POLITÉCNICA
"Ingeniamos el futuro"

CAMPUS
DE EXCELENCIA
INTERNACIONAL

Universidad Politécnica de Madrid

UPM Master in Wireless Communications

Madrid, December 2021

INTRODUCTION

UPM Campuses

University City

Montegancedo Campus

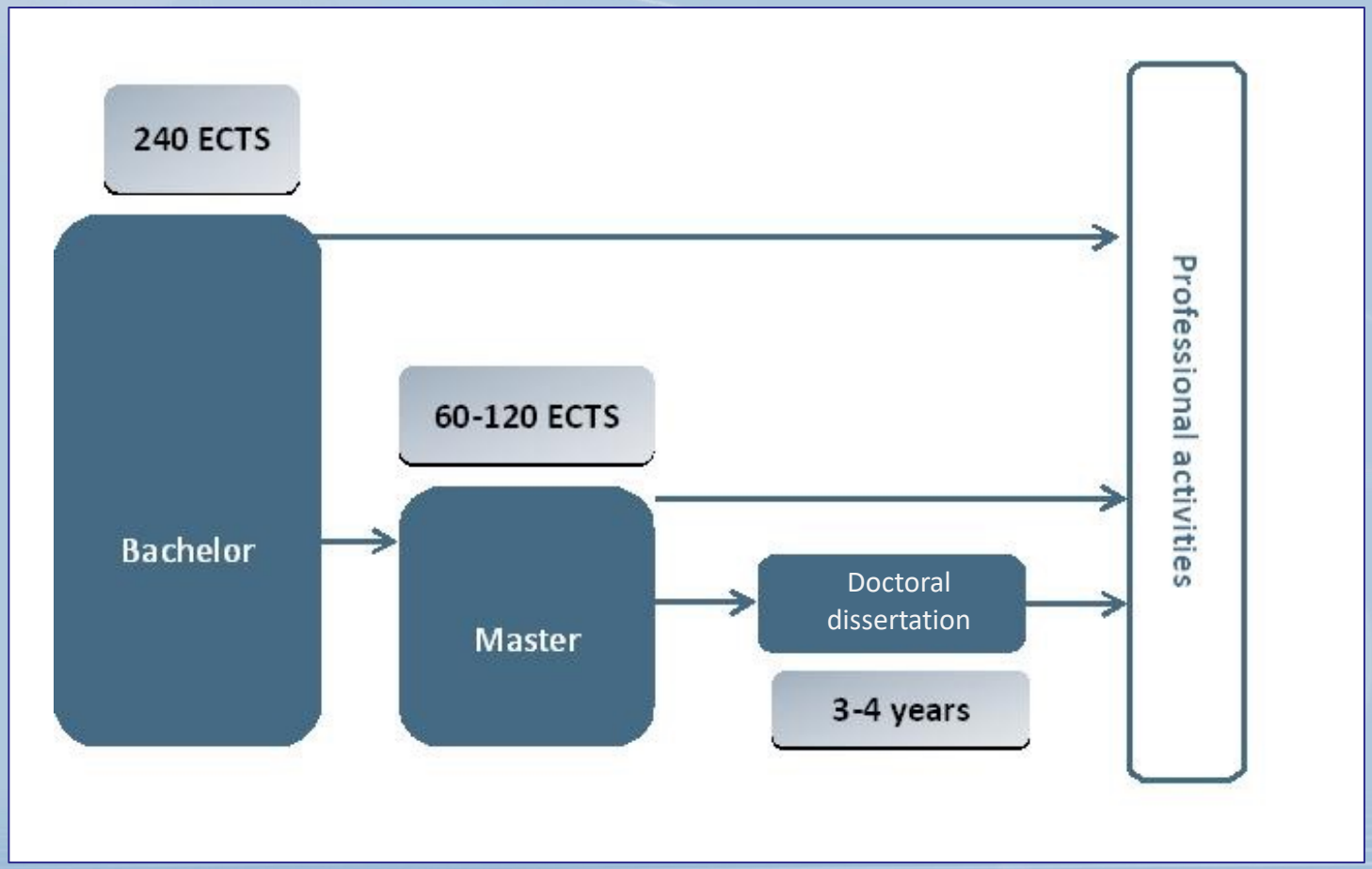
Downtown District

South Campus

UPM South Campus

- School of **Computer Science** (ETSISI)
- School of **Surveying Engineering, Geodesy and Cartography** (ETSITGC)
- School of **Telecommunications Engineering** (ETSIST)
- College of **Fashion Design** (CSDMM)

