# Training Course Outline

**ITU and National Institute of Telecommunications**

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| Title | Wireless Access Technologies to Internet Network |
| Modality | Online instructor-led |
| Level | Intermediate |
| Dates | 19 June – 26 June 2023 |
| Duration | 8 days |
| Language | English |
| Region | World or Multi-Regional |
| Registration type | Application and selection |
| Registration deadline | 12 June 2023 |
| Training fees | 150 USD |
| Description | This course focuses on Wireless Access Technologies to Internet Network including technical, business and regulatory aspects. It includes wireless and mobile evolutions including mobility approaches by IETF and 3GPP, 4G access technologies by 3GPP (LTE/LTE-Advanced), as well as Evolved Packet Core (EPC). The course also covers the other 5G technology accepted by the ITU umbrella IMT-2020, 5G New Radio (5G NR) and 5G Core, as well as WiFi access technologies from the IEEE. Further, it includes QoS (Quality of Service) in mobile and wireless networks, mobile VoIP (Voice over IP) and mobile IPTV, OTT (Over The Top) broadband Internet services in wireless and mobile networks, as well as QoS assessment and QoS parameters for mobile services. Finally, the course focuses also on regulatory and business aspects for wireless and mobile broadband access to Internet. |

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| Training topics | Wireless and fixed broadband |
| Certification | Certificate |
| Code | 23OI100224MUL-E |

## 1. TARGET POPULATION

This course is targeted at managers, engineers and employees from regulators, government organizations, telecommunication companies and academia, who are interested in understanding, implementation and regulation of Wireless Access Technologies to Internet Network, including technologies, standardization, regulation and content. Other institutions and individuals that are dedicated in building their capacity related to Wireless Access Technologies to Internet Network are also welcome to participate.

## 2. ENTRY REQUIREMENTS

## No specific prerequisites in terms of knowledge or qualifications are required for the intended target population.3. TRAINING OBJECTIVES

At the end of the training, the participant should have gained an understanding of the key aspects of:

- Wireless and Mobile Internet fundamentals
- 4G access technologies by 3GPP: LTE/LTE-Advanced
- Evolved Packet Core (EPC) for mobile Internet network
- 5G technologies by 3GPP: 5G NR and 5G Core
- WiFi access technologies: IEEE 802.11n/ac/ad
- QoS in wireless and mobile networks
- 4G mobile VoIP and mobile IPTV
- OTT (Over-The-Top) broadband Internet services in wireless and mobile networks
- QoS assessment and QoS parameters for mobile services
- Regulatory and business aspects for wireless and mobile broadband access to Internet

## 4. METHODOLOGY

This course will be delivered using instructor-led online learning. The course methodology will be as follows:

- Each day from 19 June to 23 June 2023 there will be made available two recorded video lectures. In total, there are 10 video lectures during the course.
- Course forum, asynchronous, will be organized based on discussion topics raised by the instructor on a daily basis, from Course Day 1 to Course Day 5, which will cover the course material on the

given day. Also, participant responses will be asynchronous, keeping in mind the different time zones and daily commitments of participants from different countries around the world.

- General discussion forum, asynchronous, will be provided for participants to ask their own questions which can be answered by the instructor and other participants.
- Final Quiz test will be assigned on the last day of the course, 26 June 2023.
- All announcements for all events (lectures, quiz and forum) will be given in a timely manner (prior to the event) by the course tutor.

## 5. ASSESSMENT AND GRADING

The evaluation of the participants will be based on 80% from the Final Quiz and 20% from the answers given in the course forum on the raised discussion topics on daily basis by the tutor, thus reflecting both the quantity and the quality of time spent on the course.

Each course day, from Day 1 to Day 5, there will be raised discussion topics by the tutor in course Forum, covering the course material of the video lectures opened for that course day. Both, tutor's questions and answers from each of the participant, will be in asynchronous manner in the Course Forum, with aim to suit participants from different countries and different time zones across the globe. The answers to the raised questions contributes to 20% of the total grade.

The Final Quiz will be open from 00:00 hours on Monday (26$^{th}$ of June 2023) according to the GMT+1 time, and will remain open for 30 hours after opening, so each participant can choose the most convenient time to solve it. However, after the start of the attempt the Quiz should be completed in 90 minutes. The Final Quiz contributes with 80% in the total grade.

The course is completed successfully with a total grade of 70% or higher. The grading will be completed by the course tutor after the course is fully completed.

Each fully registered participant who successfully completes the course with a total grade of 70% or higher will receive an ITU Certificate for this course.

The ITU certificates will be given to participants via the ITU Academy platform after completion of the course reporting and processing within the ITU.

