



**ITU Centres of Excellence Network for Europe**  
**The Abdus Salam International Centre for Theoretical Physics**

**Online Training Course on**  
**5G technologies for IoT**  
**September 28-30, 2020**

**COURSE OUTLINE**

|                       |   |
|-----------------------|---|
| Title                 | 5G technologies for IoT   |
| Objectives            | <p>5G technologies address a variety of applications in many fields, but those related with IoT are of particular interest given the great number of devices that are being connected. There is no doubt that 5G will play a pivotal role, both in massive and in critical applications.</p> <p>This capacity building course aims to provide the audience with an understanding of the 5G aspects relevant to IoT. Participants will be exposed to the general aspects of wireless networking with the particular requirements of machine type communications and will then dive into specifics of LTE-M and NB-IoT.</p> |
| Dates                 | September 28-30, 2020   |
| Duration              | 3 days  |
| Registration deadline | September 25, 2020  |
| Training fees         | USD 200   |
| Course code           | 20OI24833EUR-E  |

**LEARNING OUTCOMES**

- A basic understanding of IoT and its application scenarios.
- An understanding of 5G and its use cases.
- An understanding of 5G and IoT.

## TARGET POPULATION

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The training course is designed for:

- Electrical engineers
- Telecommunications engineers
- Computer scientists
- Regulators
- Telecom Operators
- Networks Operators
- Managers

## TUTORS/INSTRUCTORS

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| NAME OF TUTOR(S)/INSTRUCTOR(S)                  | CONTACT DETAILS                     |
|---|-------------------------------------|
| Anna Forster, University of Bremen              | anna.foerster@comnets.uni-bremen.de |
| Ermanno Pietrosevoli, ICTP                      | ermanno@ictp.it                     |
| Suresh Borkar, Illinois Institute of Technology | borkar@iit.edu                      |
| SUN Tan, Huawei                                 | suntan@huawei.com                   |

## EVALUATION

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For grading we will evaluate exams with multiple choices and participation in the discussion forum using the following weights:

$$G = 0.3 \times Q1 + 0.3 \times Q2 + 0.3 \times Q3 + 0.1 \times DF$$

Where: Q1 – quiz 1 at the end of the first day, Q2 – quiz 2 at the end of the second day, Q3 – quiz 3 at the end of the third day, DF – active participation in the online discussion forum.

A final grade of 70% is necessary to receive a participation certificate.

## TRAINING SCHEDULE AND CONTENTS / AGENDA

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### Schedule and content (for online courses)

| Session | Activity   | Exercises and interactions |
|---------|--|----------------------------|
| Day 1   | <b>IoT Introduction and Applications (Prof. Anna Forster, University of Bremen)</b> <ul style="list-style-type: none"><li>• History and definition of IoT</li><li>• Applications scenarios</li></ul> | Quiz 1 (multiple choices)  |

|                     |   |                                  |
|---------------------|---|----------------------------------|
|                     | <ul style="list-style-type: none"> <li>• Related Terminology</li> <li>• IoT Components</li> <li>• Main challenges of the IoT</li> <li>• ICT, IoT and the sustainable development goals</li> </ul> <p><b>The Electromagnetic Spectrum and its regulation (Prof. Ermanno Pietrosemoli, ICTP)</b></p> <ul style="list-style-type: none"> <li>• Spectrum as a commons</li> <li>• Spectrum regulators, ITU and national bodies<br/>Homologation and type approvals<br/>Licensed, unlicensed and lightly licensed spectrum<br/>Dynamic spectrum access</li> <li>• Radio channel<br/>Channel capacity<br/>Spectral Efficiency<br/>Path Loss<br/>Power Budget (Maximum Coupling Loss)<br/>Range versus speed</li> <li>• New spectrum allocations for 5G</li> <li>• Biological effects of EM radiation</li> </ul>  |                                  |
| <p><b>Day 2</b></p> | <p><b>Introduction to 5G (Prof. Suresh Borkar, Illinois Institute of Technology)</b></p> <ul style="list-style-type: none"> <li>• Differentiation with respect to 4G<br/>Performance, Functionality, Multi-RAT</li> <li>• Cloud Based 5G Radio Network and Core<br/>4G Hardware Base, Network Functions</li> <li>• Radio Access Network (gNB) Architecture<br/>High Bandwidth, Low Latency, Wide Coverage,<br/>Robust Error Management<br/>MmWave Spectrum Operation, MIMO,<br/>Steerable Beams</li> <li>• 5G Core<br/>Network Slicing, Software defined networking (SDN), Network function virtualization (NFV)<br/>Multi Edge Computing (MEC)</li> <li>• 5G System Operations<br/>Standalone, Roaming, and Handover Mobility</li> <li>• Stand Alone and Non Stand Alone<br/>deployments<br/>Interworking and Dual Connectivity Solutions</li> </ul> | <p>Quiz 2 (multiple choices)</p> |