Higher Education in Spain



Current degrees on ICT's in ETSIST-UPM

Undergraduate Programs (240 ECTS):

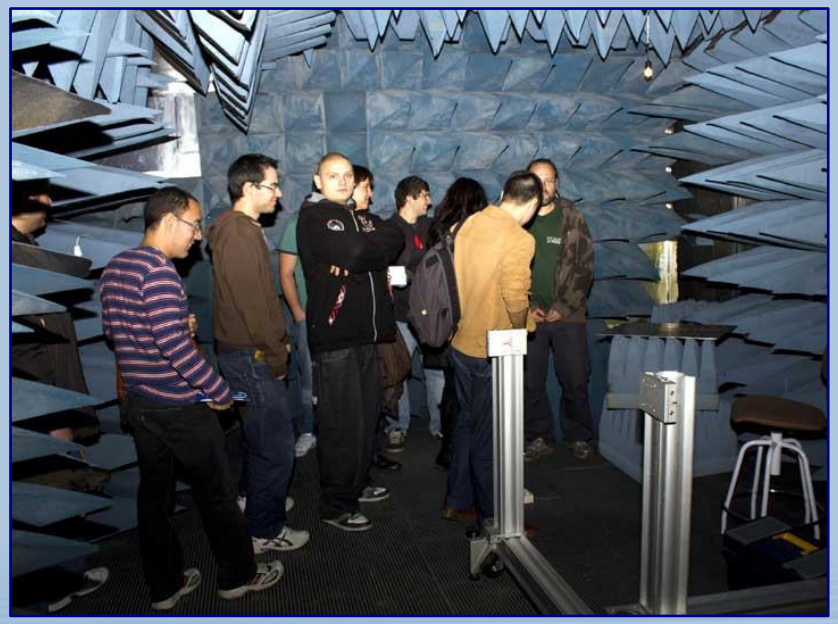
- ✓ Bachelor in Communications Electronic Engineering
- ✓ Bachelor in Telecommunication Systems Engineering
- ✓ Bachelor in Telematics Engineering
- ✓ Bachelor in Audio and Video Engineering
- ✓ Bachelor in Engineering and Data Systems

Graduate Programs (60 ECTS):

- ✓ Master degree in Internet of Things (MIoT)
- ✓ Master degree in Acoustics Engineering (MIA)

BEng, Program Structure

The School's Bachelor programs consists of **4 academic years** (8 semesters) fully adapted to the European Higher Education Area (EHEA) standards. Along these 8 semesters, students must complete a total amount of **240 ECTS credits,** which are divided as shown next:



- **Compulsory credits**: 196.5 ECTS (1,965 class hours)
- **Elective credits**: 31.5 ECTS (315 class hours)
- **Final Bachelor Thesis**: 12 ECTS (120 class hours)

MEng, Program Structure

The School's Master programs aim to provide students with either an advanced **professional training** or an oriented **research training** on systems, applications and services related to key topics on **Information and Communication Technologies** (ICTs). Main figures come next:

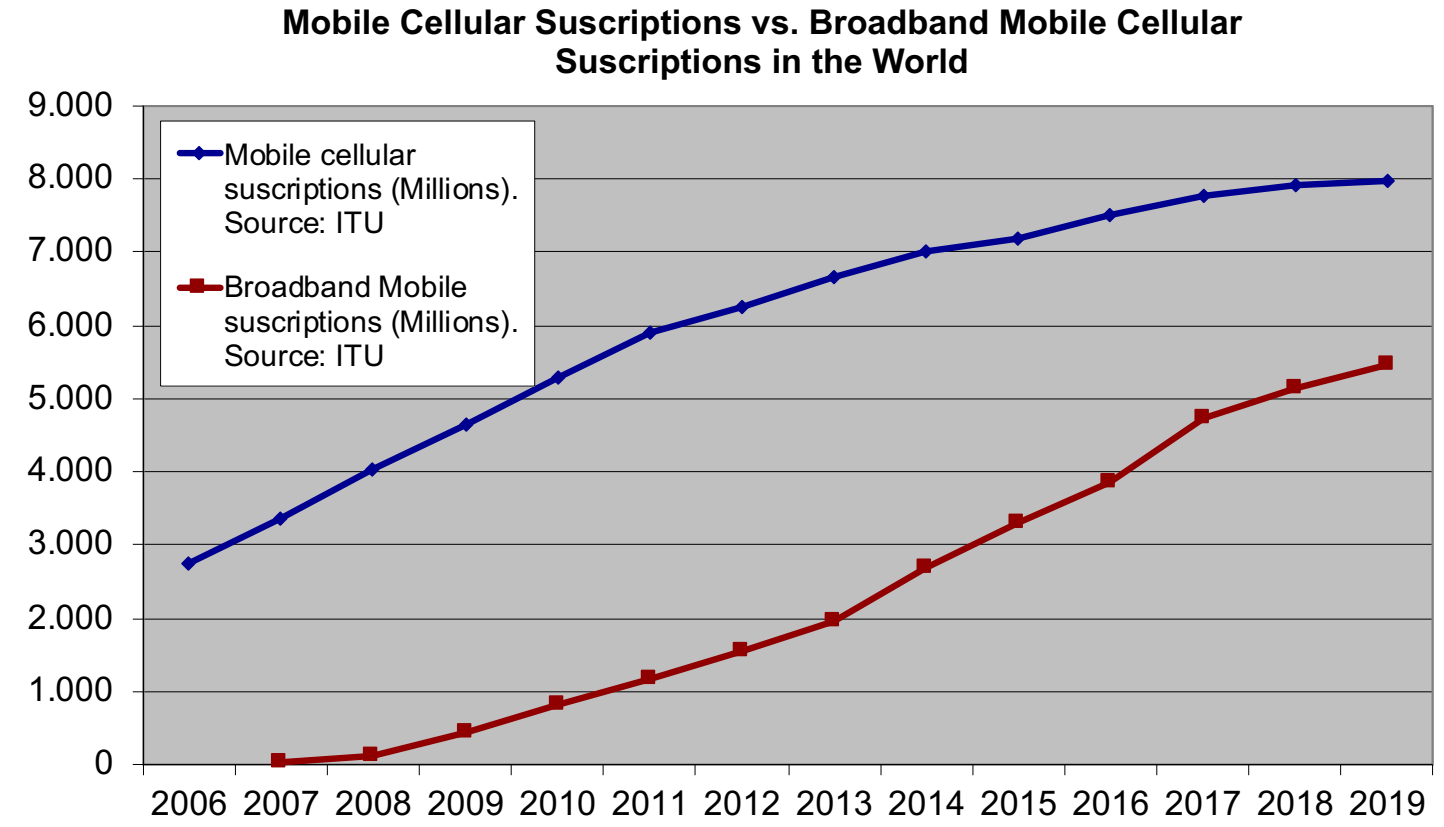
- **60 ECTS** credits (1-year, full time)
- Organized for both a **Professional** or a **Research** career orientation
- Connected to a **Doctoral** program
- Conducted in both **Spanish** and **English** languages

