Major

Wireless Autonomous Networks

(Major WAN)

Program Director :

Prof. Ana CAVALLI

Objectives:

Wireless autonomous networks are characterized by their autonomous control. They are self configured, distributed, and generally heterogeneous. They can be deployed dynamically within different contexts. They are basically independent from any physical infrastructure, and are designed to enable communication between peers using multi hops heterogeneous elements.
The objective of these type of networks is to set up systems allowing the dynamic and spontaneous creation of new applications and services, based on a transparent creation of the support networks, their connectivity and their integration to networks infrastructures, and permitting multi technological mobility between the interconnected domains.
In order to offer connectivity and enable communication in such a dynamic environment, several unicast and multicast routing protocols were proposed for the spontaneous networks. Some of them like OLSRv2 and DYMO are still under standardization process. Nevertheless, the main aim of having a spontaneous network is collaboration and information sharing between its different participants. Using peer to peer techniques is the right answer to this need in such environment. The objective of this major is to present these next generation networks and their applications.

By the end of this major courses, students will have the following skills:

- Design of spontaneous local area networks
- Design and configuration of routing protocols
- Using modelling and tests methods in order to detect conceptual and implementation errors
- Master security techniques
- Network security control (error detection, error localization, error repairing)
- Have a global vision over the new generations networks

Organisation :

The Wireless Autonomous Networks program is part of the Advanced Engineering Cycle which covers the 8th and 9th semesters of the TELECOM SudParis curriculum. Its building teaching units consist of 6 independent courses (each representing 45h lectures & labs and 90h homework) which define a complete graduate program in network engineering.

During the S9 Semester, a team project (NET5025) will allow students to gain an in-depth expertise on one of the main scientific axes presented in these UVs.

Program :

Semester 8 :

- NET4519 : Wireless data networks
- NET4518 : Routing and access lists

Semester 9 :

- NET5021 : Routing protocols for spontaneous networks
- NET5022 : Peer-to-Peer networks
- NET5023 : Verification & Test of wireless routing protocols
- NET5024: Security in spontaneous networks
- NET5025 : WAN major's project

NET4519 Wireless Data Networks

Period : S8 / P3 **ECTS :** 4 **Language :** English

Organization :

- Teaching Load / Total Load : 45/90
- Lectures/Exercices/Labs/Final Exam 1: 31,5/0/12/1,5

Course consists of lectures and laboratory sessions and experiments with WLAN, Bluetooth and WiMAX technologies.

Assessment :

The evaluation is composed of laboratory sessions where students will be asked to conduct experiments, collect results, discuss and provide interpretations of the results in a report for each session (C1). A written exam (E1) is also scheduled to validate the course and obtain the appropriate credits.

Finale grade = Average(C1, E1)

Objectives:

- To acquire knowledge on short wireless technologies such as RF tags and IDs, sensors, WLAN (WiFi), WPAN (Bluetooth), access and back haul systems and architectures such as WiMAX as well as mesh and Ad hoc networks,
- To know the differences between these systems and architectures, as well as their application areas and target sectors in the information society,
- To gain in depth understanding of related air interfaces, medium access control and higher layers involving interactions with services and applications,
- To learn how to analyze and design security protocols and mechanisms for these systems in order to protect user data and privacy.
- To have sufficient background to engage in the design and optimization of short range wireless access networks and back haul networks.

Keywords:

RFID, sensor networks, WLANs, WiMAX, OFDM, MIMO, security, ad-hoc and mesh networks

Prerequisites:

Students are required to have good knowledge of network protocols, general networking and network architectures.

Course outlines:

- Wireless Networks basics
- Description of Radio Resource Partitioning and access methods including OFDM, AAS, OFDMA and MIMO techniques

- Short range wireless technologies : RFID, UWB, ZigBee (IEEE 802.15.4 and IEEE 802.15.4a), Bluetooth
- Sensor network technology
- WLAN networks with emphasis on WiFi and expected evolution
- WMAN and WiMAX
- Ad-hoc and Mesh networks and mobility aspects
- Emerging wireless communication protocols
- Wireless Data Networks security aspects

Learning materials and literature :

Learning materials :

- Slides, papers, journal articles, forums/normalization groups white papers and specs

Literature :

-

Person in charge :

Professor Hossam AFIFI (hosam.afifi@it-sudparis.eu)

Lecturers :

From TELECOM SudParis :

- H. AFIFI : Professor
- H. CHAOUCHI : Associate Professor
- M. GIROD-GENET : Associate Professor

Guest lecturers :

- Dr. M. ASSAAD : Faculty member from Supelec

NET4518	**Routing and access lists**	
Period : S8 / P4	**ECTS :** 4	**Language :** English

Organization :

- Teaching Load / Total Load : 24/90
- Lectures/Exercices/Labs/Final Exam : 1,5/1,5/21/0

Assessment :

First session = Main assessment (A1) – 1 graded lab (A2)
Second session = 2nd attempt (A3) if (A1+A2)/2 <10/20
Final grade = (A1+A2)/2 if >10 or (A1+A2+A3)/3

