PAINLESS

Energy-autonomous portable access points for infrastructure-less networks

Grant agreement no. 812991
H2020-MSCA-ITN-2018

ITN - Innovative Training Network

D4.1– Training activities and career development planning

WP 4 – Training and Mobility

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Contributors:	All beneficiaries	

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PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

History table

Version	Date	Released by	Comments
V1	23/11/2019	Elena Gatti	Initial version
V2	24/11/2019	Emad Alsusa	Updated version

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Key word list

Mobility and training, career development plans, secondments.

Definitions and acronyms

Acronyms	Definitions
ESR	Early Stage Researcher
WP	Work Package
CDP	Career Development Plan
CB	Supervisory Board

1 ESRs Career Plans

1.1 Introduction

The aim of the Career Development Plan (CDP) is to identify the ESRs' mid-range career goals and the skills and training required to achieve them. As such, all ESRs were asked to complete a CDP in consultation with their supervisors and the PAINLESS secondment coordinator.

The information in the CDPs helps the Supervisory Board (SB) refine the training that would benefit all the ESRs as a group and helps the supervisors tailor individual training plans to the needs of their ESRs.

1.2 Process

A template has been circulated among the beneficiaries with UCL providing guidance and support. A deadline of 15/11/2019 has been agreed for all CDPs to be completed by. The ESRs in consultation with their respective supervisors were responsible to complete their own CDPs.

1.3 Progress

The CDPs have been completed by all ESRs by the agreed deadline and collected by UCL (as coordinator) in preparation for the Review Meeting. A copy of the CDPs is available on the shared drive accessible by all partners.

2 Overview of Training and Mobility Activities

2.1 Introduction

One of the aims of the Painless training program is to prepare and support the ESRs in their quest to devise and implement innovative solutions towards the realization of future energy-neutral wireless communication networks. As such, one of the objectives has been to provide the young researchers with, both, technical skills such as fundamental knowledge in wireless communication networks and energy systems, and, non-technical skills covering a broad range of commercial and social aspects to improve their career prospects and acceleration.

Moreover, since all ESRs are enrolled in a PhD program at their academic host institution the training program includes both locally organized activities and courses, within the participants' local graduate programs, as well as the Painless network-wide activities, such as Workshops, tutorials and Summer Schools. Furthermore, the PAINLESS consortium values the importance of secondments to enrich the ESRs experience and learning outcomes which is why it integrate in each ESR's research project and mobility plan, as detailed below.

2.2 Secondments Plan and Progress

The secondment plan agreed between the partners aims to allow each ESR to have exposure to relevant world-class industries and Universities to expand their horizons and learn alternative practices. To achieve maximum benefit, the allocation of the secondments for each ESR is

based on a well-defined research program which takes into account the experience and background of the home and host partners.

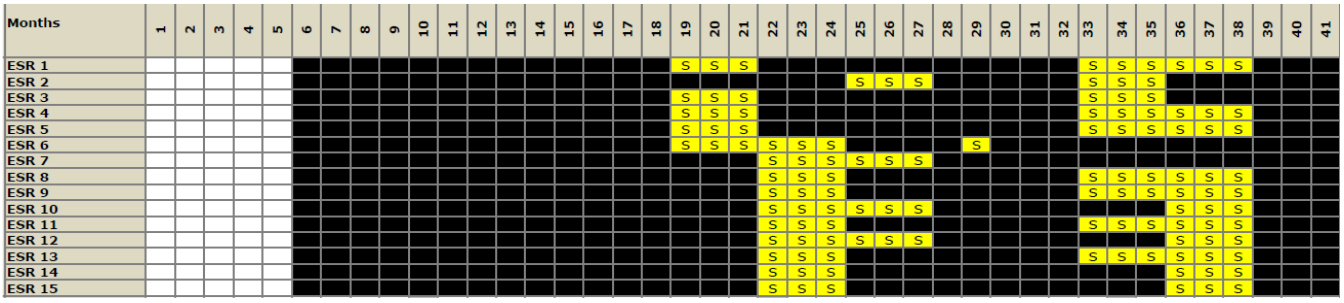
The agreed secondment plan is summarised in Table 2.1 below, where the minimum duration per secondment is 3 months and the maximum is 6 months as summarised in Table 2.2.

Due to the relatively recent start dates for most ESRs, no secondments have commenced yet with the original plans so far remaining unchanged as detailed in Tables 2.1 and 2.2. It is anticipated that some arrangements will be confirmed by early spring 2020 for a start in the summer of the same year for some ESRs followed by another batch in the following winter. Any changes that might occur will be reported in the future reports.

Table 2.1. Planned ESR Secondments

ESRs	Name	Host	1st Supervisor	2nd Supervisor	Secondments
1	Iman Valiulahi	UCL	Christos Masouros	John Mitchell	LYRA, NOK
2	Muhammad Haroon Tariq	AIT	Constantinos Papadias	Dimitrios Ntaikos	UCL, AAU
3	Mahshid Javidsharifi	AAU	Dezso Sera	Remus Teodorescu	UCL, NOK
4	Ilias Chrysovergis	UCY	Ioannis Krikidis	Georgios Ellinas	RIO, NOK
5	Arzhang Shanbazi	CNRS	Marco Di Renzo	Petar Popovski	UCL, RESEIWE
6	Mohammad aljraah	UMAN	Emad Alsusa	Daniel So	NOK, UCL
7	Francesco La Marca	NOK	David López-Pérez	Adrian Garcia Rodriguez	UCL, UPF
8	Marco Virgili	LYRA	Pete James	Rebecca Todd	UCL, UMAN
9	Xiaoye Jing	UCL	Christos Masouros	Sarah Spurgeon	ORION, AIT
10	Nithin Babhu	AIT	Constantinos Papadias	Dimitrios Ntaikos	NOK, AAU
11	Eloise De Carvalho Rodrigues	NOK	David López-Pérez	Lorenzo Galati Giordano	UPF, AIT
12	Yuan Guo	UCY	Ioannis Krikidis	Georgios Ellinas	LYRA, RIO
13	Abdelhamed Mohamed	CNRS	Marco Di Renzo	Emmanouil Kafetzakis	ORION, UCY
14	Mahmoud Alaaldeen	UMAN	Emad Alsusa	Khairi Hamdi	AIT, CNRS
15	Igor Donevski	AAU	Jimmy Jessen Nielsen	Petar Popovski	CNRS, RESEIWE

Table 2.2 Current agreed secondment periods and dates



2.3 Training events

2.3.1 Introduction

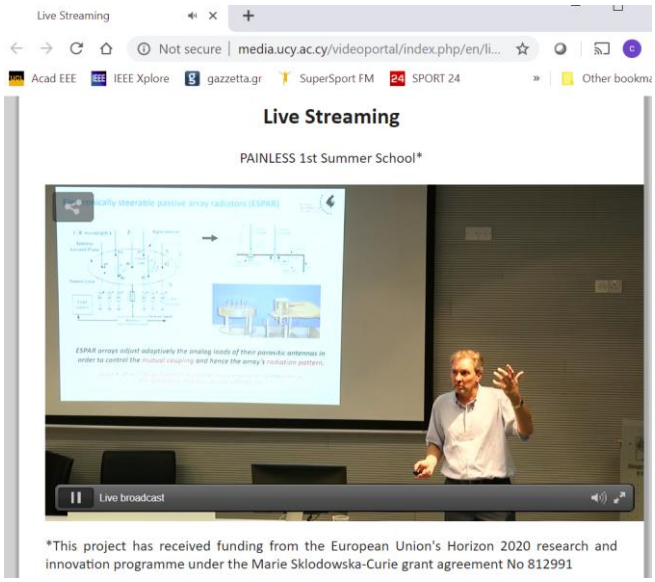
The Painless training programme, which is detailed in section 1.2.1.1 of the proposal will be delivered through Painless-networkwide training and local partners' organisations, and be captured within two types of activites:

1) **Technical course modules** taylored towards the key scientific components underpinning the research theme of the Painless Project, which includes fundamental concepts in Wireless communications and energy harvesting as well as advanced mathematical and simulation tools.
2) **Transferable skills**, which includes interpersonal and communication skills as well as a host of managment and entrepreneurship courses

2.3.2 Progress

The following courses and seminars have been provided during the 1st Summer School in September 9-13, 2019, Nicosia, Cyprus), which was atended by 66 candidates, including the 15 Painless ESRs. All sessions have been video recorded and made available for public Access along with the course material.

Technical session By David Lopez from NOK.



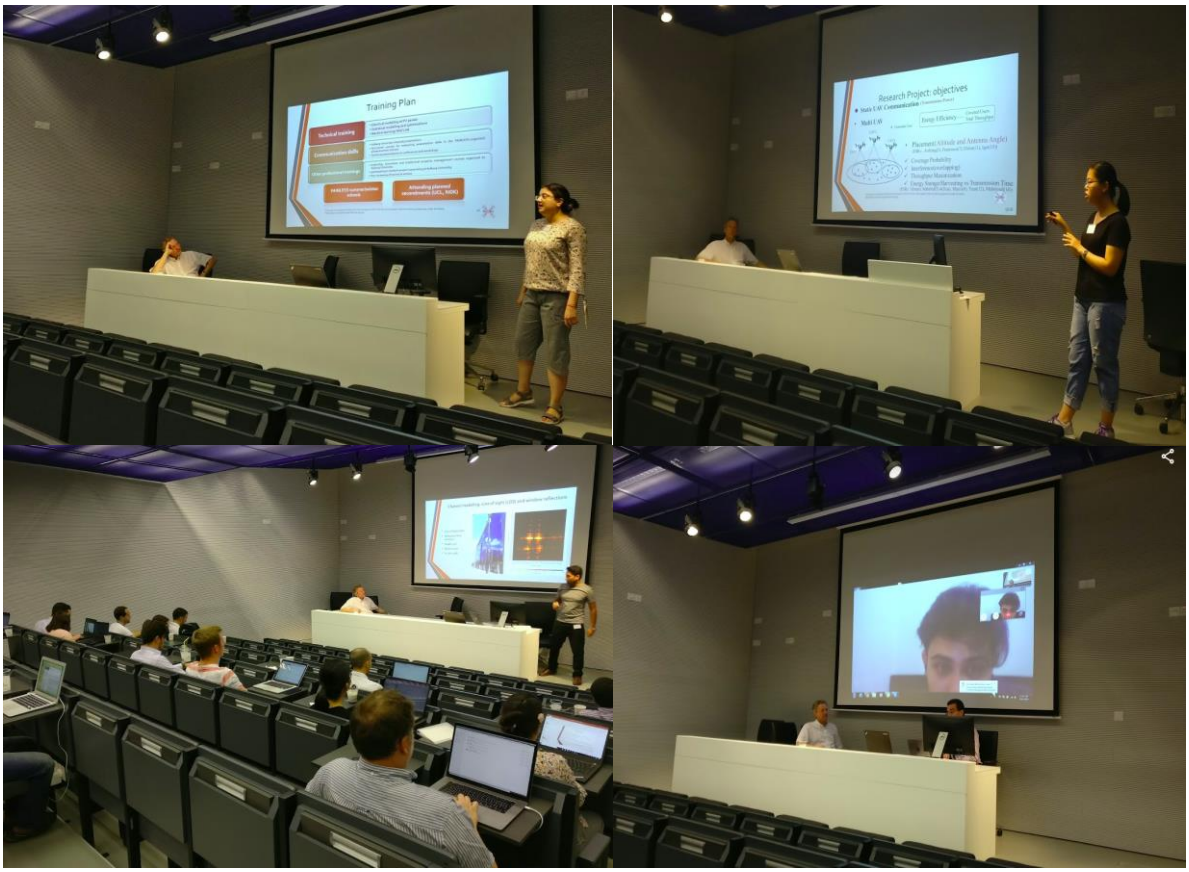
Live streaming of technical session by Constantinos Papadias from AIT

