VIETNAM NATIONALUNIVERSITY, HANOI
VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

SOCIALISTREPUBLIC OF VIETNAM
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INFORMATION ON DOCTORAL THESIS

1. Full name : Nguyen Thi Thuy Lien 2. Sex: Female

3. Date of birth: 23/7/1988 4. Place of birth: Hai Phong

5. Admission decision number: Decision No. 778/QD-CTSV dated August 21, 2017, issued by the Rector of University of Engineering and Technology.

6. Changes in academic process:

7. Official thesis title: *Propose exact and approximate solutions of traffic engineering and reliability guarantees for service function chaining in Network Function Virtualization.*

8. Major: Computer Networks and Data Communications 9. Code: 9480102.01

10. Supervisors: Assoc. Prof. Ho Si Dam and Dr. Pham Tuan Minh

11. Summary of the **new findings** of the thesis:

The thesis investigates exact and approximate solutions of traffic engineering and reliability guarantees for service function chaining in Network Function Virtualization. All proposals of the thesis are considered in both theoretical and experimental aspects. The thesis's proposals are described and analyzed by mathematical models. The effectiveness of the proposed solutions is evaluated through a network simulator. The major contributions of the thesis are as follows.

Firstly, the thesis proposes a traffic steering with multipath routing that considers fluctuations in data traffic over time and type of service to improve network performance in an NFV environment. The experiment results demonstrate that the proposed approach for traffic steering of NFV systems performs better than a scheme that ignores the classification and the fluctuations of demand volume.

Secondly, the thesis proposes the joint optimization placement problem of primary VNFs and their corresponding backup VNFs in the edge layer of an NFV-enabled IoT system in Edge Computing to avoid single node failures while reducing the overall costs and increasing the minimal reliability of SFCs overall service requests. The thesis also proposes a cost-efficient VNFs redundancy scheme that requires fewer backup costs while maintaining a high request acceptance ratio. The experiment results show that the proposed redundancy mechanism can reduce the backup cost by up to 30–40% while maintaining the same ratio of satisfied service requests.

12. Practical applicability, if any:

It can be applied to help network service providers improve some network performance parameters and improve resource efficiency in Network Function Virtualization systems.

13. Further research directions, if any:

There are several interesting research directions in our research areas. For the traffic steering problem, our future work will investigate more effective multipath routing strategies in traffic control to improve the performance of the NFV network. Another important direction might be an efficient routing solution that responds to the dynamic change of service requests over time. For the reliable SFCs problem, our future work will investigate shared backup resources for further cost-effective allocation. Another important direction might be the SFCs placement strategies in multiple edge data-centers.

14. Thesis-related publications:

[1] **Thi-Thuy-Lien Nguyen**, Tuan-Minh Pham, "*Optimization Model and Algorithm for Dynamic Service-Aware Traffic Steering in Network Functions Virtualization*". In Proceedings of the 2018 IEEE Seventh International Conference on Communications and Electronics (ICCE), Hue-Vietnam, 2018, **(Scopus)**

[2] **Thi-Thuy-Lien Nguyen**, Tuan-Minh Pham, "*Efficient Traffic Engineering in an NFV Enabled IoT System*". Sensors, vol. 20, June 2020, 3198. **(SCIE, Q1)**

[3] **Thi-Thuy-Lien Nguyen**, Tuan-Minh Pham, Linh Manh Pham, "*Efficient Redundancy Allocation for Reliable Service Function Chains in Edge Cloud Computing*". Journal of Network and Systems Management, vol. 31 December 2022. **(SCIE, Q2)**

Date: June 8 th, 2023
Scientific advisor

Date: June 8 th, 2023
Ph.D. Candidate