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|                     | <p><b>3GPP and 5G Specification (Mr. SUN Tan, Huawei)</b></p> <ul style="list-style-type: none"> <li>• Introduction of 3GPP and the work groups</li> <li>• 5G Specification road map</li> <li>• 3GPP R15 Key Technologies</li> <li>• New technology and enhancement in 3GPP R16</li> </ul> <p><b>5G Operations and Market Introduction (Mr. SUN Tan, Huawei)</b></p> <ul style="list-style-type: none"> <li>• 5G global industry progress<br/>Network Vendor's E2E product solution readiness<br/>5G terminal and specification: chipset, handsets and modules</li> <li>• 5G Spectrum auction progress</li> <li>• 5G commercial plan and business development</li> </ul>   |                                  |
| <p><b>Day 3</b></p> | <p><b>5G Use cases (Prof. Suresh Borkar, Illinois Institute of Technology)</b></p> <ul style="list-style-type: none"> <li>• IoT Application Characteristics</li> <li>• Correlation between Application Characteristics and 5G Solution</li> <li>• Selected Use Cases with 5G Contributions<br/>Industrial Digitization<br/>Intelligent Health Management<br/>Smart Agriculture<br/>Intelligent Transportation Infostructure</li> </ul> <p><b>Application of AI to 5G (Mr. SUN Tan, Huawei)</b></p> <ul style="list-style-type: none"> <li>• Opportunities and Challenges involved by 5G</li> <li>• Connectivity + AI enable autonomous driving network</li> <li>• Key Application Scenarios of ADN - MBB Wireless Network</li> <li>• Key Application of ADN - Transformation + Cooperation</li> </ul> <p><b>5G and IoT (Prof. Suresh Borkar, Illinois Institute of Technology)</b></p> <ul style="list-style-type: none"> <li>• IoT Characteristics<br/>Massive IoT, Broadband IoT, Critical IoT, Industrial Automation IoT</li> <li>• 5G Cellular IoT (CIoT)<br/>5G Foundation for Digital Transformation<br/>5G Benefits to IoT</li> </ul> | <p>Quiz 3 (multiple choices)</p> |

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|  | <ul style="list-style-type: none"> <li>• 5G Standardized Offers<br/>Enhanced Mobile Broadband (eMBB), massive Machine Type Communications (mMTC), Ultra Reliable and Low Latency Communications (UR-LLC)</li> <li>• Applicability of 5G to IoT<br/>Dynamic Network Slicing, Network Exposure, Network Analytics, Spectrum Flexibility, Device Flexibility, Inter Radio Access (RAT) Support<br/>5G Evolution and Roadmap for IoT<br/>Enhancements for IoT Solutions<br/>Interface with NB-IoT and LTE-M; 5G-Light in Release 17<br/>5G Challenges in Support of IoT</li> </ul> <p><b>IoT connectivity options: their strengths and limitations (Prof. Ermanno Pietrosemoli, ICTP)</b></p> <ul style="list-style-type: none"> <li>• Short range connectivity options<br/>Zigbee, BLE, Z-Wave, Thread, 6LowPAN, Dash 7, Home RF</li> <li>• Medium range connectivity options<br/>WiFi, Legacy Cellular</li> <li>• Low power wide area networks (LPWAN)<br/>LoRa, LoRaWAN, SigFox, RPMA<br/>NB-IoT, LTE-M<br/>Comparison of LPWAN solutions</li> <li>• Low Earth Orbit Satellites for IoT</li> </ul> <p><b>Cyber Security and Reliability Design (Prof. Suresh Borkar, Illinois Institute of Technology)</b></p> <ul style="list-style-type: none"> <li>• Security Threats and Mitigations<br/>Access security (Authorization), Confidentiality (Cipherring), Identity protection (Authentication), Information protection (Integrity)</li> <li>• Context for 5G Security<br/>4G Security Structure as a Base<br/>New paradigm of Expanded Exposure, Multiple Stake Holders<br/>User Identities and Key Structure</li> <li>• System Wide Security Elements<br/>Multi Domain Security<br/>New Elements and Their Interactions<br/>Network Slices, SDN, and NFV Security</li> <li>• Wider Considerations<br/>Use of External Authentication, Authorization,</li> </ul> |  |
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|  | and Accounting (AAA) unit<br>Private Network Infrastructure <ul style="list-style-type: none"> <li>• Reliability<br/>Radio, Core, and Cloud Elements<br/>Technology Structures</li> </ul> |  |
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## METHODOLOGY

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The training will be instructor-led and will include videos, PowerPoint slides and multiple-choice quizzes.

## COURSE COORDINATION

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| <b>Course coordinator:</b><br>Name: Marco Zennaro<br>Email address: <a href="mailto:mzennaro@ictp.it">mzennaro@ictp.it</a> | <b>ITU coordinator:</b><br>Name: Jaroslaw Ponder<br>Email: <a href="mailto:hcbmail@itu.int">hcbmail@itu.int</a> |
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## REGISTRATION AND PAYMENT

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### 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>

### Training 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/5g-technologies-iot-0>

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

### Payment

#### 1. On-line payment

A training fee of USD 200 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/5g-technologies-iot-0>

#### 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](mailto: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:

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|---------------------------|--|
| Name and Address of Bank: | UBS Switzerland AG<br>Case postale 2600<br>CH 1211 Geneva 2<br>Switzerland |
| Beneficiary:              | Union Internationale des Télécommunications                                |
| Account number:           | 240-C8108252.2 (USD)   |
| Swift:                    | UBSWCHZH80A  |
| IBAN                      | CH54 0024 0240 C810 8252 2   |
| Amount:                   | USD 200  |
| Payment Reference:        | CoE-24833-P.40595.1.09   |

### 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.