WIRELESS

Wireless Market

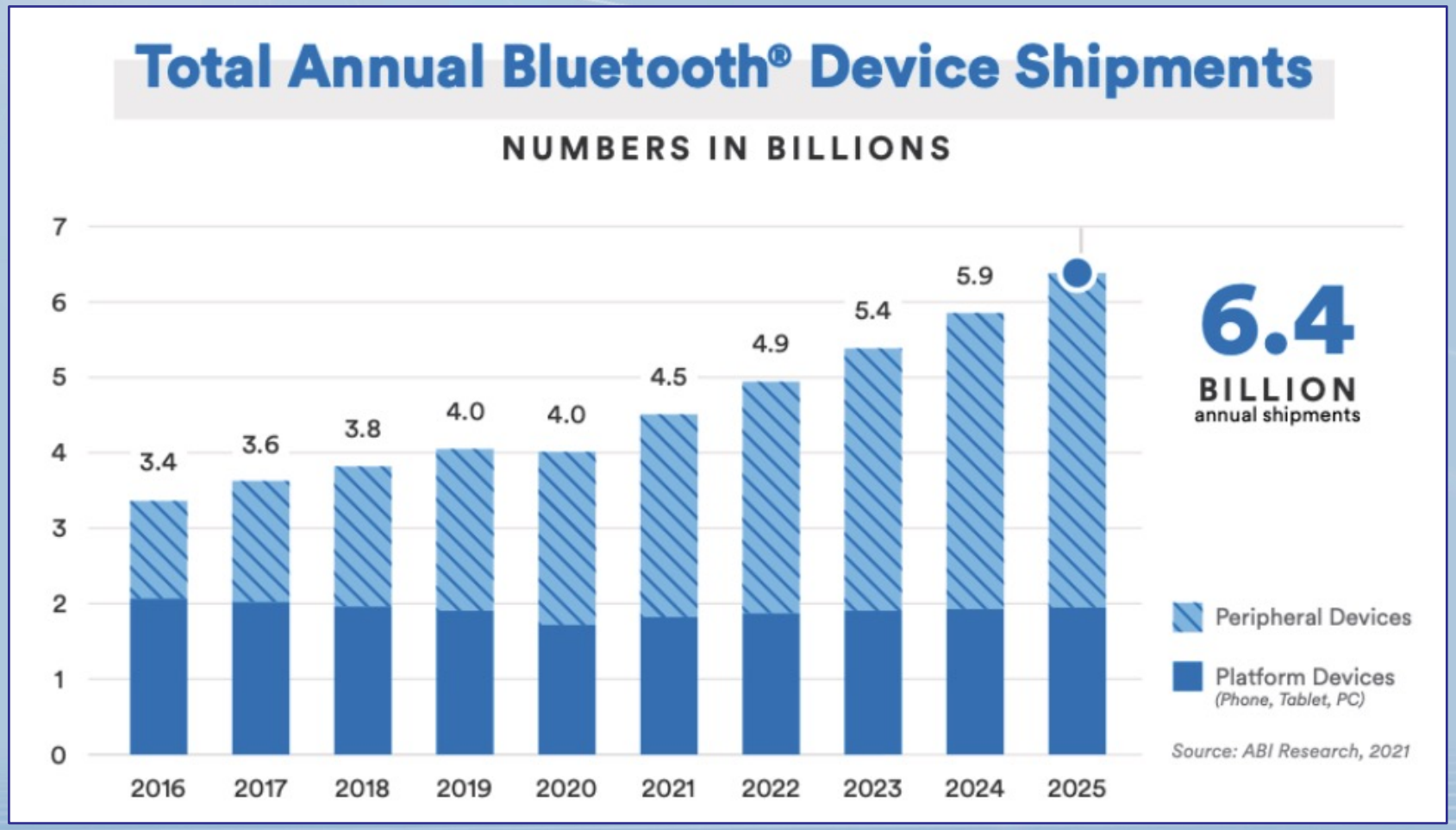
Wireless Communications is a highly demanded technical area involving all aspects on how to transmit and receive information over the electromagnetic spectrum. From a market point of view, **Wireless Communications** currently represents a main driver for innovation, social progress and economic growth.