Courses on Scientific/Technical Skills

- Fundamentals of Wireless Networks by David Lopez Perez from NOK, (1.5 Hrs)
- Antennas, Antenna Systems & Radio Propagation In Next Generation Communication Systems- Part I, by Dimitris Ntaikos from AIT, (1.5 Hrs)
- Antennas, Antenna Systems & Radio Propagation In Next Generation Communication Systems- Part II, by Constantinos Papadias from AIT, (1.5 Hrs)
- Radio Resource Management – from LTE towards 5G, by Konstantinos Ntougias from AIT, (1.5 Hrs)
- Fundamentals of UAV communication s by Adrian Garcia Rodriguez from NOK, (1.5Hrs)
- Wireless Backhaul-Fronthaul I, by Emad Alsusa from UMAN, (1 Hr)
- Wireless Backhaul-Fronthaul II, by Lorenzo Galati Giordano from NOK, (1 Hr)
- Wireless powered communication by Ioannis Krikidis from UCY, (1.5 Hrs)

Courses on Transferable Skills

- Writing, Reviewing and Presenting Scientific Work, by Dimitris Ntaikos from AIT, (1.5 Hrs)
- Presentation Practice and feedback, by All Supervisors, (5 Hrs)

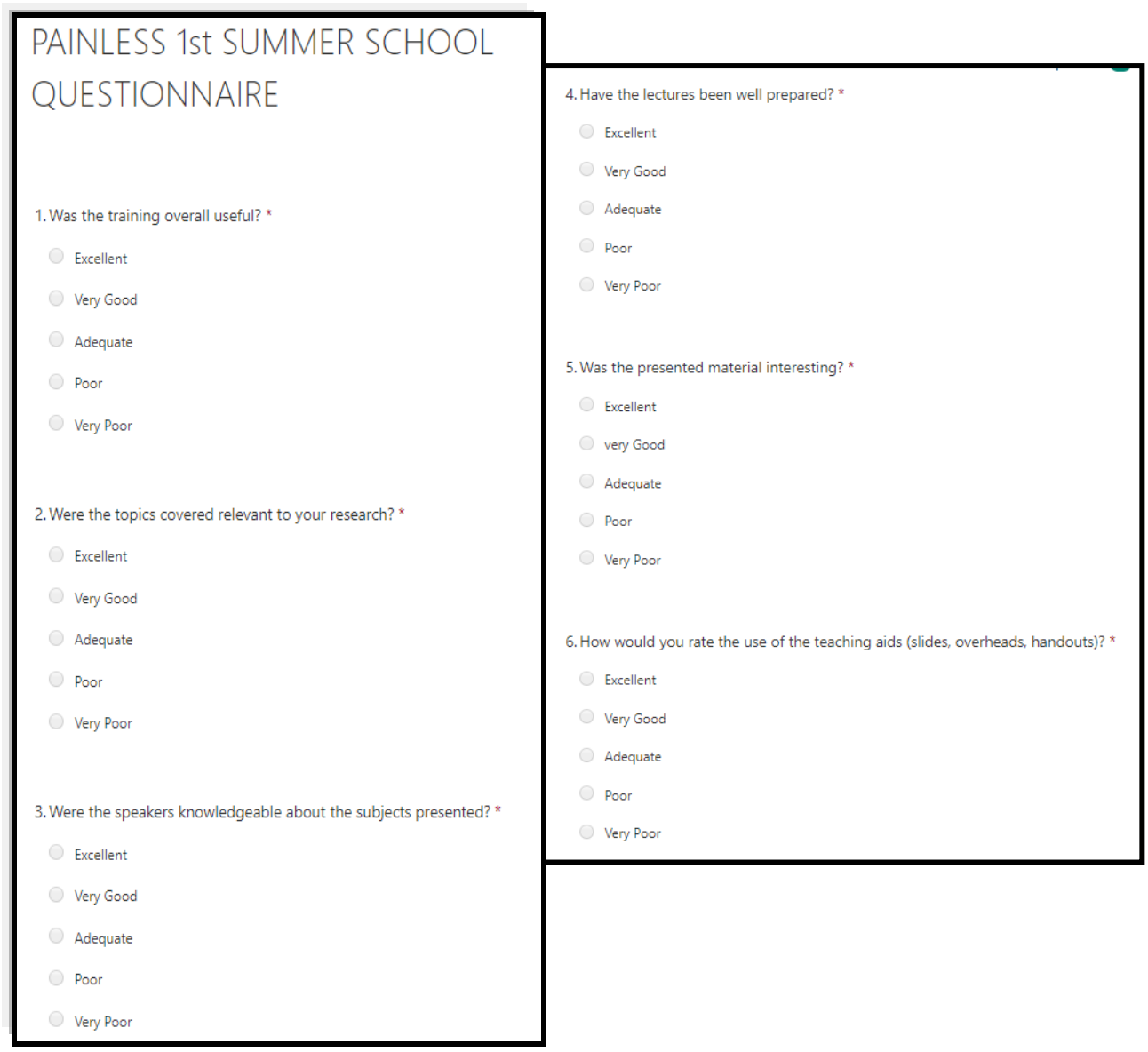


Other courses completed at local participating Universities include:

- ESR9 has competed a course on English thesis writing at UCL
- ESRs 7 and 11 have completed the following courses at NOK
    - Coursera – Machine Learning. Offered by Stanford. Instructor Andrew Ng. Certificate achieved on the 16/08/2019.
    - Summer School on Machine Learning for Communication Systems and Networks. Offered by Connect Centre (Trinity College, Dublin). Certificate achieved on the 04/09/2019.
    - Nokia Training – "An introduction to the foundations of AI/ML" – November 6th
    - Nokia Training – Respect - Helping us sustain a harassment free workplace
    - Nokia Training – Information Security
    - Nokia Training – Ethical Business Training 2019
    - Nokia Training – Inclusion at Nokia: Moving beyond bias
- ESR15, has attended the following courses from the AAU doctoral school:
    - Introduction to PhD
    - Python for Scientific Computing

- High performance computing in Python

To assess the usefulness of the first summer school program, a survey questionaire was conducted. Twnety six responses were received out of which 19 found the training as excellent while 21 found the lectures were well prepared. For further details see snapshots below.



PAINLESS 1st SUMMER SCHOOL QUESTIONNAIRE

1. Was the training overall useful? *
- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

2. Were the topics covered relevant to your research? *
- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

3. Were the speakers knowledgeable about the subjects presented? *
- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

4. Have the lectures been well prepared? *
- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

5. Was the presented material interesting? *
- Excellent
- very Good
- Adequate
- Poor
- Very Poor

6. How would you rate the use of the teaching aids (slides, overheads, handouts)? *
- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

7. Was the time allotted for the training sufficient? *

- Excellent
- Very Good
- Adequate
- Poor
- Very Poor

8. Were the meeting rooms and facilities adequate? *

- Excellent
- Very Good
- Adeguate
- Poor
- Very Poor

9. What did you like most about this training? *

Inserisci la risposta

10. What aspects of the training could be improved? *

Inserisci la risposta

11. Which topics would you suggest for next school? *

Inserisci la risposta

12. Please share other comments or expand on previous responses here: *

Inserisci la risposta

1. Was the training overall useful?

Altri dettagli

Excellent	19
Very Good	4
Adequate	4
Poor	0
Very Poor	0

2. Were the topics covered relevant to your research?

Altri dettagli

Excellent	12
Very Good	10
Adequate	3
Poor	2
Very Poor	0

3. Were the speakers knowledgeable about the subjects presented?

Altri dettagli

Excellent	22
Very Good	5
Adequate	0
Poor	0
Very Poor	0

4. Have the lectures been well prepared?

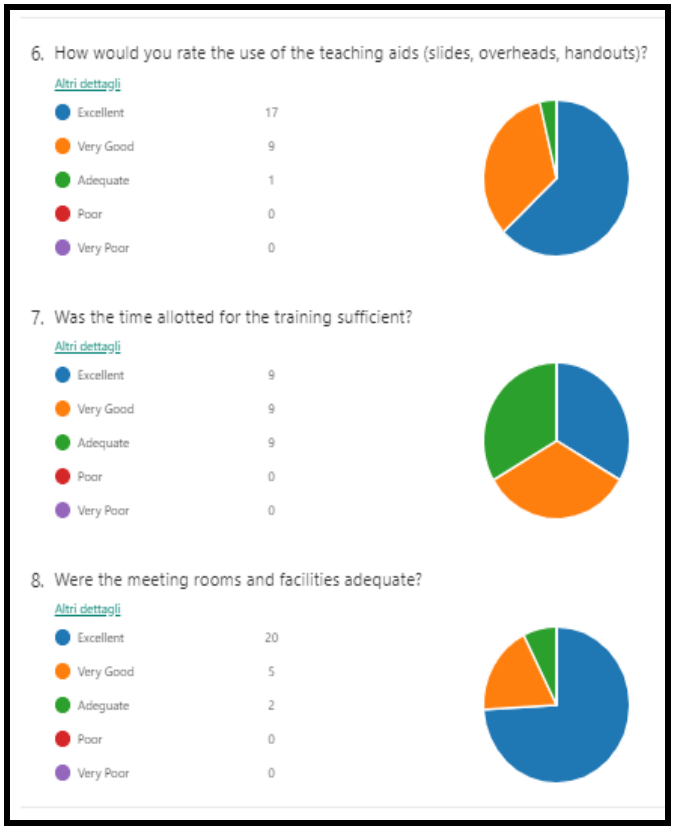
Altri dettagli

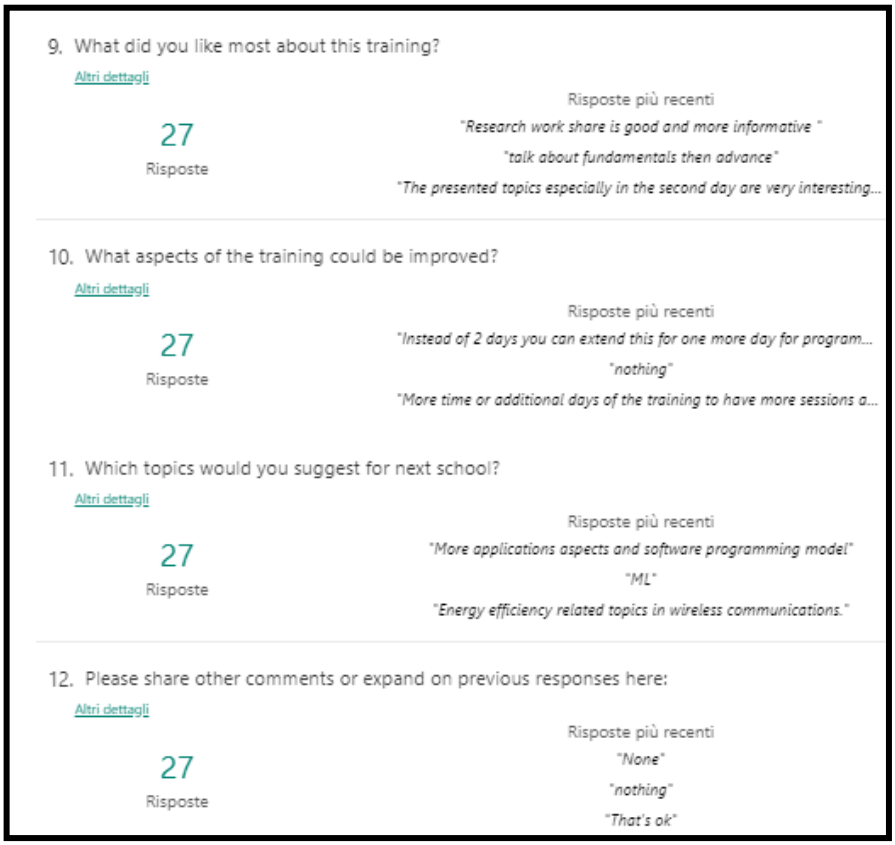
Excellent	21
Very Good	5
Adequate	1
Poor	0
Very Poor	0

5. Was the presented material interesting?

Altri dettagli

Excellent	17
very Good	8
Adequate	2
Poor	0
Very Poor	0





3 Appendix

Below are the individual Career Development Plans of the 15 PAINLESS ESRs.

