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| **Department** | School of Engineering and the Built Environment |
| **Supervisors** | Prof. Berk Canberk, Prof. Ahmed Al-Dubai, Prof. Amir Hussain |
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| **Project Title** | Smart Attack Detection and Mitigation for Autonomous Core Networks Using Digital Twin |

**PROJECT DESCRIPTION**

An internet service provider's primary responsibility is to ensure connectivity among content suppliers and end users, as well as seamless connectivity at high speeds. Internet service providers manage vast amounts of traffic in their networks, and attacks are targeted at vital network services and infrastructure. Commercially available attack solutions are constrained to edge networks and data centers. They are insufficient since managing attack detection over the entire network is impossible. Therefore, core network attack detection and mitigation are essential to managing the whole network. The core network monitoring is highly complex due to many indicators and multidimensional data that need to be monitored. With machine learning or deep learning algorithms, digital twin technology enables what-if analysis, predictive maintenance, and real-time monitoring and control to understand network activities across all physical devices' lifecycles.

With these motivations in perspective, the candidate will design a three-layered digital twin, including the physical layer, the digital twin layer, and the service layer, during this Ph.D. study. An online learning mechanism will be developed to detect and mitigate attacks intelligently and autonomously. Two specific APIs will be designed to enable real-time monitoring, detection, and mitigation between the physical layer and the digital twin layer, as well as between the digital twin layer and the service layer. Consequently, this Ph.D. study will deliver a DT-enabled autonomous attack detection and solution using online learning in core networks.

Before submitting their applications, potential applicants are advised to contact the Supervisor. Applications should include a description of the project and the names of the supervisors.

**Academic qualifications**

A first degree (at least a 2.1) ideally in Electrical and Computer Engineering with a good fundamental knowledge of Computer Networks, IoT, Simulation tools like Ansys, Anylogic, Matworks Simulink, Labview and programming languages like Python or R.

**English language requirement**

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

**Essential attributes:**

- Experience of fundamental Software Enginering, Computer Engineering
- Competent in Algoritmic Design, Machine Learning and Database Systems
- Knowledge of Simulation Environments, Data Management, and Network
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

**Desirable attributes:**

Real-Time Monitoring, Core Network Management, Smart Attack Detection and Mitigation

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| **Indicative Bibliography** | Y. Yigit, B. Bal, A. Karameseoglu, T. Q. Duong and B. Canberk, "Digital Twin-Enabled Intelligent DDoS Detection Mechanism for Autonomous Core Networks," in IEEE Communications Standards Magazine, vol. 6, no. 3, pp. 38-44, September 2022, doi: 10.1109/MCOMSTD.0001.2100022.<br><br>Y. Wu, K. Zhang, and Y. Zhang, “Digital Twin Networks: A Survey,” IEEE Internet of Things J, vol. 8, no. 18, May 2021, pp. 13,789–804.<br><br>A. Saad, S. Faddel, T. Youssef and O. A. Mohammed, "On the Implementation of IoT-Based Digital Twin for Networked Microgrids Resiliency Against Cyber Attacks," in IEEE Transactions on Smart Grid, vol. 11, no. 6, pp. 5138-5150, Nov. 2020, doi: 10.1109/TSG.2020.3000958. |
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| **Enquiries** | For informal enquiries about this PhD project, please contact Prof. Berk Canberk, b.canberk@napier.ac.uk |
| **Web page** | https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process |