VIETNAM NATIONAL UNIVERSITY-HCMC
Ho Chi Minh City University of Technology

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INFORMATION OF THE DISSERTATION

Ph.D. candidate: **DO DAC THIEM**

Dissertation's title: **PHYSICAL LAYER SECURITY IN UNDERLAY COGNITIVE RADIO NETWORKS**

Major: **Telecommunications Engineering**

Major code: **62.52.02.08**

Science advisor: **Associate Prof. HO VAN KHUONG**

Institution: **Ho Chi Minh City University of Technology, Vietnam National University - Ho Chi Minh City**

1. Objectives of the dissertation

Currently, Fifth-Generation wireless communications (5G) is being researched and deployed worldwide. 5G enables connections of more devices than ever before in the Internet of Things. Therefore, 5G along with the explosion of next-generation wireless services such as video calling, high-quality streaming, and high-speed internet access through mobile devices cause a shortage of spectrum, which can be solved by cognitive radio technology. On the other hand, information security plays a crucial role in next-generation wireless communications systems. Typically, information security is implemented at higher layers of the Open Systems Interconnection (OSI) model through the design of cryptographic protocols. However, with advances in hardware technology, achieving information security based solely on cryptographic protocols is not enough. This is why a new model for information security has shifted towards implementation at the physical layer. Therefore, researching Physical Layer Security (PLS) in Underlay Cognitive Radio Network (UCRN) is essential and urgent. That is the reason for conducting this dissertation. The following are the objectives of the dissertation:

- Study the PLS of UCRN under realistic and strict operational conditions. More specifically, analyzing system performance accounts for system parameters and specific characteristics of wireless channels such as maximum transmit power, interference power threshold, predefined security capacity, primary network interference, imperfect Rayleigh fading channel information, and the severity of Nakagami-*m* fading.

- Study the PLS of Energy-Harvesting Underlay Cognitive Radio Networks over relatively general Nakagami-*m* fading channels.
- Propose solutions to enhance the performance of PLS in UCRN. Subsequently, the dissertation analyzes and demonstrates the effectiveness of the proposed solutions.

2. Contributions of the dissertation:

The dissertation has fulfilled all the initial objectives and made the following key contributions:

- The dissertation proposes new system models of UCRN and analyzes their PLS under realistic and strict operational conditions. The novelty of these models is considering parameters such as maximum transmit power of secondary transmitters, interference power threshold that primary receivers can tolerate, imperfect Rayleigh fading channel information, Nakagami-*m* fading channels, radio frequency energy harvesting techniques, etc. Moreover, the PLS performance of these model is analyzed and evaluated.
- The dissertation proposes two solutions to enhance the PLS performance of UCRN with Helpful Jammer and Energy Harvesting Underlay Cognitive Radio Relaying Network. The analytical results demonstrate that these two solutions significantly improve security performance. Consequently, these analytical results can be used to optimize security performance and network design.
- The dissertation proposes new mathematical expressions to calculate the secrecy outage probability of the proposed system models and solutions. The accuracy of these expressions is verified through Monte-Carlo simulations. These expressions are of great significance in evaluating security capabilities, optimizing performance, and network design.

The contributions in this dissertation provide a solid scientific foundation for future research on physical layer security, cognitive radio networks, and radio frequency energy harvesting. These contributions are really essential in practice. Additionally, the dissertation is a completely new research work that meets the requirements of deploying current wireless communications systems and keeps up with the research trends worldwide.

Date:

Scientific Advisor	**Ph.D. Candidate**
Associate Prof. HO VAN KHUONG	DO DAC THIEM