Career Development Plan for the 1st and 2nd year

Name of ESR: Iman Valiulahi

Department: Department of Electronic & Electricity Engineering

Name of Supervisor: Christos Masouros

Name of Tutor:

Starting Date: 16/09/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS:

Study of optimal and suboptimal transmission for aerial BSs(UAV), based on energy availability constraints with the help of digital signal processing. The study will built models for UAV communication. Based on communication formulation, coverage with energy optimization, interference management with cooperative communication, trajectory and UAV placement with energy efficiency and power control will be considered. A number of scenarios with UAV application will be included.

EXPECTED (half page should be sufficient):

- **Model built:**
  1) User distribution model

We aim to incorporate the distribution model of users into our system design. We know in advance that users follow specifics models such as Poisson Process, Gaussian Distribution and Random Distribution. It would be beneficial to take advantage of this prior information in our design.

2) Transmission model

In the UAV communication, we need to make a connection between users with aerial base stations. Thus, an air-to-ground path should be considered.

3) Energy model

Battery based devices are not suitable in our goal. Therefore, to achieve a long-term connection, we need to collect energy from the environment. We need to find models of collecting and storing the energy.

- **Energy balancing with UAV placement techniques**

Energy balancing is a paramount important when we deal with UAV. We will employ realistic models for energy generation and storage, based on measurements of existing small base stations and EH equipment owned by partners (NOK, LYRA, AAU). These will then be used to build an analytical energy optimisation framework for ensuring energy balancing in a number of practical scenarios, and determine fundamental limits of transmission constrained on energy neutrality.

- **Energy efficiency optimization:**

As part of this work, analytical conditions for energy neutrality will be derived for a number of HetNet scenarios. The work will incorporate performance metrics based on energy autonomy, and span from link-level scenarios to multi-user and multi-cell HetNet transmission.

- **Power control techniques with interference constraint:**

Dealing with multi UAV faces issues, such as providing a specific QoS, maximum coverage, interference control and power allocation. To address all these concerns, we need to take into account additional constraints on the optimization problem, increasing the complexity of the problem.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:**
   - **Professional goals:**
     1) Interact with other researchers and professors;
     2) Think and solve problems independently;
     3) learn to supervise other researchers;
     4) Multidisciplinary technical skills, networking and industrial experience, improved employability
   - **Career goals:**
     1) Working in high prestigious companies as a researcher in the UAV communication field.
     2) Developing the skills to publish the papers and pursuing UAV research field as Post-Doc.
     3) Finding a permanent position such as a professor position in the field of communication system at a good university.
2. **What further research activity or other training is needed to attain these goals?**
   - **Research activities**
     1) The UAV communication framework is closely related to the filed of optimization;
     2) Great knowledge in other fields such as IOT will be built.
     3) Research Outcomes:
        The aim is to publish two or three papers in high prestigious communication journals such as IEEE transactions on wireless communication.
        Attending IEEE conferences such as GLOBECOM/ICC/ICASSP/ ISWCS by publishing papers.

     The ESR will improving his academic ability in the research field by publishing research outcomes, which will help him to enhance technical ability and academic writing.
   - **Other trainings**
     1) The ESR will attend trainings about career development, academic study and presentation skills in UCL and Europe;
     2) The ESR will attend trainings, discussions and meetings with other leading researchers in PAINLESS, such as summer schools and winter schools;

The ESR has two secondments: 6 months in NOKIA to develop and assess the analytical energy models and optimisation in NOK's SL. 3 months in LYRA to develop models for energy storage, and work on advanced energy optimisation algorithms.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:**
  Publish at least one first-authored papers in IEEE transactions/journals
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:**
  1) Publish one or two papers on IEEE conferences such as GLOBECOM/ICC/ICASSP/ ISWCS;
  2) Attending workshops and other activities organised in PAINLESS and adjacent projects.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc.

- **Technical skills:**
  1) Mathematics approaches about optimization, such as convex function and low complexity algorithm for implementing the optimization problems.
  2) The project is closely related to wireless communication, it would be beneficial to take the courses "Wireless Communication principals" and "Mobile Communication" presented by UCL.
- **Non-technical skills:**
  1) Writing courses, such as "Academic Writing" presented at UCL.
  2) Developing the presentation skills by presenting the achieved results to academic and non-academic people;
  3) Developing social skills during group activities.

3. Communication skills:

The ESR will enhance his scientific writing and presentation ability. Also obtain experience in writing academic papers and presenting research outputs in conferences and seminars. Through trainings in PAINLESS project, the ESR will improve his ability about presenting own research and ideas with others.

4. Other professional training (course work, teaching activity):

1) During the PAINLESS summer and winter schools, the ESR will obtain more teaching activities.
2) The ESR will also attend teaching-related training in Dept. of Electronic & Electricity Eng. at UCL.

5. Anticipated networking opportunities

During the project of PAINLESS, the ESR will have the opportunity to collaborate with world renowned UAV and communication experts.

6. Other activities (community, etc.) with professional relevance:

Participation in professional conference and seminars in wireless communication in the UK and Europe.

Date & Signature of ESR: Iman Valiulahi-05/11/2019

Date & Signature of Supervisor: Christos Masouros 06/11/2019

Career Development Plan for the 1st and 2nd year

Name of ESR: Muhammad Haroon Tariq (ESR-2)

Department: Broadband Wireless & Sensor Networks Research Lab (B-WiSE) Athens Information Technology, AIT

Name of Supervisor: Dr. Constantinos Papadias

Name of Tutor: Dr. Elisabeth de Carvalho

Starting Date: May 03, 2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

The demand for wireless broadband services has increased manifold especially over the last decade and the trend continues in this direction. At the same time, with technological advancements the smartphones, tablets and other mobile gadgets with powerful multimedia capabilities are becoming increasingly popular. In order to keep up with the growing 5G communication network must support enhanced Mobile Broadband services.The problem of backhauling of the envisioned portable access points (PAP) of the network will be studied. Since the PAPs will have to operate in different environments (e.g. urban / sub-urban / rural, high / low height, high / low interference, special venues such as sports or emergency sites, etc.), it is important that their wireless backhaul links are adaptive to such conditions. Moreover, the backhaul link must be reliable, high rate and ideally low-latency (especially for critical situations such as emergency events but also for all real-time end user applications). The study will hence focus on mm wave frequencies, which allow wide bandwidth, as well as on adaptive hardware efficient antenna arrays at such frequencies, in order to tackle the propagation and interference environment. The latter will have to be modelled according to the scenarios of interest, whereas the derived techniques and solutions will have to be robust to the frequency selectivity of the wideband propagation channel. The work will hence target both the design of wideband antenna arrays for the considered frequencies and the development of adaptive, interference-aware wireless communication techniques for the PAP backhaul.The derived techniques will be analyzed and simulated over 5G-type air interfaces, with emphasis on low-latency communication protocols.

EXPECTED (half page should be sufficient):

System definitions and cooperation framework for mmWave backhaul channels.
Channel and interference modelling for mm wave wideband backhaul links
Production of performance assured backhauling services with high data rates, unified synchronization and improved quality of experience.

Study and analysis of Techniques for Reconfiguration and dynamic switching.
Design of wideband antenna arrays for the backhauling of portable Access Points.
Performance analysis for Energy Harvesting.
Development of adaptive communication techniques for wideband backhauling.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** Research and Development, Academics (positions in the field of Wireless communications for 5G and beyond)
2. **What further research activity or other training is needed to attain thesegoals?** Long stay industrial internships. Training sections on state of the art hardware and software.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** IEEE Wireless Communications Letters, Transactions, journals
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** PAINLESS first summer school at the University of Cyprus.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc: Channel modeling and measurements for mmWaves using Teragraph Sounder Nodes

3. **Communication skills:** Presentations for Internship programs, Lectures for the Indian students.

4. **Other professional training (course work, teaching activity):** Academic Advisor to the Students for Indian Summer School Internship Program organized by AIT.
5. **Anticipated networking opportunities**
6. **Other activities (community, etc) with professional relevance:** Cultural (language, Traditions) exchange with Greek colleagues and Indian students. Trips to some known places of Greece, Islands and Athens downtown.

Date & Signature of ESR:

Aug. 5, 2019 2019

Muhammad Haroon Tariq

Date & Signature of Supervisor

Aug. 5, 2019

Constantinos B. Papadias

Career Development Plan for the 1st and 2nd year

Name of ESR: Mahshid Javidsharifi

Department: Aalborg University, Department of Energy Technology

Name of Supervisor: Dezso Sera

Name of Tutor:

Starting Date: 02/07/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

Stand-alone base stations powered by renewable energies such as the solar power have emerged as a promising solution to address the issues of reducing the carbon footprint of the telecom industry as well as that of high operational cost associated with powering such BSs. Accordingly, the main objectives can be summarized as follows:

1. Dimensioning of the PV cells and batteries to achieve the optimum size and technical criteria of a stand-alone solar-powered BSs that ensures 100% energy autonomy and long-term energy balance for it. For this purpose, the traffic demand and the weather characteristics should be appropriately modelled by taking a probabilistic approach. Accordingly, an optimization problem will be solved in which cost and reliability can be considered as indices while the battery depth of discharge (DoD) is a crucial constraint. In addition, investigating the long-term operation of solar-based BSs in which determining a reasonable time slot along with the modelling procedure of solar-powered BSs' components are of great importance.

2. Suggesting a lifetime optimization framework for off-grid solar-based BSs taking into account comprehensive aging model of battery to predict battery service period precisely.

3. Applying drone-based BSs in order to minimize the total energy consumption of the networks while maintaining the network coverage and connectivity during low and high traffic periods.

4. Proposing an efficient energy management system such that no energy waste (resulting from the situations where battery is full and the excess power of the PV cells cannot be stored) happens and no service interruption (when the PV panel is not producing enough power, and the battery is empty; in this situation, the BS must be turned off) occurs.

5. Proposing a robust control strategy for the PV panels' MPPT and power conditioner. In this regard, the proposed MPPT method should be adaptive to irradiance and temperature sudden changes. Besides, the power converter should be robust against inherent and inevitable uncertainties of the solar-based BSs and rapid changes in parameters.

The significance and expected outcomes of the project are listed as:

1) A comprehensive modelling, design and analysis method for power management of PV/battery powered BSs. The proposed model is expected to improve the performance of the communication network.

2) An energy management policy, which takes efficient decisions about charging/discharging of the battery, depending on PV generation and real time traffic load. The suggested policy will results in a significant cost reduction for the mobile network operators.

3) An applicable structure to both drone and ground-based BSs. When the ground infrastructure is subject to damage by natural disasters, or for temporary/unexpected high-traffic demand situations to maintain the QoS level, solar-powered drone BSs are expected to be made use of.

EXPECTED (half page should be sufficient):

As a result of the mentioned overview, the ESR is expected to:

1. Satisfy all the requirements set by Aalborg University to obtain a PhD degree upon finalization of the research project.