Objectives :

- To develop skills on how to configure routing protocols (RIP, OSPF and EIGRP)
- To create and apply access control lists.
- To be able to perform troubleshooting tasks.
- To divide a network into subnets using VLSM

Keywords :

RIP, OSPF, Access lists, CIDR

Prerequisites :

LAN and WAN networks, OSI model, IP addressing

Course outline :

- WANs and routers
- Configuring a router
- Routing protocols RIP version 1 and RIP version 2
- TCP/IP suite error and control messages
- Basic Router troubleshooting
- Access control lists
- Classless routing
- Routing protocols OSPF, EIGRP

Learning materials and literature :

Learning materials : CCNA curriculum, Lab guide
Literature :

-

Person in charge :

Bruno Meurisse (Bruno.Meurisse@it-sudparis.eu)

Lecturers :

- Bruno MEURISSE

NET5021	**Routing protocols for spontaneous networks**	
Period : S9 / P1	**ECTS :** 4	**Language :** English

Organization :

- Teaching Load / Total Load : 30/90
- Lectures/Exercices/Labs/Final Exam 1: 24/0/6/0

Assessment :

A graded lab (L) and a written work (W)

Final grade = Average(2L+W)

Objectives :

- Mastering of models and architectures for the design of spontaneous networks
- Mastering the design of routing protocols for different types of spontaneous networks (ad hoc, sensors and p2p networks)
- Mastering the configuration of a routing protocol

Keywords :

Routing, unicast, multicast, wireless networks.

Prerequisites :

Good knowledge on routing principles and TCP/IP.

Course outlines :

- Issues to design the routing protocols
  - Mobility
  - Bandwidth constraints
  - Error-prone shared broadcast radio channel
  - Etc.
- Classification of routing protocols
  - In sensor, ad hoc and p2p networks
  - Multicast routing protocols
  - Architecture and power management in sensor and p2p networks

Learning materials and literature :

Learning materials : Duplicate lectures notes will be distributed by the teachers.

Literature :

- Ad hoc networking, Charles E. Perkins. Addison-Wesley Professional, 1ST edition, 2001
- Ad hoc Wireless networks architectures and protocols, C. Siva Ram Murthy and B. S. Manoj, Prentice Hall, 2004

Person in charge :

Pr. Ana CAVALLI (ana.cavalli@it-sudparis.eu)

Lecturers :

From TELECOM SudParis :

- Dr. Anis LAOUITI

Guest lecturers :

- Invited teachers : Researchers from Hipercom team (INRIA) and industrials working in this area.

NET5022	**Peer-to-peer systems**	
Period : S9 / P2	**ECTS :** 4	**Language :** English

Organization :

- Teaching Load / Total Load : 30/90
- Lectures/Exercices/Labs/Final Exam 1: 24/0/6/0

Assessment :

A graded lab (L) and a written work (W).

Final grade= Average(2L+W)

Objectives :

- Mastering of architectures and behavior of peer-to-peer systems for data exchange
- Mastering of the most out-standing peer-to-peer systems
- Mastering of the peer-to-peer system design techniques

Keywords :

Peer-to-peer, content sharing, search engine, distributed hashing table, routing.

Prerequisites :

Good knowledge on routing principles, TCP/IP.

Course outlines :

- Fundamental concepts.
- Content sharing vs computing sharing (ex: Grid computing).
- Structured and unstructured peer-to-peer networks.
- Localization in large scaled systems(search engines): servers, distributed hashing table, flooding, JXTA engine.
- Content distribution (bittorrent, streaming P2P).
- P2P routing: how to route data from one peer to another, discover resources, and adapt to changing topologies.
- Security, vulnerability, and legal issues in P2P.

Learning materials and literature :

Learning materials : Duplicate lectures notes will be distributed by the teachers.

Literature :

- Peer to peer computing : the evolution of a disruptive technology, Ramesh Subramanian & Brian D. Goodman, Hershey, Pa. : Idea Group , 2005
- Legitimate applications of peer-to-peer networks, Dinesh C. Verma, Chichester, GB: John Wiley & sons, 2004

Person in charge :

Dr. Anis LAOUTI (anis.laouiti@it-sudparis.eu)

Lecturers :

From TELECOM SudParis :

- Dr. Anis LAOUITI

Guest lecturers :

- Invited teachers : Researchers from Gyroweb team (INRIA) and industrials working in this area.

NET5023	Verification & test of wireless routing protocols	
Period : S9 / P3	**ECTS :** 4	**Language :** English

Organization :

- Teaching Load / Total Load : 36/90
- Lectures/Exercices/Labs/Final Exam 1: 10,5/4,5/21/0

Among the courses, industrials will also present their own testing or specification tools.

Assessment :

A graded lab (L) and a written work (W).

Final grade = Average(2L+W)

Objectives :

- Mastering of Formal Description Techniques for the modelling of spontaneous networks protocols
- Mastering of testing methods and tools to detect conceptual and implementation errors
- Knowledge on new specification and testing techniques under research and new challenges in this area

Keywords:

Validation, Verification, Test, Protocols, SDL, Spin.