## 6. TRAINING DETAILS & INSTRUCTIONAL APPROACH

| Day | Sessions/Topics covered | Key learning points<br>(detail learning outcomes) | Training activities details |
|---|---|---|---|
| Day 1<br>Monday | Lecture 1. **Wireless and Mobile Internet Fundamentals**<br>Lecture 2. **4G access technologies by 3GPP: LTE/LTE-Advanced** | Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:<br>- Mobile evolution from 2G to 5G<br>- Internet evolution and convergence with mobile networks<br>- Mobility in all-IP networks (Mobile IP, MIPv6, 3GPP)<br>- ITU's IMT-Advanced for 4G<br>- 4G network architecture for LTE/LTE-Advanced<br>- LTE radio interface<br>- LTE-Advanced key features<br>- Throughput and latency in mobile networks<br>- Home eNodeB, Local IP Access, Selected IP Traffic Offload in 4G networks<br>- IMT spectrum<br>Small cells for mobile networks future | Watching and listening to video lectures 1 and 2. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum. |
| Day 2<br>Tuesday | Lecture 3. **Evolved Packed Core (EPC) for mobile Internet network**<br>Lecture 4. **5G technologies by 3GPP: 5G NR and 5G Core** | Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:<br>- Evolved Packet Core (EPC) including QoS<br>- IMS (IP Multimedia Subsystem) architecture<br>- 5G New Radio (NR)<br>- 5G Core network functions<br>- 5G NSA (Non Stand-Alone) and 5G SA (Stand-Alone)<br>- Network slicing in IMT-2020/5G<br>- Main 5G service scenarios: eMBB, mMTC and URLLC<br>- 5G spectrum bands vs. 5G services<br>- Integrated Access and Backhaul (IAB) for 5G | Watching and listening to video lectures 3 and 4. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum. |

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| | | - 5G URLLC and non-URLLC use cases<br>- AI/ML for 5G/IMT-2020<br><br>5G mobile Internet speeds | |
| Day 3<br><br>Wednesday | Lecture 5. **WiFi access technologies: IEEE 802.11n/ac/ad**<br><br>Lecture 6. **QoS in wireless and mobile networks** | Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:<br><br>- Main WiFi (IEEE 802.11) standards<br>- WiFi network architectures<br>- WiFi standards IEEE 802.11n/ac/ad<br>- Design of WiFi hotspots<br>- Evolution of QoS in 3GPP mobile networks<br>- QoS in LTE/LTE-Advanced, EPS and QoS parameters<br>- QoS Class Identifiers (QCI)<br>- Migration of 4G mobile networks to 5G<br>- 5G QoS framework<br>- New QoS types in 5G: delay critical GBR<br>- QoS model in 5G/IMT-2020<br><br>QoS requirements for different IoT services over 5G mobile networks | Watching and listening to video lectures 5 and 6. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum. |
| Day 4<br>Thursday | Lecture 7. **4G mobile VoIP and mobile IPTV**<br><br>Lecture 8. **OTT (Over-The-Top) broadband Internet services in wireless and mobile networks** | Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:<br>- SIP (Session Initiation Protocol) for signaling in 4G mobile networks<br>- QoS-enabled mobile VoIP for telecom operators<br>- MBMS (Multicast and Broadcast Multimedia System) and Evolved MBMS systems for mobile TV/IPTV<br>- mobile broadband access for OTT services<br>- OTT VoIP services over mobile network<br>- Comparison between Telco and OTT VoIP<br>- OTT multimedia streaming: Youtube<br>- Mobile social networking<br><br>Mobile cloud computing and OTT cloud services | Watching and listening to video lectures 7 and 8. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum. |

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| Day 5<br>Friday | Lecture 9. **QoS assessment and QoS parameters for mobile services**<br>Lecture 10. **Regulatory and business aspects for wireless and mobile broadband access to Internet** | Outline, discuss, use, analyze, design and evaluate the following topics using technical, business and regulatory aspects:<br>- Relationship between network performance, QoS and QoE<br>- ITU's QoS models<br>- QoS assessment process<br>- Service independent and service dependent QoS criteria<br>- Mobile data traffic and revenues<br>- Regulatory approaches in mobile networks<br>- ITU's QoS model for mobile services – layered approach<br>- Mobile QoS Measurements<br>- Mobile KPIs (Key Preformance Indicators) for different services<br>- Audit of Quality of Service<br>- Enforcement of QoS in mobile networks<br>Mobile QoS regulation practices | Watching and listening to video lectures 9 and 10. Answering on questions asked by the tutor, and possibility to ask questions to him via course forum. |
| Day 6<br>Saturday | Time to consolidate the acquired knowledge | Summarizing the knowledge | Possibility to watch all video lecture once again with possibility to ask questions to the tutor. |
| Day 7<br>Sunday | Time to consolidate the acquired knowledge | Summarizing the knowledge | Possibility to watch all video lectures once again with possibility to ask questions to the tutor. |
| Day 8<br>Monday | Final Quiz | Final assessment | Solving the Final Quiz. |

## 7. TUTORS/INSTRUCTORS

| Name of tutor(s)/instructor(s) | Title | Contact details |
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| Prof. Dr. Toni Janevski | Professor Doctor | tonij@feit.ukim.edu.mk |

## 8. TRAINING COURSE COORDINATION

| Course coordinator | ITU coordinator |
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| Name: Dr. Sylwester Laskowski<br>Title: Doctor, Chief Training Specialist<br>Email address: s.laskowski@il-pib.pl | Name: Emil-Eugen Iuga<br>Title: Capacity and Skills Development officer<br>Email address: emil-eugen.iuga@itu.int |