COATI

Combinatorics, Optimization and Algorithmics for Telecommunications

– since 2013 –

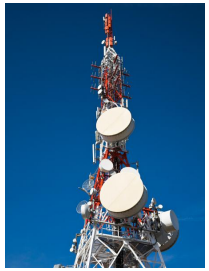
$$\min \sum_{e \in \mathcal{E}} y_e$$

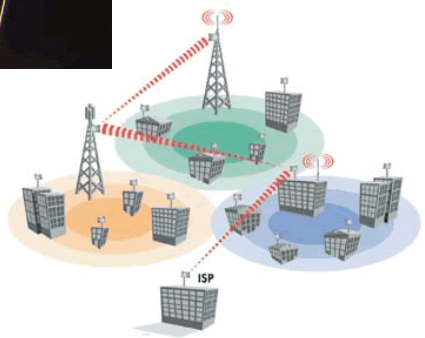
$$\text{s.t.} \sum_{a \in A_i^+(u)} f_a^i - \sum_{a \in A_i^-(u)} f_a^i = \begin{cases} |V_i| - 1 & \text{if } u = s_i \\ -1 & \text{if } u \neq s_i \end{cases} \quad \forall u \in V_i,\ V_i \in C$$

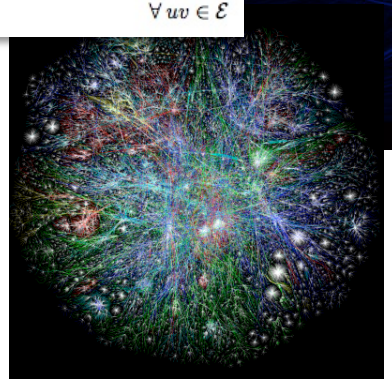
$$f_a^i \leq |V_i| \cdot x_a, \qquad \forall V_i \in C, a \in A$$

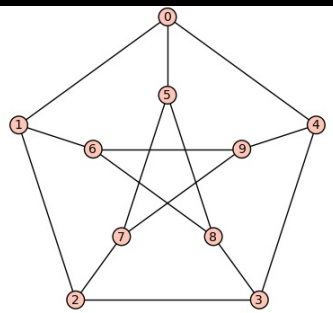
$$x_{(u,v)} \leq y_{uv}, \qquad \forall uv \in \mathcal{E}$$

$$x_{(v,u)} \leq y_{uv}, \qquad \forall uv \in \mathcal{E}$$









Team composition

Permanent members

Bensmail, J.	**MCF UNS**	(since 2016)
Bermond, J-C.	**DR CNRS**	(Emeritus)
Caillouet, C.	**MCF UNS**	
Caminada, A.	***PR & Dir. Polytech***	
Coudert, D.	**CR INRIA**	(head)
Giroire, F.	**CR CNRS**	
Havet, F.	**DR CNRS**	(vice-head)
Hogie, L.	**IR CNRS**	(30%)
Moulierac, J.	**MCF UNS**	
Nisse, N.	**CR INRIA**	
Pérennes, S.	**DR CNRS**	
Reed, B.	***DR CNRS on leave***	
Syska, M.	**MCF UNS**	

Long term visitor

Cohen, N.	**CR CNRS**

On-going PhDs

3 in 2nd year

Lochet, W.	ASN (ENS)
Mc Inerney, F.	CORDI-S
Tomassilli, A.	EDSTIC

1 in 1st year

Trolliet, T.	CORDI-S -- DIANA

Post-doc / ATER

Ait Ouahmed, A.	UCA[JEDI]	(2018-…)

Visitors, Internship students

2 assistants (part-time)

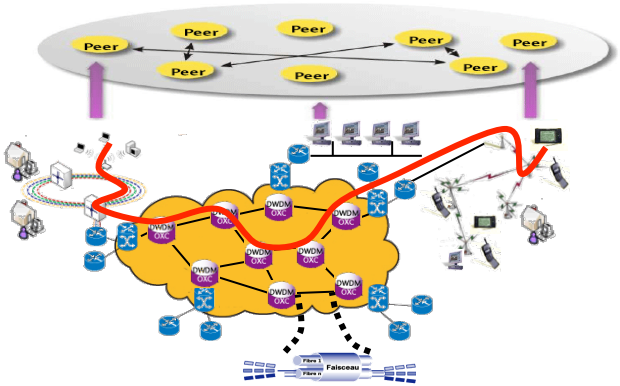
On-going research activities

Types of networks
- Connection oriented
- Backbone, backhaul, access
- Overlay

Technologies
- Wired: WDM, MPLS, SDH
- Wireless: microwave
- Software: SDN

Discrete mathematics
- Combinatorial optimization
- (Directed) Graph theory
- Operations Research

Design
- Connectivity
- Capacity
- Reliability, Robustness



Algorithmic
- Exact polynomial, exponential
- Approximations
- Centralized, distributed
- Pursuit-evasion games

Operation
- Routing, rerouting
- Fault tolerance
- Energy awareness

Software
- Graph libraries
- Routing simulator
- Reproducibility

Other application domains
- Structural biology
- Transportation networks
- Vision

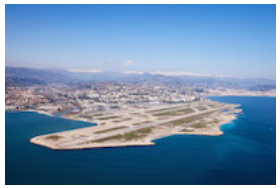
Transversal problems / other application fields

Trip planner

- Input: list of cities + sojourn constraints
  - e.g.: 3 days in city X between July 2 and July 20
- Output: min cost trip (plane tickets + hotels)
- Evaluation of computing models and algorithms
- Outcome : **prototype software**

