ITU Centres of Excellence Network for Europe

Faculty of Electrical Engineering and Information Technologies in Skopje

Online Training Course on
Wireless And Mobile Ultra-Broadband: LTE-A PRO, WLAN, and 5G NR

19 November - 16 December 2019

COURSE OUTLINE

COURSE DESCRIPTION

Title	Wireless and Mobile Ultra-Broadband: LTE-A Pro, WLAN, and 5G NR
Objectives	This course will focus on Wireless and Mobile Ultra Broadband Internet – LTE-A Pro, WLAN and 5G NR, from technology, regulation and business aspects. It will cover mobile broadband technologies, including mobile and Internet convergence, ITU's role in mobile broadband Internet, 4G LTE, LTE-A (4.5G), LTE-A Pro (4.9G), mobile Internet of Things (IoT) architectures, QoS in 4G/4.5G/4.9G mobile networks, ITU spectrum management, as well as business and regulation aspects of mobile broadband. Further, the course will include ultra-broadband WLAN, including architectures, ultra-broadband WLAN standards (IEEE 802.11 ac/ad), Next Generation WLAN (IEEE 802.11x), WLAN for Internet of Things (IoT), mobile traffic offload over WLAN, as well as regulation and business aspects of ultra-broadband WLAN. Also, it will cover 5G mobile ultra-broadband, including ITU's IMT-2020, 5G network architectures, network slicing, 5G New Radio (NR), 5G Next Generation Core (NG Core), Mobile Edge Computing (MEC), QoS in 5G, ITU WRC-2019 and 5G spectrum allocations, as well as business and regulation aspects for 5G mobile ultra-broadband. Finally, the course will incorporate mobile ultra-broadband services, including Voice over LTE (VoLTE), Voice over 5G NR (VoNR), mobile TV and video over 4G/5G, enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communication (URLLC), massive Machine Type Communication (mMTC), Virtual Reality (AR) and Augmented Reality (AR), network neutrality vs. QoS as well as regulation and business aspects for mobile ultra-broadband services.
Dates	19 November - 16 December 2019
Duration	4 weeks
Registration deadline	18 November 2019
Training fees	USD 150
Course code	**19OI24245EUR-E**

LEARNING OUTCOMES

Upon completion of this course, participants will be able to:
- Understand mobile broadband technologies: LTE/LTE-A/LTE-A Pro, including mobile QoS, mobile IoT and spectrum management;
- Perform technical, business and regulation analysis for mobile ultra-broadband technologies;
- Understand ultra-broadband WLAN, including security and QoS aspects, IoT over WLAN, mobile traffic offload over WLAN, as well as WLAN spectrum regulation;
- Understand mobile ultra-broadband with 5G New Radio (5G NR), including network slicing, 5G Next Generation Core (NG Core), Mobile Edge Computing (MEC), QoS in 5G, and ITU WRC-2019 spectrum allocations;
- Understand mobile ultra-broadband services, including 5G service types: enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communication (URLLC), and Massive Machine Type Communication (mMTC);
- Perform technical, business and regulation analysis for mobile ultra-broadband services.

TARGET POPULATION

This course is targeted at managers, engineers and employees from regulators, government organisations, telecommunication companies and academia, who are interested in understanding, implementation and regulation of Wireless and Mobile Ultra-Broadband (LTE-A Pro, WLAN, and 5G NR), including technologies, standardization, regulation and content. Other institutions and individuals that are dedicated in building their capacity related to Wireless and Mobile Ultra-Broadband (LTE-A Pro, WLAN, and 5G NR) are also welcome to participate.

TUTORS/INSTRUCTORS

NAME OF TUTOR(S)/INSTRUCTOR(S)	CONTACT DETAILS
Prof. Dr. Toni Janevski, tutor	tonij@feit.ukim.edu.mk (www.feit.ukim.edu.mk)
Dr. Pero Latkoski, tutor's assistant	
Dr. Tomislav Shuminoski tutor's assistant	

EVALUATION

The evaluation of the participants will be based on 80% from the average Quiz marks (average score from the quizzes) and 20% from the participation with substantive posts in the discussion forums, reflecting both the quantity and the quality of time spent on the course. Overall grade higher than 60% success ratio is required to complete the course and obtain an ITU certificate.

