

# Master of Science in Ubiquitous Networking and Computing

Sophia Antipolis, France

Located in Europe's largest scientific park,  
**Sophia Antipolis, France**

This program is hosted by the Polytech'Nice-Sophia  
engineering school from Nice Sophia Antipolis University

**Several scholarships available**

To apply visit the Master web site: <http://ubinet.inria.fr>

*Many thanks to Pierre Kornprobst (INRIA) who gave us the permission to use the graphic charter he designed for the website, brochure and flyer of the Master of Science in Computational Biology of the University of Nice-Sophia Antipolis which he coordinates.*

# Meet the new challenges of Ubiquitous Networking and Computing

This Masters program is designed especially for international students and corresponds to the second year of the Masters studies. Successful completion of this program leads to the award of a Master of Science degree in France. This degree will enable graduates to pursue a PhD in Europe. The aim of this program is to provide students with excellent academic or industrial career opportunities by offering high level coverage of networking principles that will help students to meet the challenges and make the technological choices of tomorrow in the domains of the Internet, Telecommunications and Distributed Systems.

The courses in this program provide basic and specialization skills in the area of Network architectures and protocols and their evolution, Performance evaluation of networks, Networking and telecommunication algorithms, Peer-to-peer networking, Middleware for ubiquitous computing and Secure diffuse computing. This program will provide the training for qualified specialists who will be able to respond to the strong industry demand for software engineers, information system designers, and technical analysts and advisers. It will also prepare candidates to undertake further investigation and research into ubiquitous networking and computing.



## Message from Emmanuel Dotaro (Alcatel-Lucent Bell Labs)

*Alcatel-Lucent Bell Labs is a leader in fixed, mobile and converged broadband access, carrier and enterprise IP technologies, applications, and services. This enterprise offers the end-to-end solutions that enable compelling communications services for people at home, at work and on the move. Alcatel-Lucent Bell Labs designs products and services that are at the forefront of communications technology, and conducts fundamental research in fields important to communications. Highly qualified master students are needed to conduct research and development to answer these new challenges. One of the exciting goals of this new Master in Ubiquitous Networking and Computing is to present the most recent tools in this topic and bring the students up to speed so that they are able to apply these modern tools to real networking problems. This master is set up in the rich environment of Sophia Antipolis, with leading researchers in the field collaborating with our labs in particular via the joint Research Lab with INRIA. This is why I strongly recommend your application in this Master.*

**Bio:** Emmanuel Dotaro received an M.S. degree in Computer Science from the University of Versailles, France in 1996. After three years spent in Institut National des Télécommunications Performance Evaluation lab while holding a teaching position at the University of Versailles, he joined in 1999 the Alcatel Research and Innovation lab. at Marcoussis, France. Emmanuel is currently Research Director at Bell Labs, heading the Semantic and Autonomic Technologies department. His current research interests are Internet of the Future including network design, performance, control plane and self-features.



## Message from Prosper Chemouil (Orange Labs)

*The telecom and IT industry is currently facing dramatic changes which call for new concepts and paradigms for network and service design and management. New challenges are raised and network providers need to understand and master upcoming networking breakthroughs for offering broadband and seamless services, based on multiple network and system technologies. In this context, the MSc in Ubiquitous Networking and Computing represents a significant program to train experienced engineers and researchers on leading technologies, addressing both network and middleware issues, and mixing theoretical and practical aspects. The notoriety of the academic labs involved in the MSc program together with a strong industry ecosystem in such a famous environment make the program very attractive. As such, I fully support this MSc program which should significantly contribute to building the core skills for the design of future networks and services.*

**Bio:** Prosper Chemouil is research director on networks and systems at Orange Labs, Orange's R&D center. He has 30+ years experience in the modeling and control of complex systems and he is currently involved in the design and management of Future Networks. He is very active in the research community on networking both in France and worldwide. Prosper has got an engineering degree from Ecole Centrale de Nantes and he obtained a PhD on control theory in 1978. He is an IEEE Fellow and got the Blondel Medal in 1996 for his contribution on adaptive routing and network management.

# Environment – Sophia Antipolis

Sophia Antipolis is a wide scientific park of approximately 1300 corporations and 30.000 jobs in R&D, mainly focusing on information technology. Nice-Sophia Antipolis University and the research and training institutes (CNRS, I3S, INRIA, Institut EURECOM, Ecole Nationale Supérieure des Mines and Polytech'Nice Sophia) form a leading competitiveness cluster in computer science.