2. Publish the outcome of the research in at least 3 technical journal articles.

3. Participate in at least 3 top IEEE-organized conferences to present the achieved results.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals:

The most relevant long-term career goals to make the ESR suitable for a range of technically skilled roles within the industry and academia are:

a) Being internationally recognized as a technical expert in the areas of Photovoltaic systems and PV supply for base stations (ground-based and drone-based BSs), PV supply for ships and Nano satellites.

b) Being a member of a distinguished organization in a leadership position to take advantage of the training acquired during the EU project PAINLESS and to further follow the project objectives.

2. What further research activity or other training is needed to attain these goals?

The key research elements outlined in the first section will need to be carried out.

In terms of training, further technical courses or personal study will be required in the areas mentioned in the subsection **'2. Research Skills and techniques'**, below.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** 1 submitted journal article
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** 1 submitted article to present at a technical conference

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc:

Achievements in technical expertise on the following scopes:
1. Energy/power consumption aspects of wireless Communication Systems
2. Electrical modelling of PV panels
3. Statistical modelling and optimizations
4. Solar resource modelling
5. MPPT and control of power electronic converters
6. Programming languages (MATLAB/Simulink/PLECS)

3. Communication skills:

In order to expand her communication skills, the ESR's will perform following activities as part of her training:
1. Aalborg University internal presentations.
2. Structured courses for enhancing presentation skills in the PAINLESS-organized winter/summer schools.
3. Technical presentations at conferences and workshops

4. Other professional training (course work, teaching activity):

The ESR will participate in leadership, innovation and intellectual property management courses organized at Aalborg University. The ESR will also participate in student project supervising at Aalborg University as well as peer reviewing of technical articles

5. Anticipated networking opportunities

Some networking opportunities can be listed as following:
a) PAINLESS-organized winter/summer schools.
b) Technical conferences and workshops.
c) University secondments at University of Manchester (UMAN) and Nokia Bell Labs (NOK).

6. Other activities (community, etc) with professional relevance:

The ESR will join the IEEE AAU student branch

12/11/2019

Mahshid Javidsharifi

Date & Signature of ESR:

Mahshid Javidsharifi

Date & Signature of Supervisor

13/11/2019

Career Development Plan for the 1st and 2nd year

Name of ESR: Ilias Chrysovergis

Department: University of Cyprus/Electrical & Computer Engineering Department/IRIDA Centre

Name of Supervisor: Ioannis Krikidis

Name of Tutor:

Starting Date: 2nd of September

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED:

The ESR will study sophisticated signal processing techniques that combine wireless power transfer with backscatter communications. This beneficial combination allows the receivers to use a portion of the received signal for energy harvesting, while the remaining portion is modulated through antenna impedance mismatching and reflected back. The first part of this work, is to model the dyadic backscatter channel and study the fundamental limits of this technology by using information theoretic tools. In the second part of this work, the ESR will study advanced signal processing techniques in order to boost the performance in terms of energy harvesting and probability of error; techniques such as MIMO, space-time coding, and spatial modulation will be re-designed for a backscatter communication framework. Finally, the ESR will be also in place to prototype the proposed technical solution in a real and complete simulation environment, by importing data from current cellular networks provided from 3GPP models.

The technology of backscatter communications has high impact on machine-to-machine communications (sensor networks, smart cities, smart homes, environmental monitoring, e-health etc). It allows a vast number of low-power devices to communicate by modulating ambient signals. In this ESR project, we will also study the related topic of passive intelligent reflecting surfaces (IRS) which a new technology to improve the spectrum and energy efficiency of future wireless networks. The technical impact of the project is the development of new knowledge in a key technological area (backscatter communications and IRS).

The expected results of the research project are the following:

a. Fundamental limits of wireless powered backscattering communications. For this problem tools like Communication Theory, Information Theory, Probability Theory, Queueing Theory, Scattering Theory and Stochastic Geometry will be used.
b. Enhancement of the energy harvesting and link performance through sophisticated signal processing techniques. In this case, research will be conducted towards Machine Learning, Deep Learning, Convex Optimization and Advanced Signal Processing Techniques.
c. Prototype of cellular wireless powered backscattering system by using real-world 3GPPP data. For the simulation of the system simulation platforms such as MatLab, Game Engines (Unreal Engine and Unity3D) will be used. Also, LabView and SDR implementations are going to be tested.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** By the end of the PhD, the ESR should have acquired a versatile professional profile that makes him suitable for a variety of technically-skilled roles within the industry and academia. As a result, the most relevant long-term career goals are:
    a. Consolidate the ESR's knowledge in Communication Systems/Wireless Communications Theory
    b. Gain Expertise in Machine Learning for Communication Systems

c. Broaden the ESR's horizons in Software Development (Software Defined Radio, Communication System Simulator)
d. Improve the ESR's abilities in Technical Writing (Journal, Conferences, PhD Thesis, Deliverables)
e. Improve the ESR's skills in Presenting Technical Solutions formally and informally
f. Gain Experience on Research for Industry (Nokia Bells Labs, RIO Systems)
g. Develop further Networking/Interpersonal Skills & Expand the ESR's International Network
h. Combine Entrepreneurship with state-of-the-art Research

2. **What further research activity or other training is needed to attain these goals?**
The ESR will study and work independently and in parallel with a research group all over Europe through the PAINLESS. Thus, he will develop skills such as discipline and empathy. He will also attend innovation and entrepreneurship events and conferences in order to close the gap between academia and industry.

SHORT-TERM OBJECTIVES (1 year):

3. **Research results**
- **Anticipated publications:** IEEE Transactions
- **Anticipated conference, workshop attendance, courses, and/or seminar presentations:**
    a. 1st PAINLESS Summer School in Nicosia, Cyprus
    b. 1st PAINLESS Winter School in London, United Kingdom
    c. 2nd PAINLESS Summer School in Manchester, United Kingdom

4. **Research Skills and techniques:**

Training in specific new areas, or technical expertise: Technical expertise to be acquired on the following areas:

a. Advanced topics of Communication Systems (postgraduate course at ECE, UCY)
b. Advanced topic in Probability Theory and Stochastic Geometry for Wireless Communication Systems (independent study, ECE, UCY)
c. Convex Optimization for Wireless Communication Systems (independent study, ECE, UCY)
d. Wireless-Powered Communications (independent study, ECE, UCY)
e. Machine Learning (independent study, ECE, UCY)
f. Tutorials for Software-Defined Radio and Labview/Simulators (independent study, laboratory IRIDA, ECE, UCY)
g. Tutorials for Writing Technical Papers (ECE, UCY)

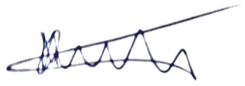
5. **Communication skills:** The following activities/training will be carried out as part of the ESR's training to develop his communication skills:
    a. University of Cyprus, PAINLESS project and IRIDA Centre internal presentations.
    b. Structured courses for enhancing presentation skills in the PAINLESS-organized winter/summer schools and other courses that the ESR will find along with his supervisor.
    c. Technical presentations at conferences, workshops and other events.

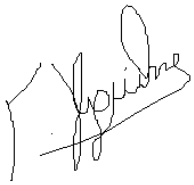
6. **Other professional training (course work, teaching activity):** The ESR will participate in leadership, entrepreneurship and innovation sessions. The ESR will also participate in the peer reviewing of technical articles.

7. **Anticipated networking opportunities:** The ESR will have the following networking opportunities:
    a. PAINLESS-organized winter/summer schools.
    b. Technical conferences and workshops
    c. Industry secondments at RIO Systems and Nokia Bell Labs
    d. IRIDA Centre Meetings
    e. Start-up, Innovation and Entrepreneurship Events
    f. Engineering Organizations Events

8. **Other activities (community, etc) with professional relevance:** The ESR will join associations such as the Institute of Electrical and Electronics Engineers (IEEE), Fédération des Ingénieurs des Télécommunications de la Communauté Européenne (FITCE) and Association for Computing Machinery (ACM) as a student member.

Date & Signature of ESR: 03/09/2019 **Date & Signature of Supervisor:** 03/09/2019





Career Development Plan for the 1st and 2nd year

Name of ESR: Arzhang Shahbazi (ESR 5)

Department: CNRS

Name of Supervisor: Marco Di Renzo

Name of Tutor: -

Starting Date: 10/07/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

The availability and reliability of the power grid is set to become a major bottleneck in providing connectivity in future generations of wireless networks. In developing countries, the booming of mobile networks cannot be accommodated due to the limited power grid infrastructure. In the developed world similar requirements arise in emergency network deployment for rapid connectivity provisioning in disaster areas, as well as in broadband provisioning in massive-scale social events such as sports events and concerts, with limited access to power grid. The pursuit of such technological solutions is further motivated by the emerging unmanned aerial vehicle (UAV) applications in rapidly-deployable communication networks. When a natural disaster / accident impedes infrastructure (transport, communications and power), drones can be deployed quickly to survey the area for search and rescue, to deliver supplies for first aid and to provide emergency communications.

My role in this research project is heavily involved in the Work Package 3 (WP3): To propose new architecture solutions and assess their fundamental communication-theoretic performance for enabling the “wireless wireless networking” vision, the realisation of the next generation of small dense cellular networks made of terrestrial and aerial (drones) base stations that require neither power generators nor wired connection for backhauling. Development of a new mathematical theory for analysing ultra-dense small cell deployments in 3D settings based on stochastic geometry and random shape theory.

EXPECTED:
The main expected results of my project are summarized as follows:

- Conceive new mathematical methodologies for system-level analysis and optimization of tethered and untethered UAVs equipped with renewable energy sources
- Provide design insights for system-level optimisation of UAVs by considering the height of surrounding buildings (and UAVs)
- Introduce novel mathematical methods for modeling and optimizing communication systems with UAVs and reconfigurable intelligent surfaces
- Identification of promising architectural designs based on energy-neutral based stations, wireless front haul based on massive MIMO, integration of low and high frequency transmission technologies.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals:

The achievement of three-year research work and my PhD program will encourage me to go forward in my research career. It will provide me several opportunities to obtain potential research positions in reputational academic institute as an independent researcher or lecturer. In addition, some practical skills and experience attained in my PhD training sessions also offer me the opportunity to become an engineer in telecommunication enterprises. I will try my best to make contributions to society and realize my personal values.

2. What further research activity or other training is needed to attain these goals?

First Year (2019-2020):

- Attending courses offered by CentraleSupélec and CNRS which are included in the syllabus of the Master's program "Systèmes Avancés de Radiocommunications" (SAR). To be specific, the SAR courses I intend to participate are,
    - Stochastic Geometry for Wireless Networks: Fundamentals and Applications
    - Physical and Statistical Modeling of Wireless Channels
    - Random Matrix Theory
    - 5G Networks and Machine Learning
    - Machine Learning for Future Networks
- Participation to all PhD courses, tutorials, seminars, workshops, and international conferences within the framework of the PAINLESS project will be valuable training activities. In particular, the conferences that I plan to participate are,
    - IEEE VTC 2020: IEEE Vehicular Technology Conference 2020
    - IEEE ICC 2020: IEEE International Conference on Communications 2020

Second Year (2020-2021):

- Attending top level international conferences, workshops which are related to my research area. The two conferences that I will attend are,
    - IEEE ICC 2021: IEEE International Conference on Communications 2021
    - IEEE GLOBECOM 2021: IEEE Global Communications Conference 2021
- Collaborating with other ESRs is to strengthen background knowledge not only for me but also for all ESRs. This goal will be achieved through my secondments in Denmark and Cyprus.

Third Year (2021-2022):

- Visiting other institutions inside the PAINLESS project will be beneficial as well for me to learn how to conduct scientific researches.

SHORT-TERM OBJECTIVES (1 year):

1. **Research result**

   Anticipated publications:

   For the first year, a quantitative target has already been set to 1 submitted journal paper.

   Anticipated conference, workshop attendance, courses, and /or seminar presentations:

   The goal is to have 1 published conference paper in a high-quality conference and to attend the conference and present the research work there (as described above).

