



## Location

**New address:** CCG-Zentrum, Technologiepark  
Argelsrieder Feld 22, bldg. TE 03, D-82234 Wessling-Oberpfaffenhofen  
A list of nearby accommodations, a description of the location and hints for travel will be mailed to the participants upon registration. Please make your own hotel accommodation.

## Fee

EUR 1.250,-  
CCG is a non-profit organisation, exempt from value-added tax in Germany. For foreign seminar locations the local tax regulations are applicable.  
Members of CCG receive a discount of 10 %. Where several employees from one company / office apply for the same course, each participant will receive a discount of 10 %. For students special rates are available on request. Discounts cannot be combined.  
Please pay by non-cash means after receiving the invoice.

## Registration

Please write or call (up to 3 weeks before the seminar) to Carl-Cranz-Gesellschaft e.V.; Argelsrieder Feld 22, D-82234 Wessling  
Tel. +49 (0) 8153 / 88 11 98 -12, Fax -19, E-Mail: [anmelden@ccg-ev.de](mailto:anmelden@ccg-ev.de)  
**Internet:** [www.ccg-ev.de](http://www.ccg-ev.de)  
After receipt of registration, a confirmation letter will be sent.

## Further Information

For more information about our organization please do not hesitate to contact the CCG at Oberpfaffenhofen at the phone number given above.  
For more information on the content of the seminar please contact  
Federico Clazzer, DLR, German Aerospace Center  
Oberpfaffenhofen, D-82234 Wessling  
Tel. +49 (0) 8153 / 28-1120, E-Mail: [federico.clazzer@dlr.de](mailto:federico.clazzer@dlr.de)

## Substitutions and Cancellations

Substitutions may be made at any time. Cancellation of an accepted registration made up to 10 days prior to the start of the seminar is subject to a EUR 25,- administrative fee. Participants canceling after that date are responsible for the entire seminar fee.  
CCG reserves the right to cancel a course up to 10 days before the course's beginning in case of low number of participants or for other significant reasons. Furthermore, CCG reserves the right, against the announcement in the programme, to possibly replace at short notice a lecturer and also the lecturer's topic. Any claims for damages shall be excluded.

## Who Should Attend

The course is of interest for all employees and experts of companies that work in the communications area, from network operators, to terminals designers. Moreover is of interest for all companies and experts that would like to get some basic knowledge about machine-to-machine communications and Internet of Things.

## Focus

The course will introduce the concept and design principles of the Internet of Things (IoT) and in particular of machine-to-machine communications. Special attention is given to existing technology including licensed band solutions, e.g. LTE-M, eMTC, EC-GSM-IoT and Narrowband-IoT (NB-IoT) as well as unlicensed band solutions as Low Power Long Range (LoRA), Ingenu, ultra-Narrowband (SigFox, NB-Fi). IoT via satellite is also presented together with existing standards and technology solutions. Finally, an outlook to the current standardization efforts in 3GPP dealing with IoT and beyond 5G investigations is provided.

## Lecturers

Federico Clazzer	DLR, Oberpfaffenhofen
Andrea Munari	Institute of Communications and Navigation

## Seminar DK 1.23

# Communications Technologies for the Internet of Things

**November 8 – 9, 2022**  
**Oberpfaffenhofen near Munich**

## Scientific Coordination

Federico Clazzer  
DLR, German Aerospace Center  
Oberpfaffenhofen

## Seminar Outline

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**Tuesday, November 8, 2022**  
**10.15 – 16.30**

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10.15 – 10.30	<b>Introduction</b>
10.30 – 12.00	<b>Internet of Things: a Primer</b> Federico Clazzer, Andrea Munari Internet of Things (IoT) applications, e.g. Industry 4.0, smart city, smart grid – IoT and machine-to-machine (M2M) basics and challenges – IoT in current and standards – importance of access control techniques for M2M
13.00 – 14.30	<b>Fundamentals of Access Control Protocols for IoT applications</b> Federico Clazzer, Andrea Munari Uncoordinated/grant-free protocols – the role of interference – spread spectrum fundamentals – ALOHA, performance and limitations
15.00 – 16.30	<b>Internet of Things Technologies in 5G – NB-IoT, LTE-M and Grant-free Access</b> Federico Clazzer, Andrea Munari 5G IoT alternatives: LTE-M, eMTC, NB-IoT and EC-GSM-IoT – MAC layer details – IoT in 3GPP Rel. 16, e.g. Early Data Transmission (EDT) and 2-Step Random Access (RA)

**Wednesday, November 9, 2022**  
**08.30 – 16.30**

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08.30 – 10.00	<b>Internet of Things Technologies in Unlicensed Bands I – LoRa, SigFox</b> Federico Clazzer, Andrea Munari Ultrawideband solutions, SigFox – spread spectrum solutions, LoRaWAN – PHY layer details – MAC layer details
10.30 – 12.00	<b>Internet of Things Technologies in Unlicensed Bands II – Ingenu RPMA, WAVEIoT, NB-Fi</b> Federico Clazzer, Andrea Munari WAVEIoT NB-Fi, Ingenu RPMA – PHY layer details – MAC layer details - applications
13.00 – 14.30	<b>IoT via satellite</b> Federico Clazzer, Andrea Munari Benefits and challenges of IoT connectivity via LEO satellites – satellite link practical issues, e.g. Doppler – SigFox/LoRa via satellite – S-MIM standard – advanced concepts via satellite and DVB-RCS2 standard – Non-terrestrial-network (NTN) in 3GPP standard
15.00 – 16.30	<b>Internet of Things Beyond 5G</b> Federico Clazzer, Andrea Munari Outlook beyond 5G, e.g. 3GPP Rel. 17 and beyond – recently developments in grant-free access

### Material

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Each attendant will be provided with detailed course material in English.

### Language

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English

### Additional Courses

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- „Ad Hoc Networks: Peer to Peer for wireless networking“, 18.–19.10.2022 (Code DK 1.22)
- „Mehrantennensysteme (MIMO-Systeme)“, 10.–12.10.2022 (Code DK 1.04)
- „5G Next Generation Mobile Communication“, 11.–12.10.2022 (Code DK 2.37)