## A rich network to start your career

You will have access to a wide network of contacts helping you to find the best opportunities for your internship, PhD or industrial position. Our professional network includes partners from other French or international academic institutions, but also industrial partners such as NXP, Orange Labs, Alcatel-Lucent, SAP, Thales, Amadeus, Nokia Siemens Network, Cisco, HP and many SMEs.

**INRIA** ([www.sop.inria.fr/](http://www.sop.inria.fr/)), the French national institute for research in computer science and control, operating under the dual authority of the Ministry of Research and the Ministry of Industry, is dedicated to fundamental and applied research in information and communication science and technology (ICST).

**CNRS** ([www.cnrs.fr/](http://www.cnrs.fr/)), the Centre National de la Recherche Scientifique (National Center for Scientific Research) is a government-funded research organization, the largest fundamental research organization in Europe, under the administrative authority of France's Ministry of Research.

**I3S** ([www.i3s.unice.fr/](http://www.i3s.unice.fr/)) is a Joint Research Unit between the University of Nice Sophia Antipolis (UNS) and the CNRS.

**Polytech'Nice-Sophia** ([www.polytechnice.fr/](http://www.polytechnice.fr/)). Courses will be given in the Polytech'Nice-Sophia, the engineering school of Nice-Sophia Antipolis University. Polytech'Nice-Sophia developed since more than 15 years exceptionally strong partnerships with the industry world, which is achieved through numerous R&D projects in France and Europe.



↑ Polytech'Nice Sophia engineering school



→ Sophia Antipolis,  
25 km from Nice, 15 km from Cannes



# Scientific Program

## Program

**Master 1** to be completed at your home institution

## Master 2

**M2 Semester 1, October-February** - 30 ECTS (European Credits Transfer System)

- 5 courses to be chosen among the 7 courses detailed below. Successful completion of each course corresponds to 4 ECTS
- 1 course (4 ECTS) to be chosen either among the 7 courses below or any other course of the Master IFI ([www.polytechnice.fr/en/page216.html](http://www.polytechnice.fr/en/page216.html))
- A personal project (6 ECTS)

**M2 Semester 2, March-August** - 30 ECTS

**6-month paid fulltime internship** in one of the research team Indes, LogNet, Maestro and Planete (INRIA), Mascotte and Oasis (INRIA/I3S), Modalis and Rainbow (I3S) or with one of our renowned industrial partners Orange Labs, SAP, THALES, AMADEUS, etc.

**Prerequisites:** Basic knowledge in computer science and applied mathematics or electrical engineering is mandatory.

**Teaching language:** English

One-month course of French lessons will be proposed to foreign students to teach them the basics

## Evolving Internet: Architectural Challenges

Team involved: Planete (INRIA)

The Internet has grown from a research curiosity to something we all rely on daily. It has been able to withstand rapid growth fairly well and its core protocols have been robust enough to accommodate numerous applications that were unforeseen by the original Internet designers. How does this global network infrastructure work and what are the design principles on which it is based? How do we ensure that it will work well in the future in the face of future demands? What are the new protocols and services that have been proposed to enhance the Internet architecture? These are some questions that we will grapple with in this course. The main topics that will be addressed in this course include : Internet routing architecture, end-to-end protocol architecture and middle-boxes, mobility and challenged networks, congestion control and quality of service, traffic engineering and network coding, network security, traffic monitoring, evaluation methodology (simulations and experimentations).



# Scientific Program

## Compute and Data Grids: Large-Scale Distributed Systems



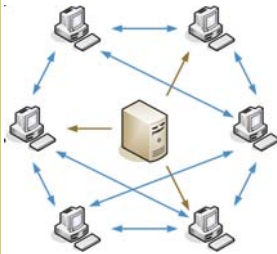
Teams involved: Oasis (INRIA/I3S) and Modalis (I3S)

Grids are large-scale distributed infrastructures leveraging on the high performance networks to federate computing, data and scientific resources from multiple institutions interconnect through the Internet. Grid technologies have undergone a very fast evolution these last years and the infrastructure deployed have become a critical tool in many scientific disciplines. This lecture describes the foundation of grids. It introduces the main computing models exploited with grids to evolve from cluster computing towards more virtualized resources and across-institutional user communities. The main problems encountered when deploying such very large scale infrastructures are discussed: users identification and authorization, security of data and computations, heterogeneity of resources, redundancy and fault tolerance, deployment, management, and computation flow control... The most wide spread technologies and their associated middlewares are reviewed. Several example illustrate the concepts introduced.