2. **Research Skills and techniques:**

   For the first year, I will mainly focus on the topics such as stochastic geometry, different channel models for UAV communication systems including untethered and tethered UAVs, optimization of UAV's altitude and implementation of Reconfigurable Intelligent Surfaces for UAV communication system.

3. **Training in specific new areas, or technical expertise etc:**

   I expect to enhance particularly the academic writing skills by writing deliverables, project proposals, and scientific publications. I expect that several seminars and complementary courses within the project framework will enable me to develop abilities to write proposals, find partners, get funds, build teams and manage projects.

4. **Communication skills:**

   Presentation skills are significant for nowadays' scientific and theoretical findings. By participating the complementary courses like "Writing scientific papers" and "Presentation techniques" offered by the PAINLESS project, I expect to build solid skills to present my research work.

5. **Other professional training (course work, teaching activity):**

   I will attend some courses from the PAINLESS project on "Innovation, Project and Risk Management" and "Entrepreneurship and venture capital" courses with the goal of creating a business from research and intellectual property (IP) and how to bring ideas to products. Also, I will attend "Applying for research fellowships" and "Interview Coaching" to enhance my skills on turning a research idea into a proposal and improve my experience for post doctorate level interview and what research employers are looking for during the recruitment process.

6. **Anticipated networking opportunities**

   As described in the project, my secondments throughout the project will provide good networking opportunities. The secondments are as follows:

   - UCY – 3 months: To develop innovative optimization techniques that account for renewable energy sources, wireless power transfer, and drones.
   - RESEIWE – 6 months: To test a number of techniques on the drone testbed, and collaborate on stochastic beamforming.

Other networking opportunities will be the plenary meetings and the training schools organized by the PAINLESS project.

7. **Other activities (community, etc) with professional relevance:**
   I will participate in public engagement events, to disseminate my research findings to the public-at-large (e.g., science festivals, MSCA researchers' nights, Fête de la science, videos, STEM activities, etc.).

Date & Signature of ESR:

1 November 2019

Date & Signature of Supervisor

1 November 2019

Career Development Plan for the 1st and 2nd year

Name of ESR: Mohammad Ahmad Mohammad Al-Jarrah

Department: Electrical and Electronic Engineering

Name of Supervisor: Dr. Emad Alsusa

Name of Tutor: Dr. Daniel So

Starting Date: 15-Oct-2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

The project considers different aspects of backhauling and cell planning for energy neutral networks (ENNs). Generally speaking, the high data rates demand and expected massive number of connected users to internet will definitely increase the amount of backhaul traffic between the basestations and corenetwork. Therefore, the currently existing communication technologies and network infrastructures may not guarantee satisfying the prospective quality of service (QoS). Consequently, spectral-efficient communication technologies and network paradigms have been recently developed; for example, mm-wave communications, free space optical (FSO) communications, massive multiple-input-multiple-output (MIMO), and small-cells network infrastructure. In addition, the need of self-powered basestation, or sometimes called renewable energy basestation (REB), has raised recently, where power harvesting units are used to feed the basestations, aiming to reach energy neutrality.

The two major challenging factors in cellular networks scale-up include 1) the extremely huge amount of backhaul traffic, and 2) the need for frequent handover between REBs. Therefore, analytical energy and traffic overheads for the backhauling are going to be formulated in this project, and the optimum routing protocol will be proposed toward achieving optimized holistic QoS. The optimization process should be subject to energy neutrality. In this context, different network structures are considered include centralised, multi-hop backhaul, and mesh networking, where these structures should be modelled to quantify their trade-offs and derive optimal hybrid backhaul solutions. We will also compare different backhaul technologies for energy neutral networks (ENNs) including mm-wave comunications, FSO, massive MIMO. Furthermore, REB clustering and cooperative transmission techniques from multiple REBs which ensure low-latency handover will be addressed under energy balancing constraints.

Project Objectives:

EXPECTED (half page should be sufficient):

1. New algorithms and optimal cell topologies.
2. Analytical energy and traffic costs and overheads for the backhauling.
3. Optimised routing strategy.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals:

1. Developing technical and personal skills which are beneficial to lead research teams.
2. Obtaining professional training and knowledge which create opportunities in industrial and academic fields.
3. To be a recognized researcher in the field of wireless communications.

2. What further research activity or other training is needed to attain these goals?

1. Extensive self-study and training.
2. Industrial internship.

SHORT-TERM OBJECTIVES (1 year):

1. Research result

- **Anticipated publications:** Publication in IEEE Journal and/or IEEE conference.
- **Anticipated conference, workshop attendance, courses, and /or seminar Presentations:**
  1. Presentation in the 1st Summer school, Cyprus, Sep. 2019. (Accomplished)
  2. Presentations in all of the remaining winter and summer schools.
  3. IEEE International Conference on Communications (ICC), Dublin, Jul. 2020.

2. Research Skills and techniques: Training in specific new areas, or technical expertise etc:

1. Machine learning applications in networks and wireless communications.
2. Advanced cellular networks.
3. Advanced wireless communications: FSO, mm-wave communications, and massive MIMO.

3. Communication skills:

1. Presentation skills.
2. Professional technical writing with English.

4. Other professional training (course work, teaching activity):

1. Self-training on relevant toolboxes of Matlab, and other useful software packages like Maple.
2. Learning Python programming language.

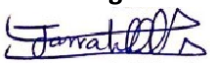
5. Anticipated networking opportunities

1. Attending the planned training schools and secondments.
2. Participating in international workshops and conferences.

6. Other activities (community, etc) with professional relevance:

1. Academic Related Volunteering / Electrical & Electronic Engineering.
2. Support sustainability initiatives.

Date & Signature of ESR:



14-Nov-2019

Date & Signature of Supervisor

Career Development Plan for the 1st and 2nd year

Name of ESR: Francesco La Marca

Department: Nokia Bell Labs: Future Indoor Networks

Name of Supervisor: David Lopez-Perez

Name of Tutor: Giovanni Geraci

Starting Date: 04/06/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (half page should be sufficient):

The main objective of this research project is to design a hyper intelligent wireless network, operating in the unlicensed spectrum, to enable high-capacity and/or low-latency communications in a cost- and energy-effective manner for future enterprise and Industry 4.0 scenarios.
This will be achieved through the design of novel networking paradigms and radio resource management techniques to optimally reuse and operate the large number of spectrum resources available in current unlicensed bands through energy-autonomous portable access points.
Specifically, the ESR will have to:

1. Leverage wireless communications theory—particularly that related to the operation of 802.11 systems operating in the unlicensed spectrum—to devise optimized medium access control (MAC) and physical (PHY) layer techniques. In line with the next generation of 802.11 wireless local area networks, emphasis will be placed on the development of
    a. multi-AP coordination schemes,
    b. multi-antenna techniques, such coordinated beamforming and joint processing, and
    c. spatial reuse enhancements.
2. Create a machine-learning framework to optimize the above-mentioned network operations, as well as critical system parameters, where these techniques will account for the challenging propagation characteristics and traffic demands in such future enterprise and Industry 4.0 scenarios.
3. Utilize and further develop Nokia Bell Labs' system-level simulation tool Ithaca to characterize the fundamental performance limits of the proposed techniques in realistic scenarios.

As a result of the above work, the ESR is expected to:

1. Satisfy all the requirements set by Universitat Pompeu Fabra to obtain a PhD degree upon finalization of the research project.
2. Publish the outcome of the research in at least 3 technical journal articles.
3. Deliver at least 4 high-quality presentations summarizing the results achieved at top IEEE-organized conferences.
4. Being involved in the submission of at least 3 patent application to Nokia's Intellectual Property Rights (IPR) department.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** By the end of the PhD, the ESR should have acquired a versatile professional profile that makes him suitable for a variety of technically-skilled roles within the industry and academia. As a result, the most relevant long-term career goals are:
    a) Being internationally recognized as a technical expert in the areas of wireless communications and machine learning.

b) Work for a prestigious organization where the training acquired during the EU project PAINLESS targets can be leveraged and the project objectives further pursued.
c) Having a highly skilled position in the organization the ESR works for thanks to the technical, leadership, and organization skills acquired during the PhD.

2. **What further research activity or other training is needed to attain these goals?** The ESR will likely have to further specialize—either through structured technical courses or personal study—in one of the technical areas specified below.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** 1 submitted journal article.
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** 1 submitted article to present at a technical conference.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc: Technical expertise to be acquired on the following areas:

1. Wireless communications theory: Through Nokia Bell Labs internal tutorials and resources.
2. Wi-Fi (802.11): Through Nokia Bell Labs internal tutorials and resources.
3. Programming language Matlab: Through Nokia Bell Labs internal tutorials and resources.
4. System-level simulations for wireless communications systems: Through Nokia Bell Labs internal tutorials and resources.
5. Machine learning: Through the online course "Machine Learning" provided by Coursera.
6. Programming language Python: Through Nokia Bell Labs internal tutorials and resources.
7. Technical writing: Through Nokia Bell Labs internal tutorials and resources that include usage of the LaTeX language for technical writing.

3. **Communication skills:** The following activities/training will be carried out as part of the ESR's training to develop their communication skills:
   1. Nokia Bell Labs and Universitat Pompeu Fabra internal presentations.
   2. Structured courses for enhancing presentation skills in the PAINLESS-organized winter/summer schools.
   3. Technical presentations at conferences and workshops.

4. **Other professional training (course work, teaching activity):** The ESR will participate in leadership, innovation and intellectual property management sessions organized at Nokia Bell Labs. Ethic courses will also be taken as per the Nokia code of conduct. The ESR will also participate in the peer reviewing of technical articles.

5. **Anticipated networking opportunities:** The ESR will have at least the following networking opportunities:
   a) PAINLESS-organized winter/summer schools.
   b) Technical conferences and workshops.

c) University secondments at Universitat Pompeu Fabra (UPF) and University College London (UCL).
d) Other research groups within Nokia Bell Labs through face-to-face and teleconference meetings.

6. **Other activities (community, etc) with professional relevance:** The ESR will join the Institute of Electrical and Electronics Engineers (IEEE) association as a student member.

Date & Signature of ESR: **Date & Signature of Supervisor**

Career Development Plan for the 1st and 2nd year

Name of ESR: Marco Virgili

Department: Lyra Electronics R&D

Name of Supervisor: Pete James

Name of Tutor: Rebecca Todd

Starting Date: 01/08/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (half page should be sufficient):

This project will produce an innovative energy storage systems with enhanced characteristics compared with the ones currently on the market: it will last longer, weigh less and be more efficient. Such goal will be achieved customising the design and programming the microcontroller according to the specific requirements of the device. The outdoor scenarios of PAINLESS project will be targeted and the best fitting solution for each of them will not only be designed, but built and tested, in order to have a physical product ready to be used by other PAINLESS researchers to test their discoveries. The energy storage system not only include a battery pack, but also a BMS (Battery Management System) and a charger, as well as any electronic converter that may be needed, depending on the application selected.

A battery sizing algorithm will also be developed, in order to automatise the process of selection of the battery pack. This will be done by implementing sizing techniques and coupling them with a database of the state-of-the-art batteries available in the market. The outcome will be a program that, if fed with the correct information regarding the device to power, will provide the user with the top 3 options available at the moment and a comparison of their characteristics. With the exception of the database, that will need an update from time to time, such program will be reusable by future researchers of the field.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** be an active member of the scientific community, either in an industrial or academic research centre.
2. **What further research activity or other training is needed to attain these goals?** Intensive study and application of state-of-the-art technologies, as well as electronic design and programming techniques.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** One publication about energy storage sizing.
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** Attending PEMD 2020 (International Conference on Power Electronics, Machines and Drives) in Nottingham.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc: Electronic design softwares and techniques (Eagle, Spice…), Microcontroller programming (C language and compilers), Laboratory and measurement techniques, Advanced simulations, Database administration, PCB soldering skills.

