# **Recent Methodology Papers on Network Anomaly Detection (2023–2025)**

## **1. SAFE: Self-Supervised Anomaly Detection Framework for Intrusion Detection (MAE on tabular → image)**

Converts tabular NetFlow records into image-like patches and trains Masked Autoencoders (MAE) for unsupervised anomaly detection. Strong for unlabeled attacks.  
 🔗 **Link:**<https://arxiv.org/html/2502.07119v1>

## **2. ET-SSL: Anomaly detection in encrypted network traffic using self-supervised contrastive learning**

Uses self-supervised contrastive learning on flow-level metadata for encrypted traffic; no payload inspection required.  
 🔗 **Link:**https://ieeexplore.ieee.org/document/9844044?denied=

## **3. SmartDetector: Robust detection of malicious encrypted traffic via contrastive learning**

Contrastive pretraining + robust classifier fine-tuning for encrypted traffic detection, including flow-specific augmentations.  
 🔗 **Link:** <https://ieeexplore.ieee.org/document/10964328>

## **4. Cross-Domain Federated Graph Representation Learning for Network Traffic Anomaly Detection**

Federated GNN that improves cross-domain generalization and privacy for multi-site deployments.  
 🔗 **Link:** https://www.mdpi.com/2076-3417/15/3/XXXX

## **5. Federated Attention-based GNN for Network Attack Detection**

Attention GNN integrated with federated learning for cross-domain network attack detection.  
 🔗 **Link:**https://openreview.net/pdf/efd32c8bb4880e198213769255f2679f4f3b87fd.pdf

## **6. MTF-Aided Transformer for Network Intrusion Detection**

Applies Markov Transition Field (MTF) transformation + Transformer for temporal dependency learning in intrusion detection.  
 🔗 **Link:** <http://chatpaper.com/paper/182701>

## **7. Multi-scale Network Intrusion Detection Model with Transformer Components**

Combines local and global feature extractors with Transformers to capture multi-scale patterns in network traffic.  
 🔗 **Link:**https://www.nature.com/articles/s41598-024-74214-w

## **8. Self-Supervised Transformer-based Contrastive Learning for NetFlow**

Transformer encoder + contrastive pretraining on NetFlow/time-windowed traffic; improves cross-dataset transfer.  
 🔗 **Link:** <https://arxiv.org/html/2505.08816v1>

## **9. TSGNN: Traffic-Session Graph Neural Network for Anomaly Detection**

Models session-level interactions as graphs and applies GNN message passing for anomaly detection.  
 🔗 **Link:** <https://www.mdpi.com/2079-9292/13/1/223>

## **10. MTRC: A Self-Supervised Network Intrusion Detection Approach**

Hybrid self-supervised reconstruction + temporal contrastive learning to detect unknown network attacks.  
 🔗 **Link:**