

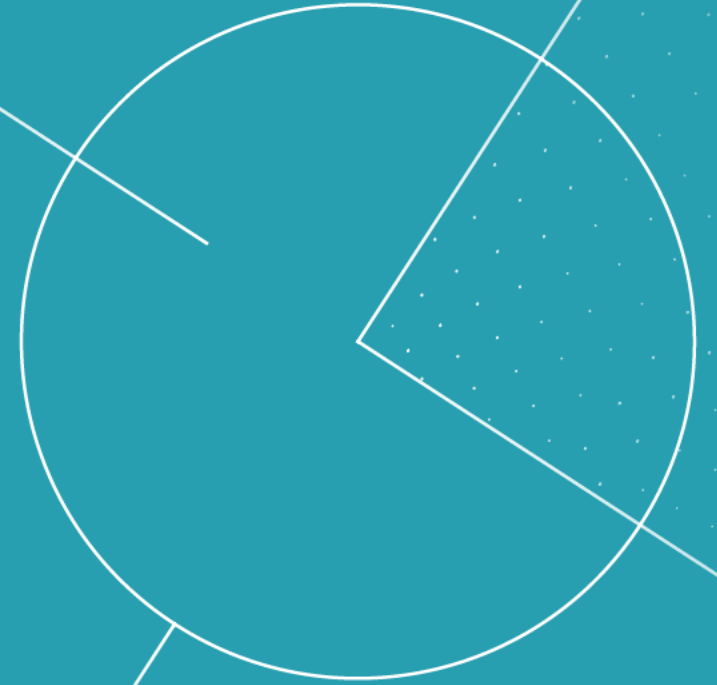


**R3S and METHODES research teams  
of SAMOVAR and Télécom SudParis**

**Networks and Distributed Systems**

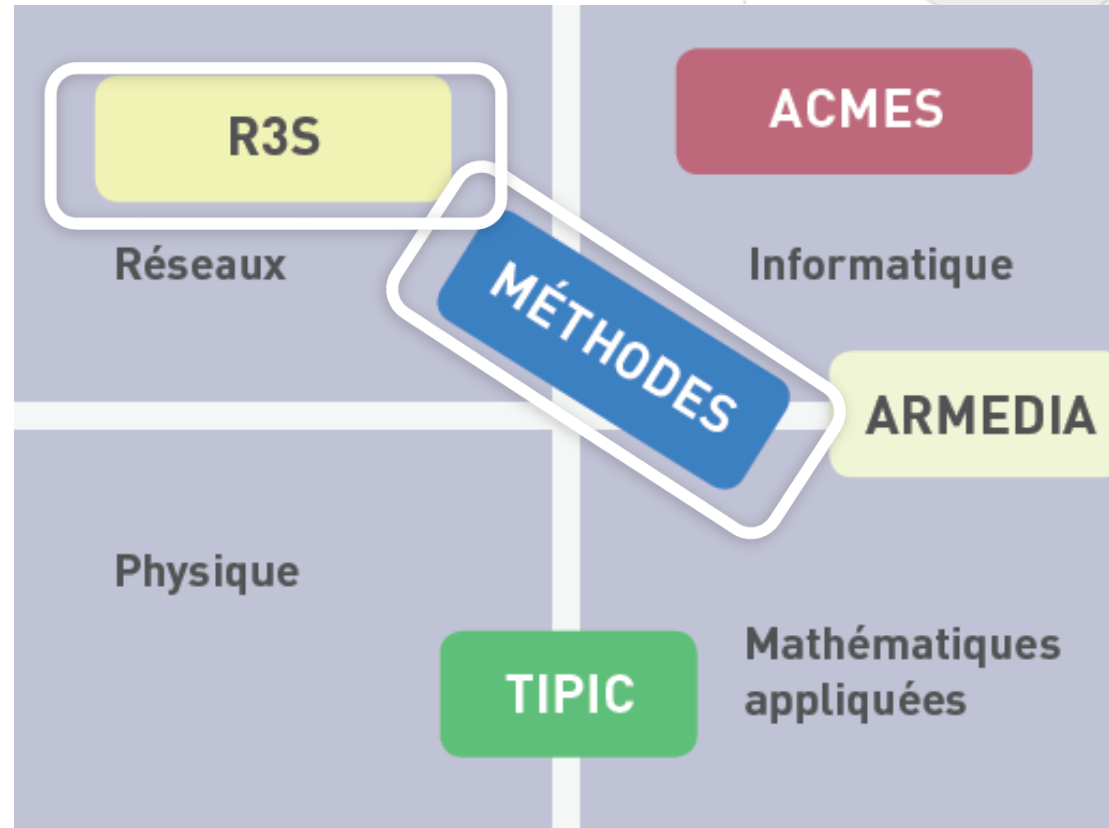
**« Next Generation Digital Infrastructures »  
IDIA Workshop of January 26<sup>th</sup>, 2021**