Wireless Figures, 1



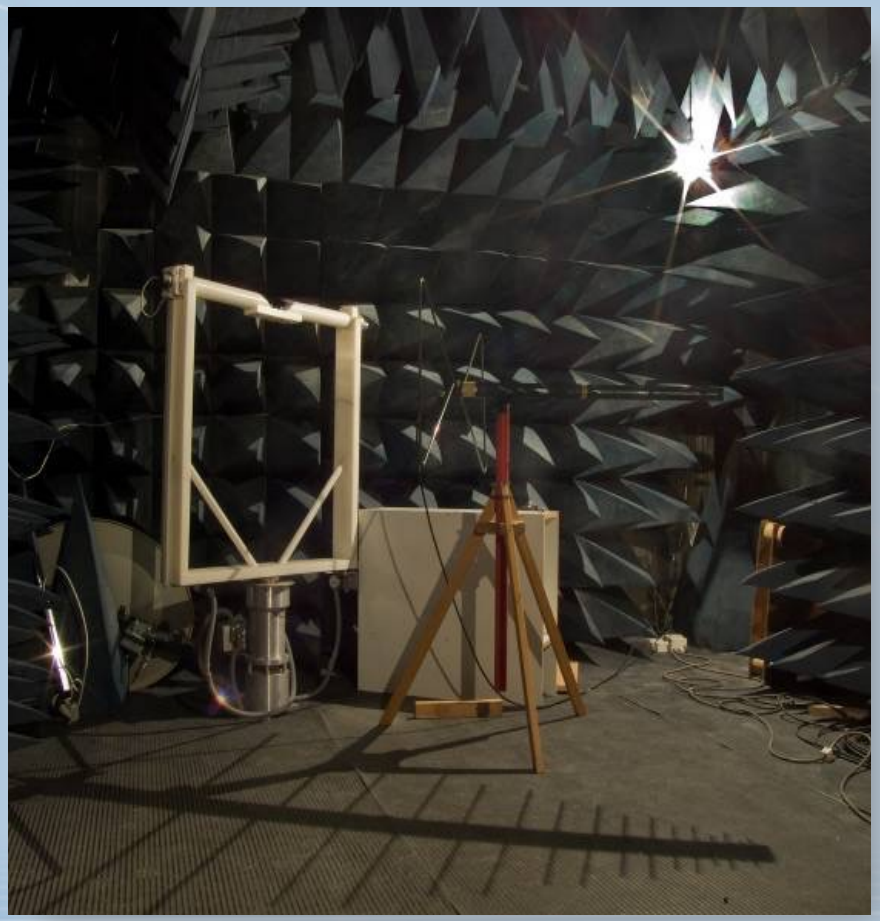
Source: ITU
Author's Ellaboration

Wireless Figures, 2



Wireless Stakes

Wireless Communications is placed in the intersection of three stake disciplines of Telecommunications: **Radio**, **Telematics**, and **Electronics**. Therefore, it requires a **multi-disciplinary** approach able to join different skills and knowledge from all of them. It represents, at the same time, an excellent opportunity for the university to contribute to the progress of **modern hot initiatives** such as: smart cities, internet of things, open radio, wearables, etc.



Similar Programs in Europe

Master programs on Wireless Communications in **Europe** are mainly targeted at Nordic countries with a usual length of **two years**. That is the case of **University of Oulu** (Finland), **University of Tampere** (Finland), or **University of Lund** (Sweden). There are also some British universities with **one year** MSc programs oriented to wireless disciplines like: **Bristol**, **Southampton** or **Lancaster**.

STRENGHTS

UPM

UPM is one of the most important technical universities in **Europe**. It has a strong commitment to research, development and innovation, with a remarkable participation in all competitive European and National research programs.

UPM is already offering **24 master programs** linked to the **ICT area,** but none of them was particularly aimed at wireless technologies until now.

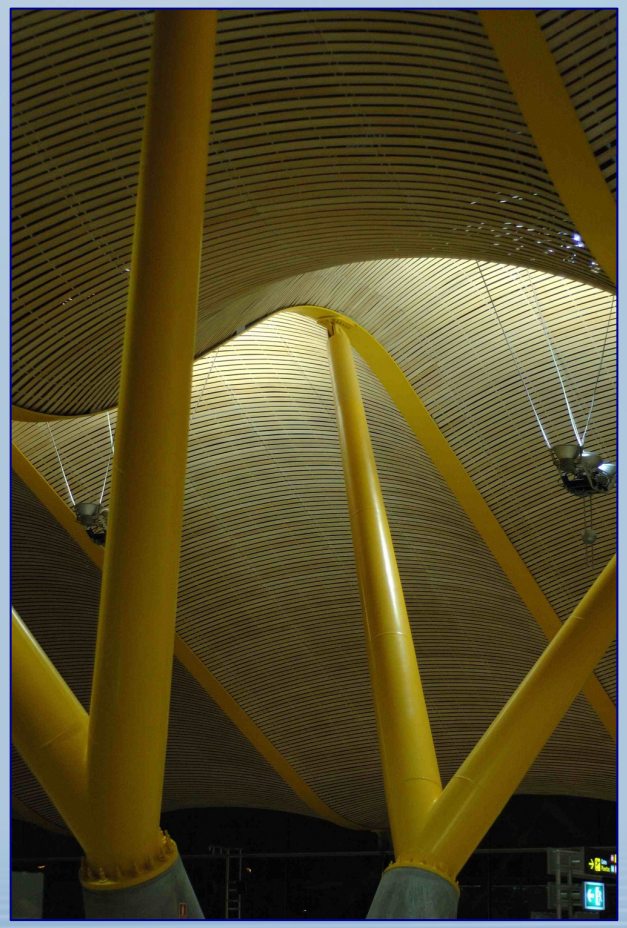
Teleco-Campus Sur

- The School's **undergraduate port-folio** includes all Communication Technologies related programs.
- Number of **undergraduate students** reaching the graduation every year is about 150.
- **99 senior and junior researchers** participating in 26 UPM researching groups, 10 of them led by faculties of Teleco-Campus Sur.
- There are over 100 **mobility agreements** for students with universities from all over the globe.

Facilities at UPM South Campus

- Library
- Cafe / Canteen
- Sports Facilities (indoor & outdoor)
- Public transportation
- Parking lots
- Green areas
- Global Internet Access (Wi-Fi)

The City of Madrid as a global attractor



Madrid is the most **touristic city** of **Spain**, the fourth most touristic in Europe and the seventh most visited city in the world according to Forbes. Madrid is also marked among the **12 greenest** European cities.

Madrid is a **modern metropolis** with a remarkable contemporary architecture and a very high standard of living and well-developed infrastructure for both **business** and **leisure** activities, what makes the city the **leading hub** in Southern Europe.

