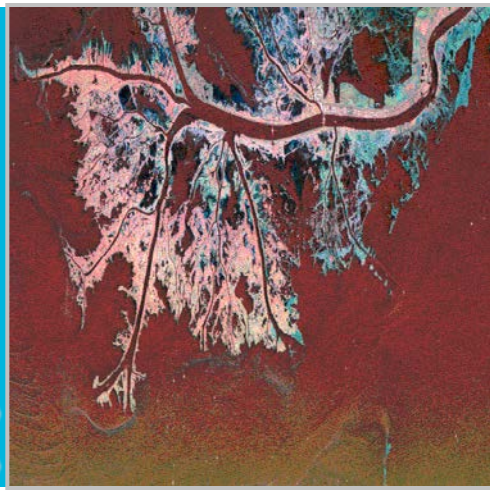
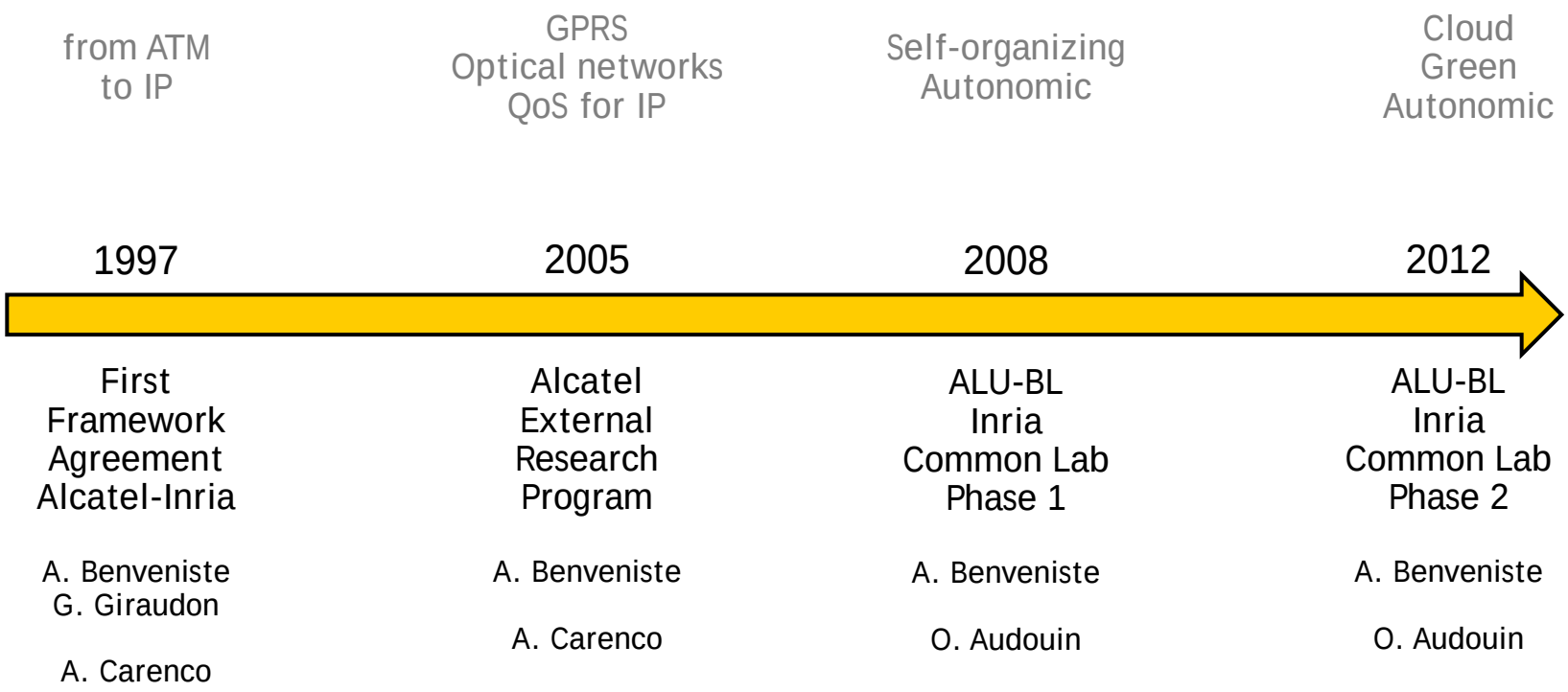
Inria / Alcatel Lucent Bell Labs Common Lab

sharing a vision of research



O. Audouin & Albert Benveniste

A bit of history…



A light weight structure (Phase 1: 2008-2011)