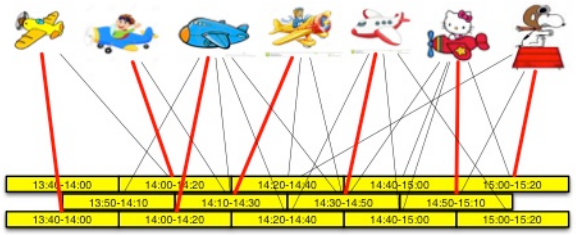
amadeus

2014 - 2015



Recovery of disrupted airlines operations

- Re-scheduling of aircraft landing slots
  - Arrival delays (bad weather, etc.)
- Specific constraints from air traffic controllers
- ongoing: code and tests



Multi-modal public transportation network

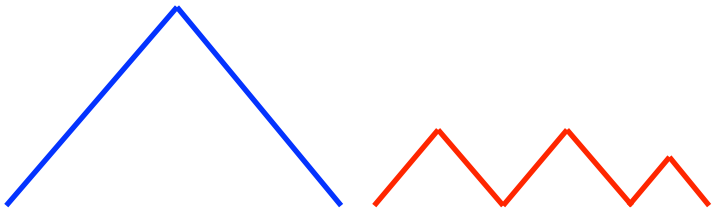
- Bus, tram, walk, bicycle, etc.
- **Originality**: combine with dynamic car-pooling

Instant System

since Dec. 2015

Some questions of interest in MultiMod

Routing with (electric) bicycle



→ How to handle slope ?

→ Forbidden / dangerous areas & transitions

→ Multi-criteria (red lights, slope, length, user ability, etc.)

Multiple paths & hub labeling

→ Can we define suitable data-structure for storing multiple routes & fast queries

→ Fast computation of multiple s-t paths (subject to different metrics)

Routing with real time events & alternative routing

→ Road & public transports

→ Can we pre-compute & store alternative paths ?

→ Tradeoff pre-computation time / memory / query time

→ Massive rerouting event: propose new itineraries to 100s (computation time, congestion, etc.)

Some questions of interest in MultiMod

On-demand transport / Dial-a-ride problem (DARP)

→ Carpooling, vehicular routing problem (VRP), DARP
- Multiple variants of similar problems: route vehicles to satisfy queries
- VRP for goods
- DARP for persons

→ Define routing of vehicles to satisfy user queries
- departure range + arrival range/deadline + distance to stop-point + luggage + …
- Planned = query 1 day/hour before
- Online

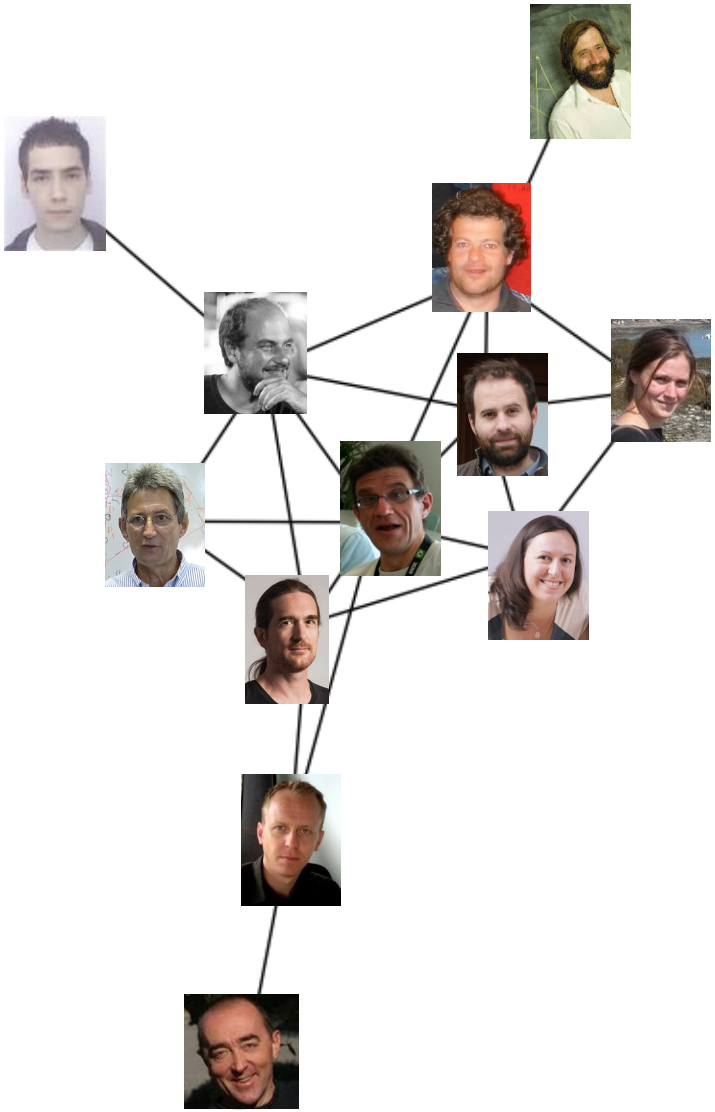
→ Optimize tradeoff cost / users satisfaction

→ Pre-positioning of vehicles based on history of queries

→ Online optimization with hypothesis on future queries

→ **Consistency** = same driver(s) for same query/user

Thanks



Co-publications of permanent members
(2013-2017)

Project-team COATI

- Location: Sophia Antipolis, France
- Combinatorics, Optimization, Algorithms
- http://team.inria.fr/coati