The City of Madrid as a global attractor

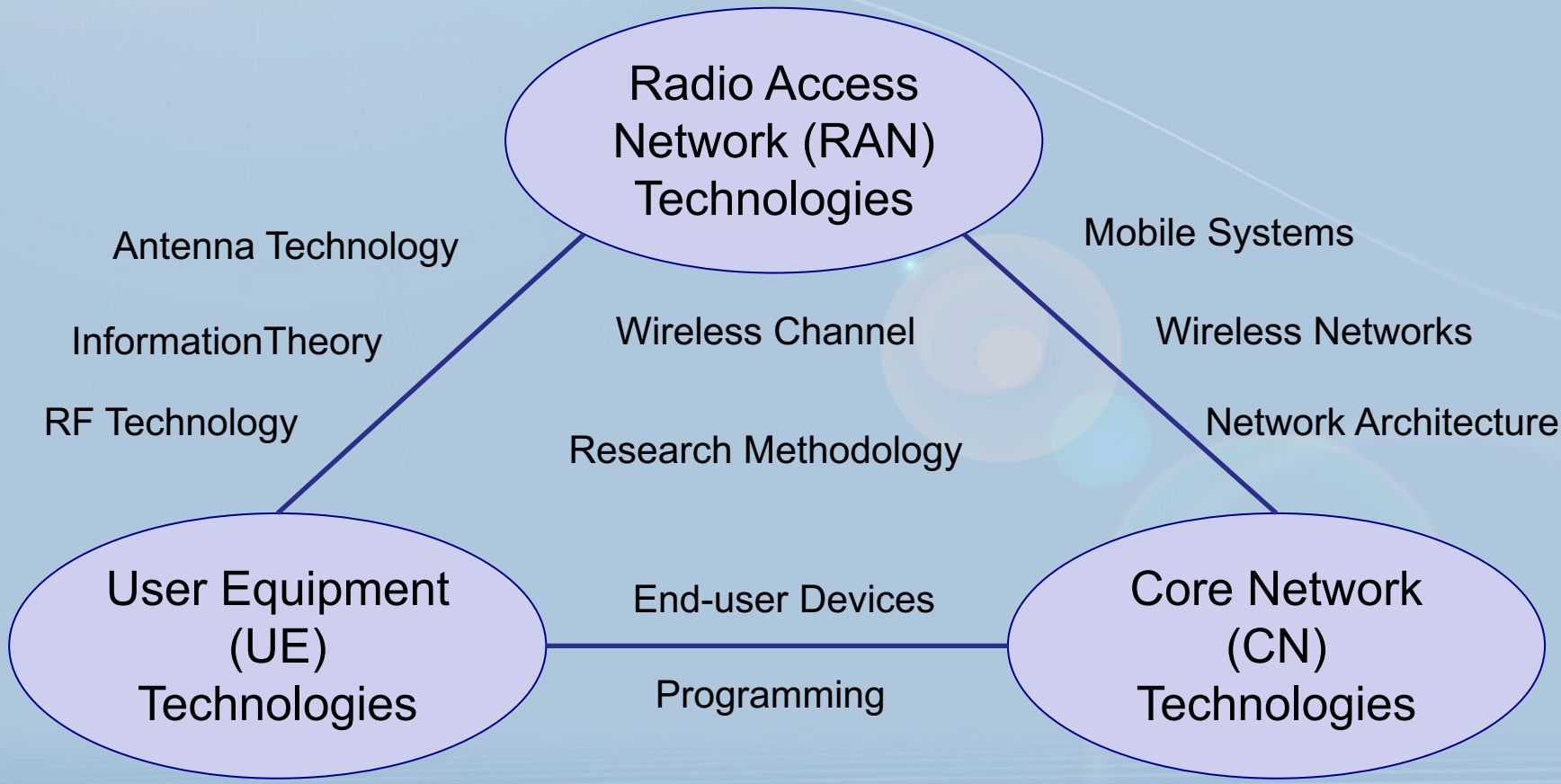
The City of Madrid as a global attractor

