Title
Metasource-Based Physical-Layer Security for Future Wireless Networks

Duration
Full day (3 hours)

Presenter
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Bio
Yuli Yang received the Ph.D. degree in communications and information systems from Peking University (China).

She is a Senior Lecturer in Communications and Networks, with the University of Essex (UK). Prior to joining the University of Essex, she was with the University of Lincoln (UK), the University of Chester (UK), Meliksah University (Turkey), and King Abdullah University of Science & Technology (Saudi Arabia) on various academic positions. Her industry experience includes working with Bell Labs Shanghai (China) as a Research Scientist and with Huawei Technologies (China) as an Intern Researcher.

Her research interests include modelling, design, analysis, and optimisation of wireless systems and networks, specifically in physical-layer security, permutation-based modulation/transmission, and ultra-reliable low-latency communications.

Description
The physical-layer security (PLS) is a promising concept to complement the cryptographic technologies at upper layers in wireless networks. Various channel-based approaches, e.g., secret-key extraction, directional modulation, and artificial-noise injection, have been conceived to exploit wireless channel characteristics in providing PLS.

Recently, legitimate channel-gain-mapped sources have been developed to constitute a novel technology of the physical-layer secret key generation, referred to as metasource-based secret key (MBSK). In contrast to the channel-based approaches, the MBSK technology not only promotes the actual realisation of the PLS concept but also induces green communications for future wireless networks.

This tutorial introduces the MBSK technology through discussing its design principles, the latest advantages, the challenges, and the road ahead in the research. Our hope is to facilitate researchers who might have interests in the PLS concept would like to kick-start their understanding of recently developed techniques in the MBSK realm.
The content of this tutorial is as below:

1. Information-theoretic PLS models
   • Shannon's communications security
   • Wyner's wiretap channel
2. Metrics for PLS evaluation
   • Secrecy rate
   • Error probability difference between Bob and Eve
   • Secrecy energy efficiency
   • Secrecy margin
3. Channel-based PLS techniques
   • Secret-key distillation
   • Directional modulation
   • Artificial-noise injection
4. Metasource-based PLS techniques
   • Modulation mapping pattern
   • Constellation design pattern
   • Channel-coding pattern
5. The road ahead
   • MBSK generation methods
   • MBSK pattern design
   • Rich scattering propagation
   • Cross-layer security
   • Federated learning for privacy

**Expected audience**
The researchers who are interested in physical-layer security.
The number of attendees in the tutorial will depend on the number of attendees in the conference.

**Recent publications (denoting the corresponding author)**

*Journal Articles*


Conference Papers


Relevance

This tutorial is on the up-to-date physical-layer security technologies for future wireless networks. The physical-layer security (PLS) is a promising concept to complement the cryptographic technologies at upper layers in wireless networks. Various channel-based approaches, e.g., secret-key extraction, directional modulation, and artificial-noise injection, have been conceived to exploit wireless channel characteristics in providing PLS.

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**Previous editions:**

The tutorial was given once, in the International Wireless Communications & Mobile Computing Conference (IWCMC 2023), on 19th June 2023.

Please refer to the webpage below.

[https://iwcmc.org/2023/tutorial-speakers/](https://iwcmc.org/2023/tutorial-speakers/)

In comparison with the previous version, the tutorial for ICCC 2023 will introduce more future research directions, specifically on federated learning based solutions.