55 researchers

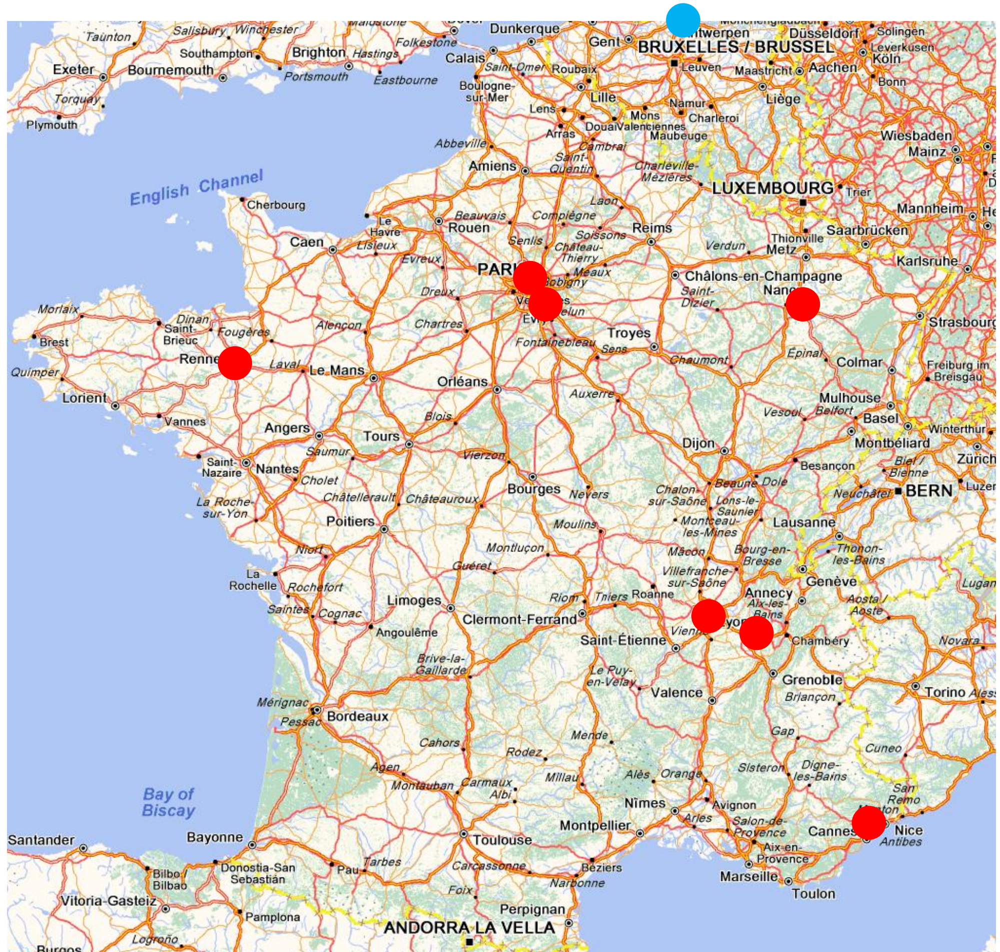
15 PhD

11 Post-Doc × year

(Antwerpen)

(Stuttgart)