PROGRAMME

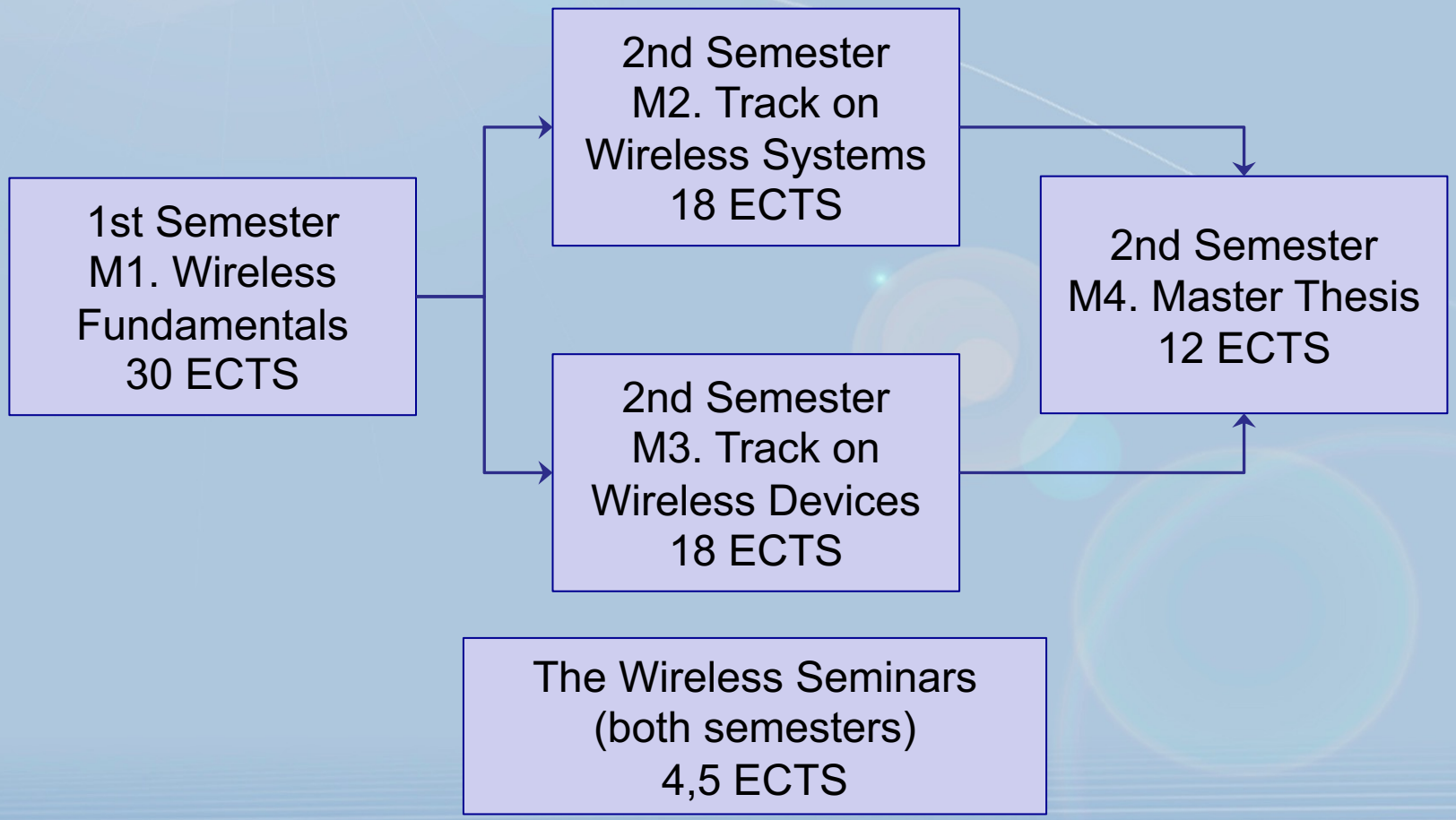
Master's Main Figures

- **Total credits**: 60 ECTS
  - **Mandatory credits**: 30 ECTS
  - **Elective credits**: 18 ECTS
  - **Master Thesis**: 12 ECTS
- **Two tracks**: Wireless Systems and Wireless Devices
- **Language:** English / Spanish
- **Extension**: one academic year (two semesters)
- **Calendar**: September-January and February-June, 28 weeks
- **Timetable**: Monday to Friday, on-site learning

Master's Technologies and Topics



Master's Structure



Master Courses

Compulsory Courses (take all 5)	ECTS	Semester	Lab
Antenna Technology (AT)	4,5	1	tbd
Advanced Information Theory (AIT)	6	1	tbd
Mobile Communication Systems (MCS)	6	1	tbd
Network Architecture and Protocols (NAP)	4,5	1	tbd
RF Wireless Technology (RWT)	6	1	tbd
Scientific Research Methodology (SRM)	3	1	tbd

Master Courses (cont.)