3. **Communication skills:** Lectures and workshops on how to write papers and present your work to the scientific community and the general public alike. PAINLESS-organised schools will be of great help.
4. **Other professional training (course work, teaching activity):** working in close contact with other Lyra professionals and learning from them, as well as attending technical and non-technical lectures of the University of Manchester.
5. **Anticipated networking opportunities:** PAINLESS summer and winter schools, international conferences, fellow students at University of Manchester, social media (LinkedIn updates on the project).
6. **Other activities (community, etc) with professional relevance:** joining the Institute of Electrical and Electronics Engineers (IEEE) association as a student member and following Russian and French online courses.

Date & Signature of ESR: **Date & Signature of Supervisor**

Career Development Plan for the 1st and 2nd year

Name of ESR: Xiaoye Jing

Department: Department of Electronic & Electricity Engineering

Name of Supervisor: Christos Masouros

Name of Tutor:

Starting Date: 25/07/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS:

Study of optimal and suboptimal transmission for aerial BSs(UAV), based on energy availability constraints with the help of digital signal processing. The study will built models for UAV communication. Based on communication formulation, coverage with energy optimization, interference management with cooperative communication, trajectory and UAV placement with energy efficiency and power control will be considered. A number of scenarios with UAV application will be included.

EXPECTED (half page should be sufficient):

- **Model built:**
  1) Transmission model
     In the transmission model, an air-to-ground path with both LoS and NLoS should be considered. Also, the attitude and beam angle of UAV are parameters in placement research.
  2) User distribution model
     The distribution of users will also influence optimization problems. Several spatial point processes will be considered, such as Possion Process, Gaussian Distribution and Random Distribution.
  3) Energy model
     a. Energy consumption model;
     b. Energy efficiency model;
     c. Propulsion energy consumption;
     d. Energy harvesting model.
- **Energy efficiency optimization with UAV placement techniques:**
  In single UAV model, select the appropriate flight altitude and beam angle to maximize the coverage area;
  In static multi-UAV scenario, propose a placement model based on energy-efficient communication.
- **Energy efficiency optimization with UAV trajectory techniques:**
  In the moving UAV scenario, study the energy efficiency of the rate maximization and energy minimization taking propulsion energy which is determined by velocity and acceleration into account.
- **Power control techniques with interference constraint:**

Power control techniques is designed in heterogeneous network. The power consumption of the UAV is optimized to satisfy its users' QoS requirement, while limiting its maximum interference to other kind of BS.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:**
   - **Professional goals:**
     1) To develop independent research and thinking abilities;
     2) To build own research framework;
     3) To learn skill of research supervision;
     4) To develop the ability of leading research topic;
     5) Multidisciplinary technical skills, networking and industrial experience, improved employability
     6) Being internationally recognized as a technical expert in the areas of wireless communications and drone networks.

        The ability above will advance the early stage researcher(ESR) to have more opportunities in a research institute.
   - **Career goals:**
     1) Obtain a position in a leading research team or institute and continue the UAV-communication research. Work for a prestigious organization where the training acquired during the EU project PAINLESS targets can be leveraged and the project objectives further pursued.
     2) Having a highly skilled position in the organization the ESR works for thanks to the technical, leadership, and organization skills acquired during the PhD.
2. **What further research activity or other training is needed to attain these goals?**
   - **Research activities**
     1) The UAV communication framework built and transmission optimization;
     2) The application of UAV in different scenarios such as vehicular network, heterogeneous network and IoT.
     3) Research Outcomes:

        Publish 3 or more first-authored papers in IEEE transactions/journals;

        Publish 3 or more papers on IEEE conferences such as GLOBECOM/ICC/ICASSP/ ISWCS

     The ESR will improving her academic ability in the research field by publishing research outcomes, which will help her to enhance technical ability and academic writing.
   - **Other trainings**
     1) The ESR will attend trainings about career development, academic study and presentation skills in UCL and Europe;
     2) The ESR will attend trainings, discussions and meetings with other leading researchers in PAINLESS, such as summer schools and winter schools per year;
     3) The ESR has two secondments: 3 months in ORION to develop and assess the models for drone energy consumption and include in optimizations. 6 months in AIT to advance joint energy balancing and transmission optimization with hardware imperfections models. These will enhance the industrial relevance of her project, and the ability to work in a team.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:**
  Publish 1-3 first-authored papers in IEEE transactions/journals
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:**
  1) Publish 1-2 papers on IEEE conferences such as GLOBECOM/ICC/ICASSP/ ISWCS;
  2) Attending workshops and other activities organised in PAINLESS and adjacent projects.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc:

- **Technical skills:**
  1) Mathematics approaches about optimization, such as convex function, game theory and graph theory;
  2) UAV module built.
- **Non-technical skills:**
  1) Proposal writing, such as UCL training course "Academic Writing: a new method that reduces anxiety";
  2) Presentation, such as UCL training course "Communicating and Presenting Without Stress";
  3) Interview skills.

3. Communication skills:

The ESR will enhance her scientific writing and presentation ability. Also obtain experience in writing academic papers and presenting research outputs in conferences and seminars. Through trainings in PAINLESS project, the ESR will improve her ability about presenting own research and ideas with others.

4. Other professional training (course work, teaching activity):

1) During the PAINLESS summer and winter schools, the ESR will obtain more teaching activities.
2) The ESR will also attend teaching-related training in Dept. of Electronic & Electricity Eng. in UCL.

5. Anticipated networking opportunities

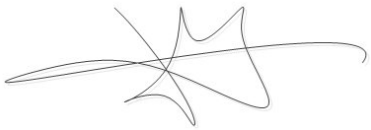
During the project of PAINLESS, the ESR will have the opportunity to collaborate with world renowned UAV and communication experts.

6. Other activities (community, etc) with professional relevance:

Participation in professional conference and seminars in wireless communication in UK and Europe.

Date & Signature of ESR: 敏晓晔 2 Sept 2019 **Date & Signature of Supervisor**

02/09/2019



Career Development Plan for the 1st and 2nd year

Name of ESR: NITHIN BABU (ESR 10)

Department: Athens Information Technology (AIT)

Name of Supervisor: Professor Petar Popovski, Dr. Constantinos B Papadias (co-supervisor)

Name of Tutor:

Starting Date: 01-05-2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

Dynamic frequency planning and spectrum management for portable access : This project will study the problem of dynamic frequency planning and spectrum management for the access segment of the portable access points. Whether the portable access points (PAPs) provide long-term (as in fixed deployments) or short term (as in special / emergency events) service, it is important to allocate them frequency bands for access that do not cause excessive interference to existing fixed or to fellow portable access points. The study will start with the case of standalone PAPs, for which data-base aided frequency allocation will be derived. Then work will continue with the more complex case of several PAPs providing service in a given area, hence potentially interfering with each other. This will be tackled with distributed resource allocation techniques, possibly assisted by a central controller. The techniques will be dynamic, in order to react to the time-varying network and traffic conditions.

EXPECTED (half page should be sufficient):

By the end of the first year, Definition of network architecture for the dynamic frequency planning of the portable access points and development of dynamic frequency planning techniques for standalone portable access points are expected to be completed.

By the end of the second year, Development of dynamic frequency planning and allocation techniques for groups of portable access points is expected to be completed.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** To take up a senior researcher position in the area of wireless communication and signal processing.
2. **What further research activity or other training is needed to attain these goals?**
   Long stay industrial internships. Training sections on state of the art hardware and software.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** one publication in IEEE Communication Letters/ EURASIP Journal on Wireless Communications and Networking.
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** PAINLESS first summer school at the University of Cyprus, 2020 IEEE 21st International Workshop on Signal Processing Advances in Wireless Communications (SPAWC).

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc: Non-Convex optimization techniques, Fractional programming theory. Cellular network simulation using Vienna 5G System Level Simulator.

3. **Communication skills**: Attend lectures related to Writing, Reviewing and Presenting Scientific Work.
4. **Other professional training (course work, teaching activity**): Supervise some of the future interns at AIT. The list of courses to be taken from AAU will be finalized after the enrollment date (1st September 2019).
5. **Anticipated networking opportunities:** First Summer school of PAINLESS, European Researcher's night.
6. **Other activities (community, etc) with professional relevance:** Participate in all the activities organized by the Marie Curie Alumni Association (MCAA) Greek Chapter.

Date & Signature of ESR:

August 5, 2019

Nithin Babu

Date & Signature of Supervisor

August 5, 2019

Constantinos B. Papadias

Career Development Plan for the 1st and 2nd year

Name of ESR: Eloise de Carvalho Rodrigues

Department: Nokia Bell Labs: Future Indoor Networks

Name of Supervisor: Adrian Garcia Rodriguez

Name of Tutor: Giovanni Geraci

Starting Date: 04/06/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (half page should be sufficient):

The key target of the research project is to design novel radio resource management techniques for enabling high-demand machine-type applications in Industry 4.0 scenarios. These techniques will focus on enhancing the latency and reliability performance of the wireless communications system and will enable the command and control of energy-autonomous portable access points. This target will be achieved through a cost-effective reuse of wireless network infrastructure and spectrum. Specifically, the ESR will have to:

1. Leverage wireless communications theory—particularly that related to the operation of 802.11 systems operating in the unlicensed spectrum—to devise optimized radio access techniques. In line with the next generation of 802.11 wireless local area networks, emphasis will be placed on the development of a) time/frequency inter-cell coordination schemes, b) multi-link operations, c) spatial reuse enhancement techniques, and d) mobility.
2. Create a machine-learning framework to optimize the above-mentioned network resources and critical system parameters. Ultimately, these techniques will account for the challenging and characteristic data traffic, propagation, and mobility conditions that machine-type communications undergo in Industry 4.0 scenarios.
3. Utilize and further develop Nokia Bell Labs' system-level simulation tool Ithaca to characterize the fundamental performance limits of the proposed techniques in realistic scenarios.

As a result of the above work, the ESR is expected to:

1. Satisfy all the requirements set by Universitat Pompeu Fabra to obtain a PhD degree upon finalization of the research project.
2. Publish the outcome of the research in at least 3 technical journal articles.
3. Deliver at least 3 high-quality presentations summarizing the results achieved at top IEEE-organized conferences.
4. Being involved in the submission of at least 3 patent applications to Nokia's Intellectual Property Rights (IPR) department.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** By the end of the PhD, the ESR should have acquired a versatile professional profile that makes her suitable for a variety of technically-skilled roles within the industry and academia. As a result, the most relevant long-term career goals are:
   a) Being internationally recognized as a technical expert in the areas of wireless communications and machine learning.
   b) Work for a prestigious organization where the training acquired during the EU project PAINLESS targets can be leveraged and the project objectives further pursued.
   c) Having a highly skilled position in the organization the ESR works for thanks to the technical, leadership, and organization skills acquired during the PhD.

2. **What further research activity or other training is needed to attain these goals?** The ESR will likely have to further specialize—either through structured technical courses or personal study—in one of the technical areas specified below.

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** 1 submitted journal article.
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** 1 submitted article to present at a technical conference.

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc: Technical expertise to be acquired on the following areas:

1. Wireless communications theory: Through Nokia Bell Labs internal tutorials and resources.
2. Wi-Fi (802.11): Through Nokia Bell Labs internal tutorials and resources.
3. Programming language Matlab: Through Nokia Bell Labs internal tutorials and resources.
4. System-level simulations for wireless communications systems: Through Nokia Bell Labs internal tutorials and resources.
5. Machine learning: Through the online course "Machine Learning" provided by Coursera.
6. Programming language Python: Through Nokia Bell Labs internal tutorials and resources.
7. Technical writing: Through Nokia Bell Labs internal tutorials and resources that include usage of the LaTeX language for technical writing.