Murray-Hill

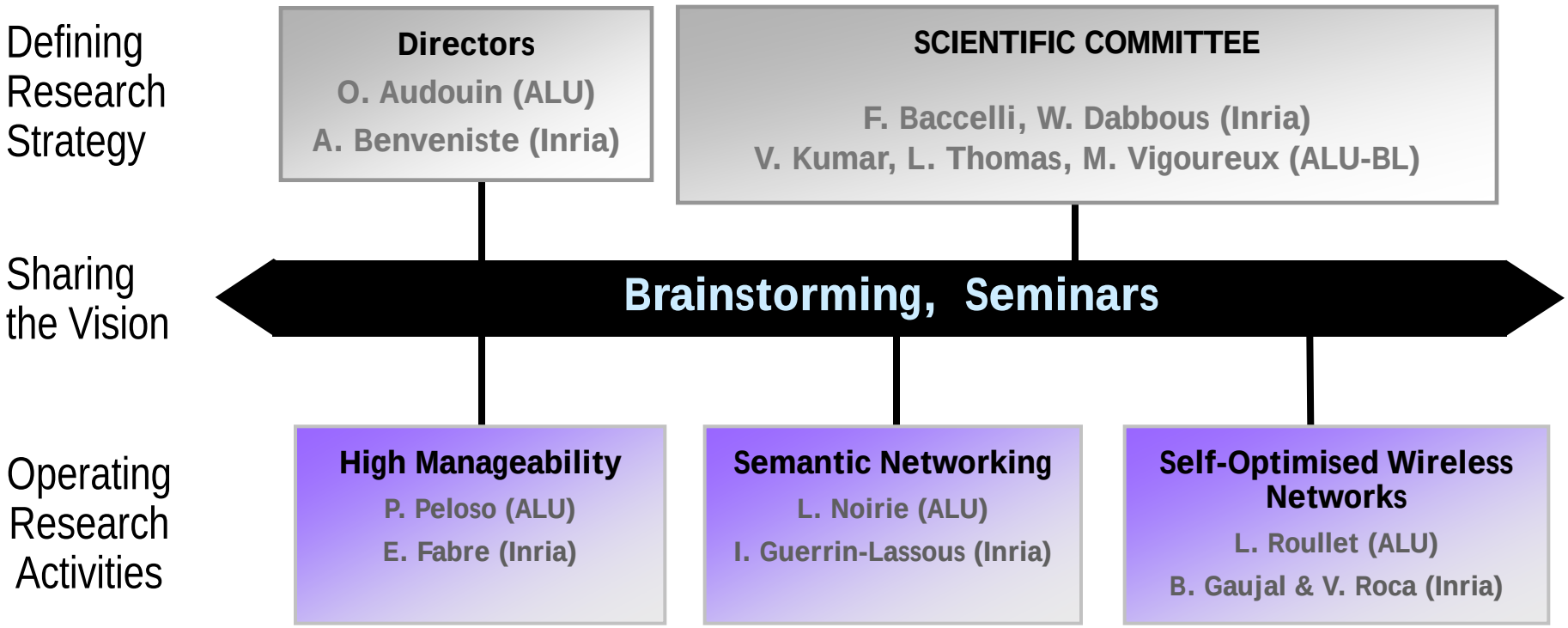


Alcatel·Lucent

Inria INVENTEURS DU MONDE NUMÉRIQUE

A light weight structure (Phase 1: 2008-2011)

Cost of operating the structure ≈ 10 days / year for each Director



Results of Phase 1: key figures

Publications: 95 (among which ≈35% are joint)

Patents: 13

Seed technologies (industrialization in progress or for consideration):

- Autonomic Channel Power Tuning in an Optical Network; distributed constrained convex optimization
- Self-configuration and self-tuning of wireless cellular networks; Voronoi based models, coverage processes, random spatial trees, Gibbs random fields
- Flow aware routing based on DPI and statistical analyses

Projects born: *IP-UniverseIf* (HiMa), *ANR-ARSSO* and *ECOSCELLS* (SelfNets)

People:

- Calvin Chen TREC → BL Villarceaux + LINCS
- Amira Alloum → software architect in wireless BD

Two sample results: Autonomic Wavelength Power Tuning in a Photonic Network

Challenges:

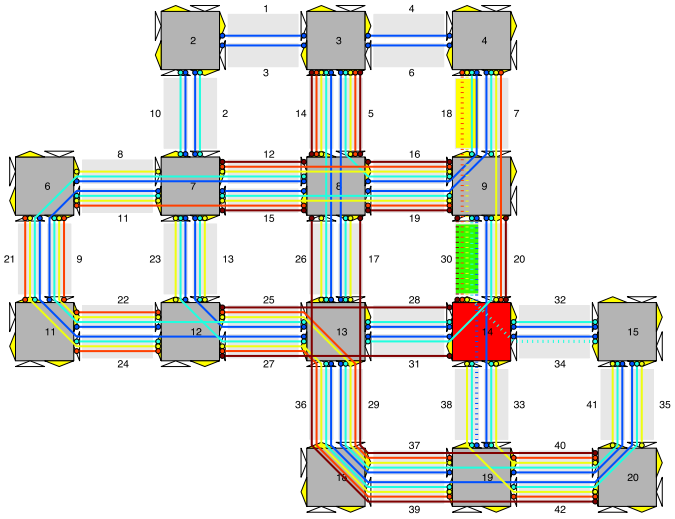
- optimize optical reach without regeneration
- optimize & equalize quality of all connections
- avoid manual tuning, and over-dimensioning
- better use of available resources

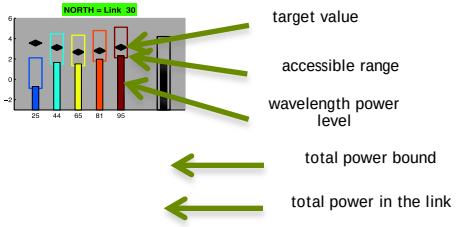
Distributed and adaptive solution:

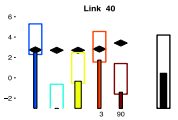
- huge non-linear constrained optimization problem
- distributed P2P tuning (at node scale), derived from Markov fields inference techniques
- dynamic optimal power (re)allocation when connections join/leave

Results:

- ALU simulations:
  50% reduction in regeneration equipment
- 2 joint ALU-Inria patents







Two sample results: Autonomic cellular networks

Stochastic approach from statistical physics

- (Gibbs sampler) to explore the discrete tridimensional space {power;user-association;channel-allocation} and converge to an optimal configuration.

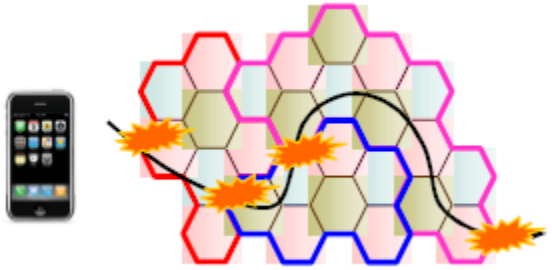
Distributed adaptive algorithm $\Rightarrow$ *flexibility*

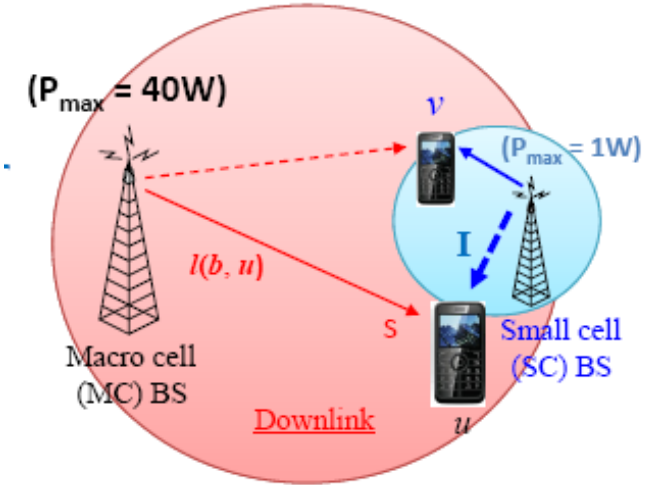
Adaptive optimization $\Rightarrow$ *bandwidth efficiency*