R3S : Réseaux Services Systèmes et Sécurité  
METHODES : Méthodes et modèles



# “R3S” and “METHODES”

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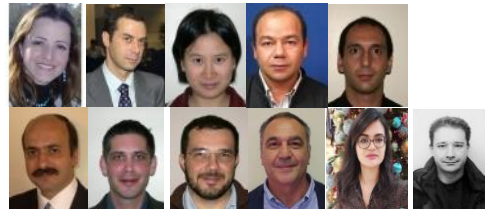


- R3S and METHODES main research direction
  - Data and Model Driven Networks, Services and Systems Science and Engineering

# R3S and METHODES Faculty

## Network Science and Engineering

### R3S



Networks  
and  
Services  
CNR

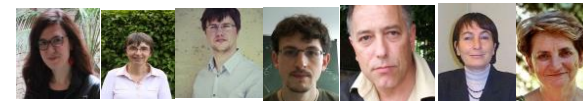


Security and Cybersecurity

### METHODES



Emérite Emérite  
Modeling and methods (including networks)



Emérite Emérite

### Collaborations with ACMES



Distributed systems and services

# Samovar R3S et METHODES

(Networks and distributed Systems) / Members

## R3S Networks, Services Systems et Security

### ■ 20 Faculty members

#### ● *Networks and services (12)*

- N. Crespi, R. Minerva, V. Gautier, A. Laouiti, H. Chaouchi, M. Marot, H. Ngyuen, B. Jouaber, H. Afifi, F. Bannour, E. Renault, D. Ranc, D. Zeglache

#### ● *Security (8)*

- M. Laurent, H. Debar, J. Garcia-Alfaro, C.Kiennert, G. Blanc, N. Kaaniche, A. M'Hamed, Z. Zhang

### ■ 3 associate members

- O. Levillain, H. MOUNGLA, L. Nachabe

## METHODES : Methods and Models for Networks

### ■ 17 Faculty members

#### ● *Optimization (4)*

- W. Ben-Ameur, J. Néto, D. Watel, A. Madaloni

#### ● *Formal methods (8)*

- G. Burel, A. Cavalli, C. Dubois, J-P. Gibson, N. Kushik, S. Maag, A. Mammar, R. Rioboo

#### ● *Performance evaluation (5)*

- A. Araldo, T. Atmaca, M. Becker, H. Castel, T. Chahed

### ■ 6 associate members

- A. Faye, J. Forest, J. Jakubowicz, M. Merabet, A. Berriri, S. Nouleho

+ 40 PhD students + 10 post-doctoral

# R3S and METHODES research teams of SAMOVAR and Télécom SudParis

## R3S

### ■ R3S: Networks, services, systems and security

- Networks and Services Science and Engineering
- Networks and services design, modeling, representation, description, performance evaluation and optimization
- Sharing, configuration, control and management (of the lifecycle) of networks, services and resources
- Evolution towards programmable and dynamic infrastructures
- E2E Distributed intelligence and multi-agent based cooperation
- Data & model driven science & engineering of networks & services