3. **Communication skills:** The following activities/training will be carried out as part of the ESR's training to develop their communication skills:
   1. Nokia Bell Labs and Universitat Pompeu Fabra internal presentations.
   2. Structured courses for enhancing presentation skills in the PAINLESS-organized winter/summer schools.
   3. Technical presentations at conferences and workshops.

4. **Other professional training (course work, teaching activity):** The ESR will participate in leadership, innovation and intellectual property management sessions organized at Nokia Bell Labs. Ethic courses will also be taken as per the Nokia code of conduct. The ESR will participate in the peer reviewing of technical articles.

5. **Anticipated networking opportunities:** The ESR will have at least the following networking opportunities:
   a) PAINLESS-organized winter/summer schools.
   b) Technical conferences and workshops.
   c) University secondments at Universitat Pompeu Fabra (UPF) and Athens Information Technology (AIT).
   d) Other research groups within Nokia Bell Labs through face-to-face and teleconference meetings.

6. **Other activities (community, etc) with professional relevance:** The ESR will join the Institute of Electrical and Electronics Engineers (IEEE) association as a student member.

Date & Signature of ESR: **Date & Signature of Supervisor**

Career Development Plan for the 1st and 2nd year

Name of ESR: YUAN GUO

Department: Department of Electrical and Computer Engineering, University of Cyprus

IRIDA Research Centre for Communication Technologies

Name of Supervisor: Prof**.** Ioannis Krikidis

Name of Tutor: Prof**.** Ioannis Krikidis

Starting Date: 09/09/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

This ESR will study millimetre wave (mmWave) communications in the context of wireless power transfer (WPT) and simultaneous wireless information and power transfer (SWIPT) to address the aims of T3.4.

System level analysis will be undertaken for different architectures e.g. sensor, cellular, aerial networks with EN constraints, with the use of mathematical tools such as stochastic geometry.

The fundamental limits of mmWaves in both WPT and SWIPT scenarios will be investigated under specific energy neutrality constraints and the considered parameters will be optimized.

Finally, a comparison between mmWaves and sub-6 GHz in terms of energy harvesting but also an investigation of their co-existence in the same network will be performed.

EXPECTED (half page should be sufficient):

Based on the previous UCY work on 5G cellular systems, we will be concentrated on the communication theory aspects of WPT/SWIPT mmWave cellular systems from a stochastic geometry standpoint. The focus will be on the modelling, analysis and design at the PHY layer, with implications on the network architecture and higher layer protocols.

The proposed work will have significant impact on the design of future 5G networks and WPT systems- we vision a communication infrastructure that beyond the conventional communication operations, it will convey energy to low-power devices.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals:

[1] Get the PHD degree

[2] Publish high level publications in the field of wireless communications

[3] Have experience working in the communications industry

[4] Complete the topic required in the PAINLESS project

2. What further research activity or other training is needed to attain these goals?

[1] Technical courses and tutorials about communication systems

[2] Tutorials for writing technical papers

[3] Summer and winter school of PAINLESS project

[4] Seconded to work in the industry

[5] Discuss technical issues with supervisor and tutor regularly

SHORT-TERM OBJECTIVES (1 year):

1. Research results

- **Anticipated publications:** High level publications in field of wireless communications
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:**
  ***Conference*:** PAINLESS Summer & Winter School

  Courses:

  [1] Advanced topics of Communication Systems;

  [2] Advanced topic in probability theory and stochastic geometry for wireless communication systems;

  [3] Convex optimization for wireless communication systems;

  [4] Wireless-powered communications.

  ***Seminar presentations*:** Regular presentation for project process.

2. Research Skills and techniques:
Training in specific new areas, or technical expertise etc:

[1] Advanced topics of Communication Systems (postgraduate course at ECE, UCY)

[2] Advanced topic in probability theory and stochastic geometry for wireless communication systems (independent study, ECE, UCY)

[3] Convex optimization for wireless communication systems (independent study, ECE, UCY)

[4] Wireless-powered communications (independent study, ECE, UCY)

[5] Tutorials for software-defined radio and Labview (laboratory IRIDA, ECE, UCY)

[6] mmWave wireless communication systems (independent study, ECE, UCY)

3. Communication skills: Training for technical presentation in English; Learn basic Greek for daily communication.

4. Other professional training (course work, teaching activity): Practice writing technical papers

5. Anticipated networking opportunities: Regularly meeting with teammates of PAINLESS project group and

6. Other activities (community, etc) with professional relevance: Participate in international academic conference

Date & Signature of ESR: **Date & Signature of Supervisor**

郭琳 03/09/2019

Career Development Plan for the 1st and 2nd year

Name of ESR: Abdelhamed Mohamed (ESR 13)

Department: CNRS

Name of Supervisor: DR. Marco Di Renzo

Name of Tutor: -

Starting Date: 01/08/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS

The availability and reliability of the power grid is set to become a major bottleneck in providing connectivity in future generations of wireless networks. For example, in Africa only 10% of individuals have access to the electrical grid, and cellular coverage is only at 15%. Furthermore, even developed countries contain several regions that have low broadband penetration. A Paradigm shift from Energy Efficient (EE) networks to Energy Neutral (EN) networks is hence vital, towards enabling self-powered networks that are unplugged from any fixed infrastructure ("infrastructure-less"), Which will rely on renewable energy such as wind, solar, kinetic, radiated power as well as high efficiency high-capacity batteries and by the emerging unmanned aerial vehicle (UAV). We can summarize some of benefits as follows:

- **Cost-effective –** The deployment of such Renewable-Energy powered BSs (REBs) could also be incorporated into conventional networks to reduce energy bills and hence the cost per MB seen by the users that could meet the cost-effective demand in 5G networks.
- **Sensitive to disasters –** For several scenarios, especially when natural disasters, or even malicious attacks on the power grid, the flying BSs(UAVs) can be deployed quickly to survey the area for search and rescue, to deliver supplies for first aid and to provide emergency communications.
- **More flexible** – In front of the different high data traffic demand events and activities, such infrastructure offers a potential solution to maintain reliable communications with high flexibility

Looking forward, The envision of a grid-independent network of small, portable, and flexibly deployable BSs with the potential is to replace the power-grid restricted pico and femto BS topologies, towards infrastructure-less communication networks. It also aims for a dramatic improvement in the network coverage of problematic / remote / developing areas, to the coverage levels of urban networks in the developed world. This coverage will not be based on a wasteful static network, but instead on a flexible, green and "on demand" provision of ICT services.

More specifically, my PhD program and research work will be proceeded under the title "Network-level modelling and optimization of EN ultra-dense terrestrial Het-Nets based on SWIPT and renewables". The main objectives and tasks are summarized as follows:

- **Network Modeling –** State-of-the-art review of spatial point process modeling for wireless network and study the methodology to capture the properties of Renewable

energy sources and SWIPT technology for the analysis of ultra-dense small cell networks.

- **Mathematical Analysis –** Developing a comprehensive mathematical theory for analyzing ultra-dense cellular networks whose low-energy mobile devices and base stations can be powered via conventional power generators, radio frequency energy (e.g., power beacons) and renewable energy sources.
- **Performance Evaluation** – Developing a new approach based on the theory of point processes that accounts for practical deployment constraints, such as the actual location of all network elements, the network traffic, and practical propagation conditions at low (sub 6 GHz) and high (millimeter-wave) frequencies.

EXPECTED:

As a result of the above work, it's expected to :

I. Developing a new mathematical methedology based on the spatial point process to analysis this type of green energy networks.
II. Design insight for network planning and system level optimization.
III. Quantification of the potential of emerging power (green) sources for cellular / portable network applications

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:**
   The achievement of three-year research work and my PhD program will encourage me to go forward in my research career. It will provide me several opportunities to obtain potential research positions in reputational academic institute as an independent researcher or lecturer. Getting international recognition from the scientific community due to the contribution to the development of communication theory and technology. Besides; the transferable, management and research skills gained during the project will provide me with the opportunity in the telecommunication industry.

2. **What further research activity or other training is needed to attain these goals?**
   In order to attain these goals, I will attend PhD courses, Tutorial, Seminars, International conferences and other training modules related to my research activity which can be summarized as follows:

First Year (August 2019 – July 2020)

- I will attend courses offered by CentraleSupélec and CNRS which are included in the syllabus of the Master's program "Systèmes Avancés de Radiocommunications" (SAR). In the first year, I will attend courses "5G Networks and Machine Learning" and "Stochastic Geometry for Wireless Networks".

- Participation to all PhD courses, tutorials, seminars, workshops, and international conferences of PAINLESS Project. In the first year, I attended the first summer schools at the university of Cyprus.

- Collaborating with other ESRs is to strengthen background knowledge and exchanging ideas to fulfil the overarching goals of PAINLESS project.

Second Year (August 2020 – July 2021)

- Attending courses offered by CentraleSupélec and CNRS which are included in the syllabus of the Master's program "Systèmes Avancés de Radio communications" (SAR). In the second year, I will attend the courses "Physical and Statistical Modelling of Wireless Channels" and "Cellular Communications".

- Attending top level international conferences and workshops, e.g., ICC, GLOBECOM, which are related to my research area such as SWIPT technology for cellular networks, stochastic geometry, mm-Wave communications, etc., are also helpful for my training.

- Collaborating with other supervisors and ESRs is to strengthen background knowledge as well for me to learn how to conduct scientific researches which is going to be within my secondment period at University of Cyprus and ORION.

- Participation to all PhD courses, tutorials, seminars, workshops, and summer/Winter schools that will be organized by PAINLESS Partners.

Third Year (August 2021 – July 2022)

- Visiting other institutions inside and/ or outside the PAINLESS project will be beneficial as well for me to learn how to conduct scientific researches. This includes my secondment periods.

- Participation to International conferences, tutorials, seminars, workshops, and summer/Winter schools that will be organized by PAINLESS Partners.

SHORT-TERM OBJECTIVES (1 year):

1. Research result

- **Anticipated publications:** A quantitative target to, high quality journal and conferences, has already been set to have 3 accepted conference papers, 1 accepted journal paper, and 1 submitted journal paper during the project period. More specifically, the publication plan is provided as follows:

First Year:
- IEEE Wireless Communications and Networking Conference

Second Year:
- IEEE Global Communications Conference
- IEEE Transaction on Communications

Third Year:
- IEEE International Conference on Communications
- IEEE Transaction on Wireless Communications

- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:**

I have attended the PAINLESS first summer school at the University of Cyprus and I will attend the workshops and Seminars that will be organized by PAINLESS project consortium, CNRS and Centralesupelec that have real impact to fulfill the research topic aims.

3. Research Skills and techniques: Training in specific new areas, or technical expertise etc:

Technical expertise and a specific training to be acquired in emerging research areas such as:

I. Reconfigurable Intelligent Meta-surface.
II. Applied Machine Learning for wireless networks and channel Modelling.
III. Applied optimization for Wireless communication.
IV. Random Matrix theory for wireless communication.
V. Advanced topics in energy storage modelling and SWIPT technology.
VI. Hands on system-level optimization based on Practical spatial point processes.

4. Communication skills:

There are several courses and activities/training modules will be carried out by CNRS and PAINLESS project to develop PhD and ESR's communication skills such as:

1. A course offered by CNRS for "Practice speaking in public".
2. Structured courses for enhancing presentation skills in the PAINLESS-organized winter/summer schools.
3. Technical presentations at conferences and workshops.

5. Other professional training (course work, teaching activity):

This section includes courses, that I will attend, provided by CNRS, PhD School and PAINLESS project partners to enhance the complementary skills.