## Peer-to-Peer Applications

Teams involved: Mascotte (INRIA/I3S), LogNet and Planete (INRIA)

Since the early days of the Internet, from the email to the Web, the client-server architecture has been used for data transfer. However, in a few years, the peer-to-peer architecture has changed our way to share information. At the present time, peer-to-peer communications account for between 40% to 80% of the Internet traffic. The goal of this lecture is to present the foundations of the peer-to-peer architecture focusing on localization and content replication. In particular, we will give an overview of the notions of Distributed Hash Table (DHT), unstructured localization, publish subscribe paradigm, and content replication techniques. Then, we will focus on the BitTorrent protocol in order to give a high level of expertise to the students in that protocol. In particular, we will describe in details the BitTorrent core algorithms and protocol, we will demonstrate why BitTorrent is highly efficient, and we will present various applications of this protocol and their current usages.

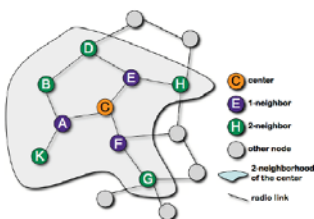
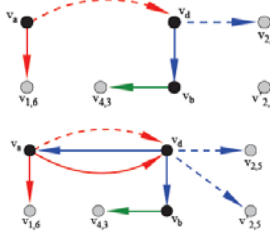


## Algorithms for Telecommunication

Team involved: Mascotte (INRIA/I3S)

The lectures will present problems arising in the design of telecommunication networks considered by operators like France Telecom or manufacturers like Alcatel. There will be two kinds of networks studied including optical WDM (Wavelength Division Multiplexing) networks with MPLS (Multi Protocol Label Switching) management and wireless radio networks. In both cases environmental aspects like minimization of energy will be considered. Examples of such problems are tunnels in MPLS, multicasting, WiFi access, gathering in radio networks, placement of access points, fault tolerant on board satellite networks.

For each problem we will show how to give simple models to tackle them. Then we will introduce algorithmic tools to solve them. All these problems being difficult, we will emphasize approximation algorithms, dynamic programming and heuristics. We will also present some powerful theoretical tools in graph theory and combinatorial optimization.



# Scientific Program

## Performance Evaluation of Networks

Team involved: Maestro (INRIA)

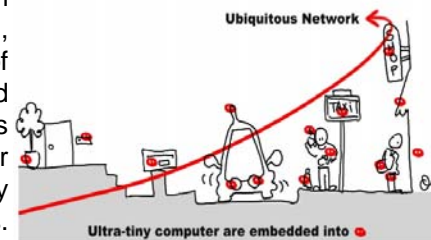
This course will expose the students to a variety of modern mathematical tools entering the modeling, performance evaluation, optimization and control of large-scale computer networks and distributed systems. These tools include the theory of Markov chains (including absorbing Markov chains), basic elements of queueing theory, game theory, stochastic geometry, mean-field approximations, network calculus, dynamic programming and extreme value theory. Numerous applications will be studied throughout the class, including the modeling of TCP and of Web servers, service differentiation, sized-based scheduling, mobility models, file sharing systems (e.g. BitTorrent), distributed storage systems, routing in mobile ad hoc networks.



## Middleware for Ubiquitous Computing

Team involved: Rainbow (I3S)

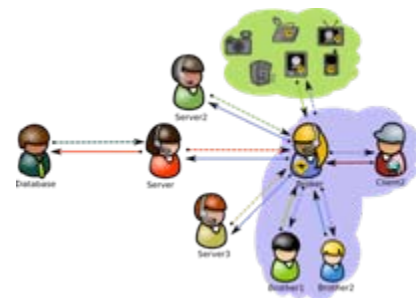
Between the two lies "ubiquitous computing", where mobile phones, home-based information appliances, car navigation systems, video games machines will be linked by broadband wired and wireless network. Alan Kay of Apple calls this "Third Paradigm" computing. Friedemann Mattern, explains this trend from four technological reasons: miniaturization of devices, new materials, progress in communication technologies and better sensors. Anyway, ubiquitous computing introduces new challenges in the software engineering domain leading to numerous innovations for middleware. In this course, we present current approaches already introduced for the software design of applications on mobile devices. Then, we introduce the main research works led on the topic preparing the future of ubiquitous computing like, multi-device and wearable computing, context-awareness and adaptive middleware.



