1 Introduction

In today's cybersecurity landscape, MITM attacks remain a significant threat, as attackers exploit unsecured communication channels to intercept and manipulate sensitive data. With the increasing complexity of network environments and the proliferation of remote work, organizations rely heavily on Intrusion Detection Systems (IDS) to monitor network traffic and detect any signs of unauthorized access or malicious activity, including MITM attempts. As cyber threats evolve, incorporating advanced MITM prevention techniques such as end-to-end encryption and integrating robust IDS solutions has become essential for organizations to enhance their security posture and protect against the growing risks in today's digital world.[1][2]. MITM attacks exploit vulnerabilities in communication protocols, such as SS7. Despite the introduction and increasing adoption of 5G and newer technologies, 3G remains in use. As illustrated in Figure 1, the 3G phase-out is far from complete. Securing SS7 poses significant challenges due to limited access to open datasets, which are restricted by privacy concerns [3]. Although efforts to improve SS7 security using machine learning have been documented [4], the inherent transparency of these "black-box" models raises concerns about their trustworthiness [5].

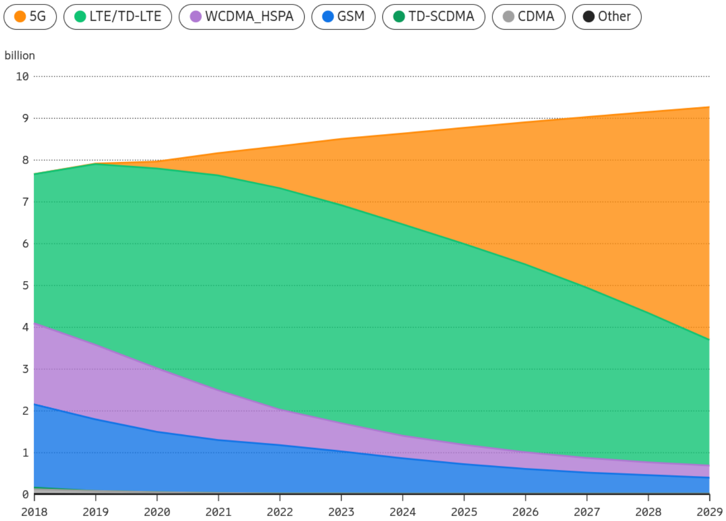

Fig. 1. Number of 3G, 4G, and 5G Subscribers as per Ericsson Study [6]

To enhance transparency, tools such as SHAP explain AI decision-making processes, increasing trust in these technologies. This study employs interpretable algorithms, including Random Forest, Autoencoders, and K-Means, chosen for their balance of precision and interpretability. Random Forest improves detection accuracy and mitigates overfitting through the use of ensemble decision trees. Meanwhile, Autoencoders and K-Means are utilized for dimensionality reduction and data clustering tasks, respectively.

This research develops detection models that are interpretable, reliable, and robust. Detailed results and analysis are provided in the subsequent sections of this study.