TRAINING SCHEDULE AND CONTENTS

Week	Activity	Exercises and interactions
Week 1	Module 1: **Mobile broadband technologies: LTE/LTE-A/LTE-A Pro**	Learning topics: • Mobile and Internet convergence • ITU's role in mobile broadband Internet • 4G LTE • LTE-A (4.5G) • LTE-A Pro (4.9G) • Mobile Internet of Things (IoT) architectures • QoS in 4G/4.5G/4.9G mobile networks • ITU spectrum management for 4G/4.5G/4.9G • Business and regulation aspects of mobile broadband Discussion / Forum Self test quiz
Week 2	Module 2: **Ultra-broadband WLAN**	Learning topics: • WLAN architectures • Ultra-broadband WLAN standards (IEEE 802.11 ac/ad) • Next Generation WLAN (IEEE 802.11x) • WLAN security and QoS • WLAN for Internet of Things (IoT) • 3GPP mobile traffic offload over WLAN • Ultra-broadband WLAN spectrum regulation • Business aspects of ultra-broadband WLAN Discussion / Forum Self test quiz
Week 3	Module 3: **Mobile ultra-broadband: 5G New Radio (5G NR)**	Learning topics: • ITU specification for 5G: IMT-2020 • 5G network architectures • Network slicing in 5G • 5G New Radio (NR) • 5G Next Generation Core (NG Core) • Mobile Edge Computing (MEC) • QoS in 5G mobile ultra-broadband • ITU WRC-2019 and 5G spectrum allocations • Business and regulation aspects for 5G mobile ultra-broadband Discussion / Forum Self test quiz
Week 4	Module 4: **Mobile ultra-broadband services**	Learning topics: • Voice over 4G LTE (VoLTE) • Voice over 5G NR (VoNR)

Week	Activity	Exercises and interactions
		• Mobile TV and video services in 4G and 5G • Enhanced Mobile Broadband (eMBB) services • Ultra-Reliable Low-Latency Communication (URLLC) • Massive Machine Type Communication (mMTC) • Virtual Reality (AR) and Augmented Reality (AR) • Network neutrality vs. QoS for mobile ultra-broadband • Regulation and business aspects of mobile ultra-broadband services
		Discussion / Forum
		Self test quiz Final Evaluation

METHODOLOGY

The course methodology will be as follows:

- Each module will be studied and discussed over a time period of one week;
- Course materials will be made available on a weekly basis;
- Discussion forums will be organized based on discussion topics given on a daily basis, where students are highly encouraged to participate and interact with instructors and other students;
- Quiz tests will be assigned weekly, one per module, at the end of a given course week;
- All announcements for all events (materials, quizzes and forums) will be given in a timely manner (prior to the event) by the course tutor.

COURSE COORDINATION

Course coordinator:	ITU coordinator:
Name: **Prof. Dr. Toni Janevski** Email address: tonij@feit.ukim.edu.mk	Name: **Jaroslaw Ponder** Email address: jaroslaw.ponder@itu.int

REGISTRATION AND PAYMENT

ITU Academy portal account

Registration and payment should be made online at the ITU Academy portal.
To be able to register for the course you **MUST** first create an account in the ITU Academy portal at the following address:
https://academy.itu.int/index.php/user/register.

Course registration

When you have an existing account or created a new account, you can register for the course online at the following link: https://academy.itu.int/index.php/training-courses/full-catalogue/wireless-and-mobile-ultra-broadband-lte-pro-wlan-and-5g-nr

You can also register by finding your desired course in our training catalogue https://academy.itu.int/index.php/training-courses/full-catalogue.

Payment

1. On-line payment

A training fee of USD 150 per participant is applied for this training. Payment should be made via the online system using the link mentioned above for training registration https://academy.itu.int/index.php/training-courses/full-catalogue/wireless-and-mobile-ultra-broadband-lte-pro-wlan-and-5g-nr

2. Payment by bank transfer

Where it is not possible to make payment via the online system, select the option for offline payment to generate an invoice using the same link as above. Download the invoice to make a bank transfer to the ITU bank account shown below. Then send the proof of payment/copy of bank transfer slip and the invoice copy to Hcbmail@itu.int and copy the course coordinator. **All bank transaction fees must be borne by the payer**.

Failure to submit the above documents may result in the applicant not being registered for the training.

3. Group payment

Should you wish to pay for more than one participant using bank transfer and need one invoice for all of them, create an account as **Institutional Contact. Institutional Contacts** are users that represent an organization. Any student can request to be an institutional contact or to belong to any existing organization.

To do this, head to your profile page by clicking on the **"My account"** button in the user menu. At the bottom of this page you should see two buttons:

a. If you want to **become an institutional contact**, click on the "**Apply to be an Institutional Contact"** button. This will redirect you to a small form that will ask for the organization name. After you fill the name of the organization you want to represent, click on **"continue"** and a request will be created. An ITU Academy manager will manually review this request and accept or deny it accordingly.

b. If you want to **belong to an existing organization**, click on the **"Request to belong to an Institutional Contact"** button. This will redirect you to a small form that will ask you to select the organization you want to join from an organization list. After you select the correct organization, click on **"continue"**, a request will then be created. The Institutional Contact that represents that organization will manually accept or deny your request to join the organization.

ITU BANK ACCOUNT DETAILS:

Name and Address of Bank:	UBS Switzerland AG Case postale 2600 CH 1211 Geneva 2 Switzerland
Beneficiary:	Union Internationale des Télécommunications
Account number:	240-C8108252.2 (USD)
Swift:	UBSWCHZH80A
IBAN	CH54 0024 0240 C810 8252 2
Amount:	USD 150
Payment Reference:	CoE-**19OI24245EUR-E** -WBS No. **P.40595.1.03**

4. Other method of payment

If due to national regulations, there are restrictions that do not allow for payment to be made using options 1 & 2 above, please contact the ITU coordinator for further assistance.

CERTIFICATES

Each fully registered participant who will successfully complete the course, based on the evaluation, will receive an ITU Certificate after the course.