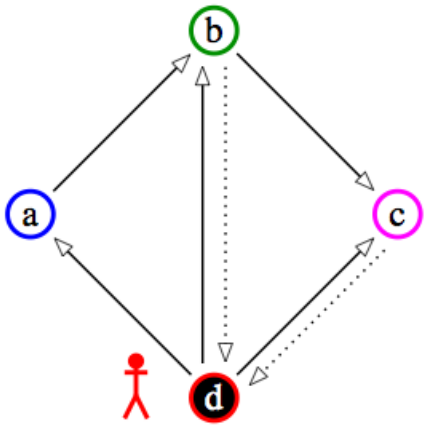
Mathematical models and approach

- 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 *wrt.* traffic load
  - Realistic power consumption models
- Energy aware designs/routing *wrt.* QoS, fault tolerance, …
- Tradeoff reduction of the power-consumption *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 *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