### ■ R3S: On going research

- Resource allocation and network optimization
- Slicing, services/networks virtualisation
- Data driven services & networks optimization
- ML and AI techniques and modeling frameworks (e.g.: MDP, MPC, ML, DL, RL)
- Test and monitoring and validation
- Behavior analysis, anomaly detection, prediction
- Energy efficiency in networks and systems
- Large scope in terms of addressed networks and infrastructures, includes verticals

# R3S and METHODES research teams of SAMOVAR and Télécom SudParis

## METHODES

### ■ METHODES: Methods and models for networks and services

- Combining networks, computer science and applied mathematics
  - Optimization, test and validation and performance evaluation.
  - Fundamental and Applied Science based on methods including:
    - graph theory, stochastic bounds, stochastic modeling, formal methods, robust optimization, queuing theory, game theory, Markov decision processes, aggregation, etc...

### ■ On going research

- Robust Optimization
- Quadratic programming
- Graphs and combinatory optimization
- Distributed Optimization
- Diffusion and dynamics of information and opinions
- Data analysis
- Verification and proof-making
- Resource allocation in networks (4/5/6G)
- ML and AI techniques

# Projects and collaborations

R3S and METHODES	
<b>Collaborative projects sample</b>	
ANR MAESTRO 5G	Slice management in 5G access network
PSPC LTE4PMR	High bit rate communications based on 4G LTE for dedicated and private networks in the 400 MHz band
ANR AIDY-F2N	ANR LABCOM with SME Davidson
DGA-RAPID ISCHyO	Secure Cloud Infrastructure for observable hybrid clouds
ANR CHIST-ERA RADIOSENSE	Wireless Big Data Augmented Smart Industry
H2020 Idea-Fast	Identifying digital endpoints to assess fatigue, sleep and activities in daily living in neurodegenerative disorders and immune-mediated inflammatory diseases
Celtic Plus SENDATE	SEcure Networking for a DATa center cloud in Europe
ITEA 3 PAPUD	PAPUD : Profiling and analysis Platform Using Deep Learning
H2020 MEASURE	Measuring software engineering by implementing a comprehensive set of tools for automated and continuous measurement
<b>Cooperation/collaboration</b>	
National	CEA, INRIA, TP, IMT, LaBri,...
International	IMEC, Uni. Oulou, TCD, Kassel, Alto, ...



# (Trails for) Vision, challenges and priorities (1)

- “Network Engineering and Science” orientation to strengthen the underlying scientific knowledge
- **Distribution and cooperation via multi-agent cooperative systems**
- Softwarization, SDN/NFV/Slicing for agile and dynamic networking, Radio slicing
- **Applied AI, Data analysis, Social Media Analysis**
- Service architecture Evolution, Internet of Things, Digital Twins
- **Edge AI challenge on how to distribute data, AI models and their training**
- Network operating models for verticals, energy efficiency and green challenges
- **Modeling that embeds/includes applications and Things as part of the overall system**
- AI (artificial intelligence) based control systems in critical application areas in society and industry
- **Autonomous decision-making for optimizing network performance and marshalling billions of devices**
- IoT and edge convergence and continuum
- **No storage/no processor terminals impact on networks and services**
- Effect of quantum computing on end devices and networks



# (Trails for) Vision, challenges and priorities (2)

## ■ Math programming and optimization

- Partitioning and cover in graphs
- Multi-source maximal concurrent flow in graphs
- Dominance in k-independent clusters
- Multipolar approach to robust optimization

## ■ Complex networks and systems verification

- Verifications, Proofs,
- Monitoring, Test

## ■ Performance evaluation models for dynamic networks

- MDP, MCP, Learning, prediction
- Resource allocation in all types of networks and multi domain and technologies context