ITU Centres of Excellence Network for Europe

Faculty of Electrical Engineering and Information Technologies in Skopje

Online Training Course on

Future Mobile and Wireless Broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI

16 November - 13 December 2021

TRAINING COURSE OUTLINE

COURSE DESCRIPTION

Title	Future Mobile and Wireless Broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI
Objectives	This course will cover Future mobile and wireless broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI, including technologies, regulation and business aspects. The course will include mobile broadband LTE/LTE-Advanced architecture, 4G Evolved Packet Core (EPC), 4.9G LTE-A-Pro, 4.9G QoS and mobile Internet access, cellular Internet of Things (IoT), LTE in unlicensed bands, LTE-A-Pro V2X and mission critical services, as well as business and regulatory aspects of mobile broadband. Further, it will cover future wireless/satellite broadband, including WiFi Next Generation (WiFi 6), Extremely High Throughput WiFi (WiFi 7), mobile and WiFi integration, Satellite broadband systems, Satellites for Internet access, M2M/IoT operation via Satellite, future Satellites for 5G broadband access, as well as business and regulatory aspects for future wireless and satellite broadband. The course will also include 5G New Radio (NR) access and 5G Next Generation core, 5G network slicing and SDN/NFV, 5G QoS, 5G Fixed Wireless Access (FWA), 5G spectrum management, Artificial Intelligence (AI) and Machine Learning (ML) in 5G, as well as business and regulatory aspects for future 5G mobile broadband. Finally, it will also include VoLTE and VoNR, 5G Media Streaming and AR/VR/XR, 5G Broadcast and MBS, eMBB for 5G Internet access and broadband services, Massive MTC/IoT and smart services, URLLC services (Industry 4.0, V2X, smart grids), future IoT/BigData/AI services in 5G, future 5G OTT services vs. network neutrality, as well as business and regulatory aspects for future services in 5G era.
Dates	16 November - 13 December 2021
Duration	4 weeks
Registration deadline	15 November 2021
Training fees	USD 150
Course code	21OI26418EUR-E

DESCRIPTION OF THE TRAINING COURSE

This course will cover Future mobile and wireless broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI, including technologies, regulation and business aspects. The course will include mobile broadband LTE/LTE-Advanced architecture, 4G Evolved Packet Core (EPC), 4.9G LTE-A-Pro, 4.9G QoS and mobile Internet access, cellular Internet of Things (IoT), LTE in unlicensed bands, LTE-A-Pro V2X and mission critical services, as well as business and regulatory aspects of mobile broadband. Further, it will cover future wireless/satellite broadband, including WiFi Next Generation (WiFi 6), Extremely High Throughput WiFi (WiFi 7), mobile and WiFi integration, Satellite broadband systems, Satellites for Internet access, M2M/IoT operation via Satellite, future Satellites for 5G broadband access, as well as business and regulatory aspects for future wireless and satellite broadband. The course will also include 5G New Radio (NR) access and 5G Next Generation core, 5G network slicing and SDN/NFV, 5G QoS, 5G Fixed Wireless Access (FWA), 5G spectrum management, Artificial Intelligence (AI) and Machine Learning (ML) in 5G, as well as business and regulatory aspects for future 5G mobile broadband. Finally, it will also include VoLTE and VoNR, 5G Media Streaming and AR/VR/XR, 5G Broadcast and MBS, eMBB for 5G Internet access and broadband services, Massive MTC/IoT and smart services, URLLC services (Industry 4.0, V2X, smart grids), future IoT/BigData/AI services in 5G, future 5G OTT services vs. network neutrality, as well as business and regulatory aspects for future services in 5G era.

LEARNING OUTCOMES

Upon completion of this course, participants will be able to:

- Understand mobile broadband, including LTE/LTE-Advanced, LTE-Advanced-Pro, 4G Evolved Packet Core (EPC), mobile QoS, cellular IoT, LTE in unlicensed bands, LTE-A-Pro V2X and mission critical services;
- Understand future wireless and satellite broadband, including Next Generation WiFi, mobile and WiFi integration, Satellites for Internet access, Satellites for M2M/IoT, as well as future Satellites for 5G broadband access;
- Perform technical, business and regulatory analysis for LTE/LTE-Advanced-Pro mobile broadband, next generation WiFi and future Satellite broadband;
- Understand future mobile broadband, including 5G New Radio (NR), 5G Core, network slicing in 5G/IMT-2020, 5G edge computing, Fixed Wireless Access (FWA), 5G spectrum management, as well as Artificial Intelligence (AI) and Machine Learning (ML) in 5G;
- Understand future mobile services, including VoLTE and VoNR, 5G Broadcast and MBS, eMBB, URLLC and mMTC services, future IoT/BigData/AI services in 5G, as well as 5G OTT services and network neutrality;
- Perform technical, business and regulatory analysis of future 5G mobile broadband and future mobile 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 Future mobile and wireless broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI, including technologies, regulatory and business aspects. Other institutions and individuals that are dedicated in building their capacity related to Future mobile and wireless broadband: LTE-A-Pro, WiFi, Satellites, 5G NR and AI are also welcome to participate.

ENTRY REQUIREMENTS

No prior knowledge or qualification is required to register for this course, considering the given target population.