## Secure Diffuse Computing

Team involved: Indes (INRIA)

Diffuse computing deals with distributed applications in highly heterogeneous networks. Current web applications may span multiple devices such as classical computers, TV sets, mobile phones, smart sensors, each of which has its own language and communication protocol. The heterogeneity of technologies used to build diffuse applications is currently visible at the conception and programming level, and increases their vulnerability to security attacks. Implementing today diffuse applications requires engineers to use a vast set of hardly compatible technologies, tools and languages. The HOP language developed by the INDES team is a proposal to develop applications within a unique formalism. The goal of this course is to introduce execution environments and tools that embrace the development of diffuse applications inside a global and coherent approach. The domain of this approach ranges from models of parallelism and security, to compilation and implementation of languages for diffuse computing.



# Faculty

Sara Alouf  
*Research Scientist INRIA*

Konstantin Avratchenkov  
*Research Scientist INRIA*

Chadi Barakat  
*Research Scientist INRIA*

Jean-Claude Bermond  
*Research Director CNRS,  
Project-Team Leader Mascotte*

G rard Berry  
*INRIA and French Academy of Sciences*

Denis Caromel  
*Professor Universit  Nice-Sophia Antipolis,  
Project-Team Leader Oasis*

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Project-Team Leader Plan te*

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Project-Team Leader Rainbow*

Manuel Serrano  
*Research Director INRIA,  
Project-Team Leader Indes*

Jean-Yves Tigli  
*Associate Professor Universit  Nice-Sophia  
Antipolis*

**Scientific Committee:** J-C. Bermond, D. Caromel, W. Dabbous (*chair*), J. Montagnat, P. Nain, M. Riveill, M. Serrano

# Admission information

## Admission Criteria

The program is designed for those having completed the first-year MSc program at home institution in either computer science, applied mathematics, or electrical engineering.

## Tuition Fees

The French educational system allows all students to follow their studies with a low cost financial commitment. The cost of this program is based on regular French university fees which is approximately € 600 euros for the year. Tuition fees cover course expenses.

## Scholarship

The scholarship program offers outstanding students the chance to receive a grant for the first half of the program (M2S1). The second half (M2S2) will be funded by the employer (research lab or industry) for every student who is admitted to the program.

## Procedure

Applicants are encouraged to submit applications early in the year through the MSc website (<http://ubinet.inria.fr>). The department treats applications as they are received. Therefore, it is in the applicant's best interest to submit his/her application during the early stages of the cycle (i.e., by April 23 if possible). Early application increases the chances of receiving financial aid.

## Housing

Several low cost University dormitories in Sophia Antipolis welcome students during the academic year. Antibes and Nice which are nearby cities also have accommodation possibilities. An information booklet will be sent to you after confirmation of your registration.

### Postal address:

Université de Nice-Sophia Antipolis  
Polytech'Nice-Sophia  
930 route des colles – BP 145  
F-06903 Sophia Antipolis Cedex  
FRANCE

## Important dates



**April 2 – May 10, 2009**  
**First round of applications**

**May 15, 2009**  
**Notification of acceptance**



**May 15, 2009 – July 31, 2009**  
**Second round of applications**  
*Candidatures will be studied on the fly.*

**July 31, 2009**  
**Final notification of acceptance**

## Contact Information

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### ■ Walid Dabbous

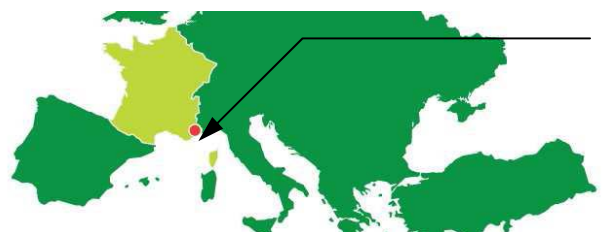
Chair of the Scientific Committee

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### ■ Web site: <http://ubinet.inria.fr>

Nice-Sophia Antipolis University







**Centre National de la Recherche Scientifique**

<http://www.cnrs.fr>



**Laboratoire d'Informatique, Signaux et Systèmes de Sophia Antipolis**

<http://www.i3s.unice.fr/>



**Université de Nice Sophia Antipolis (UNS)**

<http://www.unice.fr>



**Institut National de Recherche en Informatique et en Automatique**

<http://www.inria.fr>