First Year:

- I attended the complementary courses of "Writing and Reviewing Scientific Papers" offered by PAINLESS project. The aim of this course was to improve the participants' competence in writing and reviewing scientific papers

- I will attend the "Improving personal development and teamwork skills" course organizedby CNRS. This course provided a set of personal career development strategies for ESRs, which included time management techniques, decision-making and career planning, networking, goal setting, task prioritization and delegation, as well as scheduling and workspace conflict resolution. I also received knowledge on how to best structure my CV, while also learning how to communicate effectively in a Job Interview.

Second Year:

- I expect that several training modules and workshops within the project framework like "Research funding and writing research proposals" will enable me to develop abilities to write proposals, find partners, get funds, build teams and manage projects.

- I expect to improve particularly the academic writing skills and the oral presentation skills by writing project proposals, and scientific publications giving talks on seminars, workshops and international conferences.

- I will attend the courses of "Management of Technology and Innovation" and "Ethics standards for researchers and organizations" with The goal to go beyond "traditional" approaches towards technology and innovation management and how to contribute effectively to science in an ethical manner. Moreover, Our responsibilities towards society.

Third Year:

- I will attend "Innovation, Project and Risk Management" and "Entrepreneurship and venture capital" courses with the goal of creating a business from research and intellectual property (IP) and how to bring ideas to products.

- I will attend "Applying for research fellowships" and "Interview Coaching"to enhance my skills on turning a research idea into a proposal and improve my experience for post doctorate level interview and what research employers are looking for during the recruitment process.

- I also foresee that I will develop good interpersonal communication skills by participating events organized by PAINLESS with other ESRs and similar academic activities.

6. Anticipated networking opportunities:

There are several Network opportunities such as**:**

1- During the secondment periods at UCY, Cyprus and ORION, Greece.
2- The PAINLESS summer/ winter schools.
3- Participation to Conferences and workshops.

6.1 Secondment Plan

First Secondment Period	
Visiting Partner:	ORION, Greece
Duration:	M22-M24
Responsible:	Dr. Emmanouil Kafetzakis
Research Objective:	To integrate scheduling and routing capabilities in the network-level optimization
Second Secondment Period	
Visiting Partner:	University of Cyprus, Cyprus
Duration:	M33-M38
Responsible:	Dr. Ioannis Krikidis
Research Objective:	To integrate efficient EH techniques in the network level modelling and optimization

7. **Other activities (community, etc.) with professional relevance:** Participation to European Research Night as a public engagement event to disseminate the role of our research and its impact on the society. I have participated in this year EU research Night in Paris and presented an overall view of PAINLESS project and my research topic and its effective impact to the society in various life scenarios.

Date & Signature of ESR:

1 November 2019

abdelhamed Mohamed Sayed Ahmed

Date & Signature of Supervisor

1 November 2019

Career Development Plan for the 1st and 2nd year

Name of ESR: Mahmoud AlaaEldin

Department: University of Manchester, Department of Electrical and Electronic Engineering

Name of Supervisor: Emad Alsusa

Name of Tutor:

Starting Date: 01/09/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND EXPECTED MAJOR ACCOMPLISHMENTS

The key target of this research is to design novel low complexity physical layer network coding (PLNC) techniques for enabling high information exchange rate between the wireless nodes for the case of large scale distributed and energy-autonomous access-point formations. These techniques will focus on the optimization at the physical layer with the objective to maximize the longevity of all network nodes. This target will be achieved through the use of efficient PLNC techniques that have low energy consumption for processing as well as high achievable data rates. Specifically, the ESR will be responsible for:

1. Developing and exploring novel low-complexity and energy-efficient Lattice Network Coding (LNC) and PLNC techniques that complement T3.2
2. The selection of the optimal mapping function that make into consideration not only the channel characteristics but also **non-uniform power availability** amongst the network nodes.
3. Considering both the compute and forward and integer forcing approaches and establishing the trade-off relationship between quantization level, performance and energy longevity.
4. Minimizing side information exchange in T3.3 which could be a significant burden on power limited networks.

As a result of the mentioned overview, the ESR is expected to:

1. Satisfy all the requirements set by University of Manchester to obtain a PhD degree upon finalization of the research project.
2. Publish the outcome of the research in top journals.
3. Deliver high-quality presentations summarizing the achieved results at top IEEE-organized conferences.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. Goals:

By the end of the project, the ESR should have gained a wide range of both technical and soft skills that grant him a strong professional CV. These skills will nominate the ESR for multiple highly-skilled jobs within both industry and academia. To achieve this, the planned long-term career goals are:

I. Building up a strong professional profile that makes him internationally recognized as an expert in the field of wireless communications and signal processing

II. Being employed at a distinguished organization (academic or industrial) in a leading position making use of the professional training acquired during the PAINLESS project and the skilled gained in following the project objectives.

2. What further research activity or other training is needed to attain these goals?

The research points stated in the first section will be undertaken and intensively carried out. Regarding the training, first there will be training in each summer/winter school organized by the project supervisors. Second, the ESR will attend technical courses whether at the university or self-study through online courses in the areas mentioned below. Third, further training will be acquired through planned secondments in other participating organizations.

SHORT-TERM OBJECTIVES (1 year):

1. Research result

- **Anticipated publications:** 1 submitted journal paper
- **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** 1 submitted conference paper to be presented at a top conference

2. Research Skills and techniques:

Training in specific new areas, or technical expertise etc.: Technical expertise shall be gained in the following areas:

1. Information and coding theoretic aspects in PLNC
2. Lattice coding and decoding techniques
3. Abstract algebra and algebraic structures to be used in algebraic approaches in PLNC
4. The compute and forward as well as integer forcing techniques
5. Mathematical modeling and optimization theory

3. Communication skills: The ESR will go through multiple activities in order to gain good communication skills. These activities are as the following:

I. Giving presentations whether in University of Manchester or presenting his work in front of the project supervisors
II. Attending courses for enhancing presentation and communication skills in the PAINLESS-organized winter/summer schools
III. Giving technical presentations at conferences and workshops

4. Other professional training (course work, teaching activity): I will attend professional development courses organized by University of Manchester for their post graduate students. These courses include:

I. Research essentials (first year) which includes introduction to research, academic writing, critical reading, how to work with your supervisor and how to plan your PhD
II. Research essentials (second year) which includes designing research posters, planning the final year, preparing presentations content, presentation practice and feedback, publishing academic papers and turbo charging for writing.
III. Research essentials (third year) which includes managing electronic thesis submissions and writing up your thesis.

IV. Attending career management course which provides workshops on how to hone your career ideas, job hunting, CVs and interview technique. Also the course includes planning of how to build a career after the PhD from the 1st year which is the right time to start thinking about the future.

V. Attending wellbeing and personal effectiveness events as
   a. Wellbeing:
      i. Building emotional resilience on the research journey
      ii. PhD social events
      iii. Exploring positive psychology course
   b. Personal effectiveness:
      i. Developing Effective Communication
      ii. Increasing Your Emotional Intelligence
      iii. Influencing Others
      iv. Learning to Be Assertive
      v. Networking for Researchers
      vi. Negotiation Strategies for Researchers
      vii. Project Management for Researchers
      viii. Time Management for Researchers

5. Anticipated networking opportunities:

The ESR will have a collections of networking opportunities as follows:

a) Interaction with other ESR's through PAINLESS-organized winter/summer schools.
b) Interaction through technical conferences and workshops.
c) Interaction through planned secondments at CNRS and AIT.

6. Other activities (community, etc.) with professional relevance: I will participate in several community activities organized by the university of Manchester including teaching for school students and other charity activities. I will participate in organizing events held by University of Manchester.

Date & Signature of ESR:

Mahmoud Alaa

14/11/2019

Date & Signature of Supervisor

Alsusa

Career Development Plan for the 1st and 2nd year

Name of ESR: Igor Donevski

Department: Aalborg University (AAU), Connectivity Section

Name of Supervisor: Jimmy Jessen Nielsen

Name of Tutor: Petar Popovski

Starting Date: 01/06/2019

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED:

This research project will accentuate coverage, reliability and delay sensitive connectivity for UAVs by:

- Addressing the gap in the research for dynamic repositioning for channel improvements regardless of end-user mobility. Testing the eligibility of different algorithms and conclude with a real-world applicability evaluation.
- A protocol that is adaptable to the state of the LoS for end-users of different type and density will be worked upon. Promising technologies that are widely available are in the industrial, scientific and medical (ISM) radio bands that are free to use without a license. Mainly, IEEE 802.11 access is considered accompanied by LoRaWAN support. The combination of the interfaces is good in the sense that both interfaces use different spectra, have very different data rates and coverages.
- Device cooperation scheme where the positioning of the devices and the UAV is exploited. The 3D location and the geometry of the link positions hold great potential in improving the link.

However, the implementation complexity of all the previous adaptations may be hard to handle. Therefore, Machine Learning algorithms will be tested for several aspects of the UAV behavior as part of the research project.

As a result of the above work, the ESR is expected to:

i. Satisfy all the requirements set by Aalborg University to obtain a PhD degree upon finalization of the research project.

ii. Publish the outcome of the research in at least 3 technical journal articles.

iii. Deliver at least 5 high-quality presentations summarizing the results achieved at top IEEE-organized conferences.

iv. Being involved in the submission of patent applications.

LONG-TERM CAREER OBJECTIVES (over 5 years):

1. **Goals:** By the end of the PhD, the ESR should have acquired a versatile professional profile that makes him suitable for a variety of technically-skilled roles within the industry and academia. As a result, the most relevant long-term career goals are:

    i. Be recognized by the scientific community as a significant contributor to the field of UAV communications

    ii. Being internationally recognized as a technical expert in the areas of wireless communications and machine learning.

    iii. Work for a prestigious organization where the training acquired during the EU project PAINLESS can be leveraged and the project objectives further pursued.

2. **What further research activity or other training is needed to attain these goals?** The ESR will take specialization courses in several technical and general areas. The choice of courses are chosen such that they directly impact the ESR's effectiveness in his contribution to the PAINLESS project.

SHORT-TERM OBJECTIVES (1 year):

1. **Research results**
   - **Anticipated publications:** 1 submitted journal article
   - **Anticipated conference, workshop attendance, courses, and /or seminar presentations:** 2 submitted articles to present at a technical conference or workshop

2. **Research Skills and techniques:**
   Training in specific new areas, or technical expertise etc: Technical expertise to be acquired on the following areas through AAU PhD courses:
   i. Wireless communications theory for specific use cases
   ii. Programming language Python for Scientific Computing
   iii. Machine learning
   iv. Probabilistic Models for Machine Learning
   v. Data integration and Machine Learning
   vi. Advanced Topics in Machine Learning
   vii. Writing and Reviewing Scientific Papers

3. **Communication skills:** The following activities/training will be carried out as part of the ESR's training to develop their communication skills:
   i. Internal presentations during Connectivity Section meetings and AAU presentations.
   ii. Presentations at conferences and workshops.
   iii. Attending PhD courses provided by AAU that aim to improve written and spoken communication skills

4. **Other professional training (course work, teaching activity):** The ESR will participate in an AAU organised course as an introduction to the PhD programme and a course to Applying the Danish Code of Conduct for Research Integrity. Furthermore, a basic course with focus on Problem Based Learning will help the ESR issue and supervise student projects within AAU. The ESR will also participate in peer reviewing of technical articles.

5. **Anticipated networking opportunities:** The ESR will have at least the following networking opportunities:
   i. Participating in Connectivity Section meetings along with many other researchers and research guests
   ii. PAINLESS-organized winter/summer schools
   iii. Conferences and workshops.
   iv. Secondments at CNRS, Paris and RESEIWE, Aalborg

6. **Other activities (community, etc) with professional relevance:** The ESR will join the Institute of Electrical and Electronics Engineers (IEEE) association as a student member.

Date & Signature of ESR:

Date & Signature of Supervisor

9/8-2019