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	

TRAINING CONTENTS

The training contents are organized in 4 Modules, where each of the Modules is covering a given topic area with given contents, as shown in the table below:

Topic	**Contents**
Module 1: **Mobile broadband: LTE-Advanced/LTE-A-Pro, mobile Internet and cellular IoT**	• Mobile broadband evolution • LTE/LTE-Advanced architecture • 4G Evolved Packet Core (EPC) • 4.9G: LTE-Advanced-Pro • 4.9G QoS and mobile Internet access • Cellular Internet of Things (IoT): LTE-M and NB-IoT • LTE in unlicensed bands • LTE-A-Pro V2X and mission critical services • Business and regulatory aspects of mobile broadband
Module 2: **Future wireless/satellite broadband: Next Generation WiFi and Satellite broadband access**	• WiFi architectures • WiFi 6 – Next Generation WiFi (IEEE 802.11ax) • Extremely High Throughput WiFi (IEEE 802.11be) • Mobile and WiFi integration • Satellite broadband systems • Evolving satellite communication for Internet access • M2M/IoT operation via Satellite • Future Satellites for 5G broadband access • Business and regulatory aspects for future wireless and satellite broadband

Topic	Contents
Module 3: **Future mobile broadband: 5G New Radio (NR), 5G NG Core and Artificial Intelligence**	• 5G New Radio (NR) • SDN, NFV and network slicing in 5G/IMT-2020 • 5G Next Generation Core • 5G Quality of Service (QoS) • 5G Fixed Wireless Access (FWA) • 5G Edge Computing and native clouds • Artificial Intelligence (AI) and Machine Learning (ML) for 5G/IMT-2020 by ITU • 5G spectrum management by ITU • Business and regulatory aspects of future 5G mobile broadband
Module 4: **Future mobile services: eMBB, URLLC, massive MTC, IoT/BigData/AI and mobile OTT services**	• VoLTE and 5G VoNR • 5G Broadcast/TV and 5G MBS • 5G Media Streaming (5GMS) and AR/VR/XR • eMBB: 5G Internet access and broadband services • Massive MTC/IoT: smart services • URLLC services: Industry 4.0, V2X, smart grids • Future IoT/BigData/AI services in 5G • Future 5G OTT services and network neutrality • Business and regulatory aspects for future mobile services in 5G era

TRAINING SCHEDULE

Week	Topic	Exercises and interactions
Week 1	Module 1: **Mobile broadband: LTE-Advanced/LTE-A-Pro, mobile Internet and cellular IoT**	Learning topics from course materials: • Mobile broadband evolution • LTE/LTE-Advanced architecture • 4G Evolved Packet Core (EPC) • 4.9G: LTE-Advanced-Pro • 4.9G QoS and mobile Internet access • Cellular Internet of Things (IoT): LTE-M and NB-IoT • LTE in unlicensed bands • LTE-A-Pro V2X and mission critical services • Business and regulatory aspects of mobile broadband
		Discussion / Forum
		Self test quiz
Week 2	Module 2:	Learning topics from course materials:

Week	Topic	Exercises and interactions
	Future wireless/satellite broadband: Next Generation WiFi and Satellite broadband access	• WiFi architectures • WiFi 6 – Next Generation WiFi (IEEE 802.11ax) • Extremely High Throughput WiFi (IEEE 802.11be) • Mobile and WiFi integration • Satellite broadband systems • Evolving satellite communication for Internet access • M2M/IoT operation via Satellite • Future Satellites for 5G broadband access • Business and regulatory aspects for future wireless and satellite broadband
		Discussion / Forum
		Self test quiz
Week 3	Module 3: **Future mobile broadband: 5G New Radio (NR), 5G NG Core and Artificial Intelligence**	Learning topics from course materials: • 5G New Radio (NR) • SDN, NFV and network slicing in 5G/IMT-2020 • 5G Next Generation Core • 5G Quality of Service (QoS) • 5G Fixed Wireless Access (FWA) • 5G Edge Computing and native clouds • Artificial Intelligence (AI) and Machine Learning (ML) for 5G/IMT-2020 by ITU • 5G spectrum management by ITU • Business and regulatory aspects of future 5G mobile broadband
		Discussion / Forum
		Self test quiz
Week 4	Module 4: **Future mobile services: eMBB, URLLC, massive MTC, IoT/BigData/AI and mobile OTT services**	Learning topics from course materials: • VoLTE and 5G VoNR • 5G Broadcast/TV and 5G MBS • 5G Media Streaming (5GMS) and AR/VR/XR • eMBB: 5G Internet access and broadband services • Massive MTC/IoT: smart services • URLLC services: Industry 4.0, V2X, smart grids • Future IoT/BigData/AI services in 5G • Future 5G OTT services and network neutrality • Business and regulatory aspects for future mobile services in 5G era
		Discussion / Forum
		Self test quiz and Final Evaluation

METHODOLOGY (Didactic approach)

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.

EVALUATION AND GRADING

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.

COURSE COORDINATION

Course coordinator:	**ITU coordinator:**
Name: **Prof. Dr. Toni Janevski** Email address: tonij@feit.ukim.edu.mk	Name: Ana-Maria Meshkurti Email address: ana.maria.meshkurti@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

Training 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/training-courses/full-catalogue/future-mobile-and-wireless-broadband-lte-pro-wifi-satellites-5g-nr-and-ai

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 at https://academy.itu.int/training-courses/full-catalogue/future-mobile-and-wireless-broadband-lte-pro-wifi-satellites-5g-nr-and-ai .

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-EUR 26418 – 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.