Bounded domain of exploration $\Rightarrow$ *stability*

Tunable for a variety of contexts

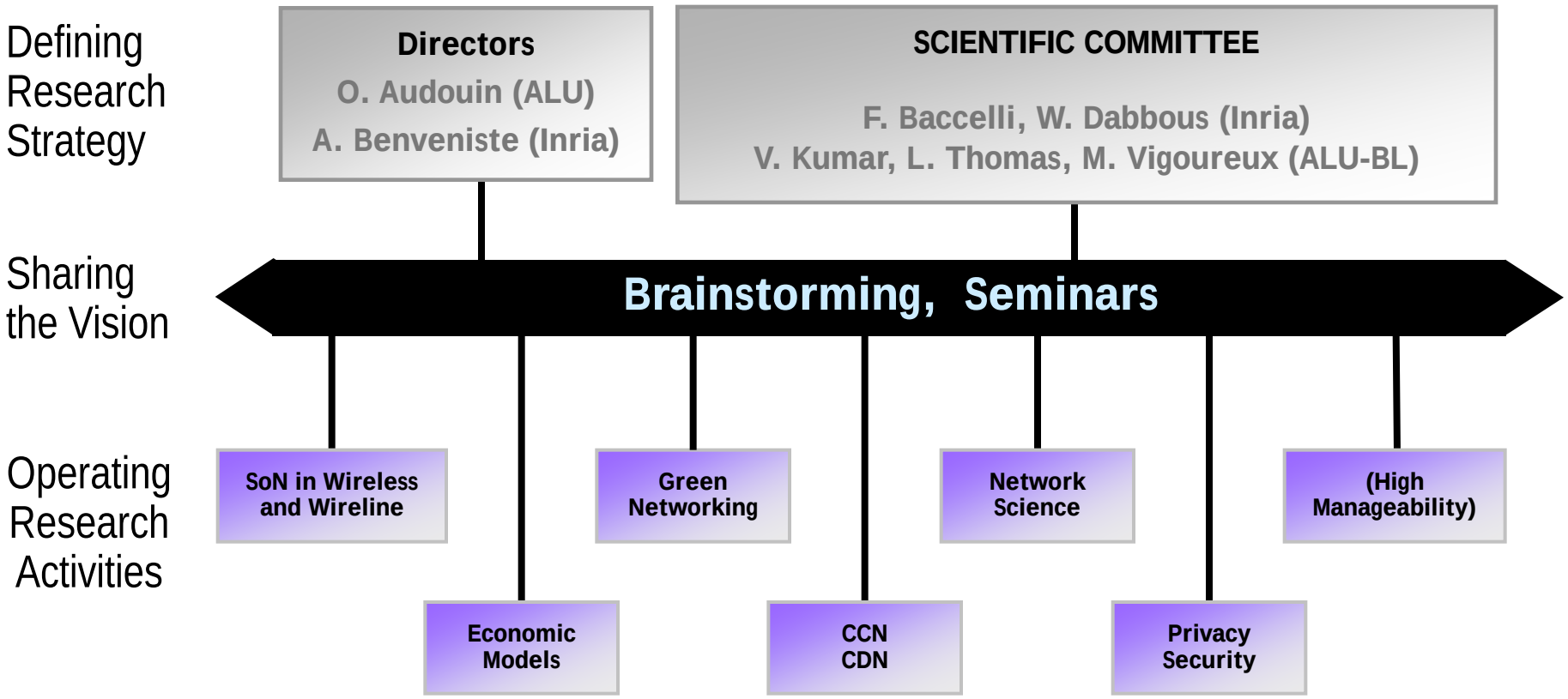
3 Patents, 3 joint publications





$$\mathcal{E}_u = \underbrace{\frac{N_u + \sum_{v \neq u} P_v(c_u) l(b_v, u, c_u)}{\underbrace{P_u(c_u) l(b_u, u, c_u)}_{=1/(\mathrm{SINR}_u)}}}_{\text{Selfish part}} + \underbrace{\sum_{v \neq u} \frac{P_u(c_v) l(b_u, v, c_v)}{P_v(c_v) l(b_v, v, c_v)}}_{\text{Altruistic part}}$$

Phase 2: 2012-2015



Concluding remarks

Benefits for ALU	Benefits for Inria
Giving breathing to research thanks to longer time scales	Better understanding strategic industrial issues
Accessing some breakthrough technologies & mastering	Discovering new problems for research
Jointly developing technologies with externals skills	Jointly developing research with externals skills
Structuring effect	Structuring effect
Brain drain	

At a low cost

Www.alcatel-lucent.com

Www.inria.fr