Elective Courses (select 4)	ECTS	Semester	Lab
Wireless Channel Modelling (WCM)	4,5	2	tbd
Programming of Wireless Devices (PWD)	4,5	2	tbd
Short Range Wireless Communications (SRW)	4,5	2	tbd
Wireless Systems Manufacturing (WSM)	4,5	2	tdb
Wireless Sensor Networks (WSN)	4,5	2	tbd
Wireless Communications in ITS (WCI)	4,5	2	tbd

Courses' Description

Antenna Technology (AT)

This course is aimed to acquire a good ability to analyze the more **common antennas** employed in wireless communication systems. Main **antenna parameters** will be learnt, and **modern new techniques** will be studied.

Advanced Information Theory (IT)

This course is aimed to give students a knowledge on the principles for **processing** and **transmission of information**. An in-depth review of modern source coding and channel coding techniques will be provided.

Mobile Communication Systems (MCS)

This course is aimed to gain an understanding on **present and future** personal mobile communication systems, particularly **LTE** and **5G** and mainly focused to the Radio Access Network.

Courses' Description

Network Architecture and Protocols (NAP)

This course is aimed to review the **core network architecture** of modern mobile communication systems and to study the **layers 2 and 3** of radio protocols, mainly oriented to present **LTE** and **5G** mobile communication networks.

RF Wireless Technology (RWT)

This course is aimed to learn about innovations on the latest and most significant topics in the area of **circuit design of RF devices** for wireless communications systems, both in wireless infrastructure and user equipment.

Scientific Research Methodology (SRM)

This course is aimed to introduce students to concepts and practices of scientific research methodology. During the course, students will demonstrate their understanding and competence through the development of the study design for their own research project.

Courses' Description

Wireless Channel Modeling (WCM)

This course is aimed to give a comprehensive view of the **wireless channel characteristics**. This includes an understanding of the underlying physical propagation mechanisms and measurements of the channel properties.

Programming of Wireless Devices (PWD)

This course is aimed to learn how to build **HTML** and **CSS** based **apps** in today's smartphones, tablets and wearables user devices, as well as getting acquainted with modern **integrated development environments** for wireless devices.

Short Range Wireless Communications (SRW)

This course is aimed to describe radio theory and applications for **wireless** communication with ranges of **centimeters** to **hundred of meters**, including transmitter and receiver architectures. Typical examples are RFID, NFC, UWB, BLE, Zigbee and WIFI.

Courses' Description

Wireless Systems Manufacturing (WSM)

This course is aimed to address the state-of-the-art of **integrated circuit** and of **systems-on-a-chip** in the context of modern wireless devices. Emerging materials for manufacturing of wireless circuits will also be reviewed.

Wireless Sensor Networks (WSN)

This course is aimed to introduce **wireless sensor networks** by using the **cognitive communications** concept. Implementation of WSN equipped with real-time positioning devices will be also introduced.

Wireless Communications in ITS (WCI)

This course is aimed to gain a comprehensive understanding on the use of **Wireless Communications** in **Intelligent Transportation Systems**. The more representative technologies and results will be provided.

The Wireless Seminars (TWS)

The **Wireless Seminars** is a scientific forum intended for hosting and organizing internal and external educative activities, mainly oriented to the wireless market and fully optional for students. This could gather own UPM researching oriented courses, some visiting researchers' conferences, as well as project-oriented activities organized by the School research groups, among other options. This activity is accounted **up to 4.5 ECTS** conveniently distributed along the year.

Master Thesis (MTH)

A final **Master Thesis** must be carried out in the context of one of the research groups of the School. This activity is accounted as **12 ECTS**, resulting in a final **dissertation** to be reviewed by an **evaluation committee**. To get to that point, students have to previously gain the **acceptance for a publication** in a technical journal or in a conference proceedings or, at least, to **submit a full paper to** any of them. This will be part of the thesis' contents.

RULES

Applicable National Rules

- **Organic Law 6/2001**, of 21 December 21, from the Ministry of Universities, amended by the **Organic Law 4/2007**, of 12 April.
- **Royal Decree 1393/2007**, of 29 October, amended by the **Royal Decree 861/2010**, of 2 July, by means of which the official higher education studies in Spain are organized.
- **Royal Decree 99/2011**, of 28 January, regulating the structure of the official doctoral studies in Spain.

Direct Entry Bachelor Programs

- Bachelor on Technology and Telecommunications Services.
- Bachelor on Telecommunication Systems Engineering.
- Bachelor on Telematics Engineering.
- Bachelor on Communication Electronics Engineering.
- Bachelor on Data Systems Engineering.
- Bachelor on Electric and Electronics Engineering.
- Any other similar bachelor to previous ones.

ETSIST-UPM @ Madrid

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School of Telecommunication
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