Prerequisites :

Software engineering basics and routing protocols

Course Outlines:

- Introduction to the formal techniques for protocols specification.
- Introduction to verification techniques (model checking) and to specific languages for formal verification.
- Use of the SPIN tool to verify Promela models.
- SDL language presentation (architecture, behavior and data types). Use of an industrial tool ObjectGEODE.
- Labs to specify real protocols and services.
- Introduction to the conformance testing problematic.
- Study of various techniques to automatically generate test sequences.
- Formal analysis of a routing protocol for an ad hoc network and automatic generation of test sequences. Application of the test sequences to a real implementation of the protocol.

Learning materials and literature:

Learning materials : "The SDL language", Stéphane Maag

Literature :

- P- Design and Validation of Computer Protocols, *G.J. Holzmann,* Prentice Hall, 1991
- Ingénierie des protocoles et qualité de service, *A.Cavalli et al.,* Hermes, Lavoisier, 2001
- Validation of Communications Systems with SDL: The Art of SDL Simulation and Reachability Analysis, 310 pages - John Wiley & Sons - May 2003, Laurent Doldi.

Person in Charge:

Dr. Stéphane MAAG (stephane.maag@it-sudparis.eu)

Lecturers :

From TELECOM SudParis :

- Pr. Ana CAVALLI
- Dr. Stéphane MAAG

Guest lecturers :

- Emmanuel ALLIBERT (Telelogic)
- Pierre COMBES (FT R&D)
- Dr. Fatiha ZAIDI (Univ. Orsay)

NET5024 Security in spontaneous networks

Period : S9 / P4 **ECTS :** 4 **Language :** English

Organization :

- Teaching Load / Total Load : 36/90
- Lectures/Exercices/Labs/Final Exam 1: 30/0/6/0

Assessment :

Continuous evaluation based on lab assignments (N1) and an individual or peer project (N2).

Final grade = (N1+N2)/2

Objectives :

- Practical knowledge in network security
- Access control and Firewalls
- IPsec and VPNs
- Authentication and AAA
- Encryption and key management
- Research-oriented security in spontaneous networks
- Understanding security problems in spontaneous networks,

-Presentation of current security solutions under research, and remaining challenges like distribution of keys will be analyzed.

Keywords :

Network Security, Access Control, security in spontaneous networks.

Prerequisites :

Students are required to have good knowledge in general networking, spontaneous network protocols, and network architectures.

Course outlines :

- Network security basics including Cryptography, Communication Security protocols, and firewalls
- Security in domestic and ad hoc networks
- AAA in mobile and wireless networks
- Security in sensor networks
- Key distribution within spontaneous networks
- Configuring firewalls (Labs)

Learning materials and literature :

Learning materials :

Literature :

- CHESWICK, W.R., BELLOVIN, S.M., & RUBIN, A.D. (2003). Firewalls and Internet Security: Repelling the Wily Hacker, Addison-Wesley, Reading

- FRANKEL S (2001), Demystifying the IPsec Puzzle, Artech House Computer Security Series, 2001.

- GUPTA, M. (2002). Building a Virtual Private Network, Premier Press

- KIZZA J.M. (2005), Computer Network Security, Springer

- POHLMAN, N. & CROTHERS, T. (2002). Firewall Architecture for the enterprise, Wiley

- RESCORLA E (2001), SSL and TLS : Designing and Building Secure Systems, Addison-Wesley, 2nd Edition

- SCHNEIER B (1996), Applied Cryptography: protocols, Algorithms and source Code in C, 2ème Ed., John Wiley & Sons

Person in charge :

Dr. Hakima CHAOUCHI (hakima.chaouchi@it-sudparis.eu)

Lecturers :

From TELECOM SudParis :

- Dr. Hakima CHAOUCHI
- Pr. Maryline MAKNAVICIUS

Guest lecturers :

- Nicolas PRIGENT (Thomson)
- Pars MUTAF

NET5025	WAN major's project	
Period: S9	**ECTS:** 8	**Language:** English

Organization :

- Scheduled Meeting / Total Load : 18h/225h

WAN major's project is done during the whole semester 9. Each student must make a project with two or three other students. Planning time slots are dedicated to the project. Meeting with project manager take place about every other week.
Three types of projects are proposed to students: Experimentation projects, study projects for companies or administrations, research projects.

Assessment:

The validation of this project is based on the writing of a report (R) and an oral presentation (P).

Final grade = Average(R, P)

Examples of topics :

- State of the art of overlay networks and ad hoc networks
- Peer to peer system design for ad hoc networks
- Security issues in spontaneous networks
- Access control in spontaneous networks
- Trust management in spontaneous networks
- Formal description and test generation for ad hoc network routing protocols
- Description and validation of a security policy for ad hoc networks
-Detection and localization of routing errors

Coordinator :

Ana CAVALLI (ana.cavalli@it-sudparis.eu)

Supervision staff :

Pedagogic team of WAN major