Intrusion Detection using Peer-to-Peer Distributed Context-Information for Electric Vehicle Supply Equipment

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Introduction

Christoph Moser

About Me

- **B.Sc. in Computer Science**, Technische Hochschule Ingolstadt (2022)
- **M.Sc. in Computer Science** with a focus on **Computer Engineering**, Ostbayerische Technische Hochschule Regensburg (2024)
- Since **June 2024**, working as a **Scientific Assistant** at the **Automotive Security Laboratory** at OTH Regensburg, contributing to the **ReSiLENT Project** on secure EV charging infrastructure
- My **research interests** include **Peer-to-Peer Networks**, **Security Engineering**, and **e-mobility infrastructure security**

Introduction

Aims and contributions of our paper

Aims:

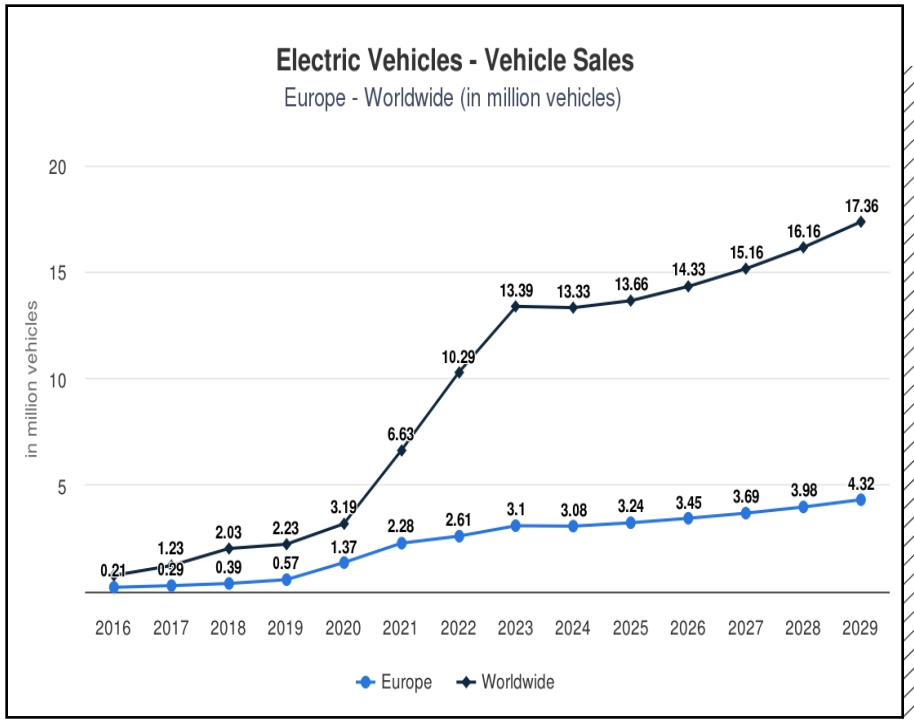
- Develop a cost-effective system designed for seamless integration into charging stations and wallboxes, enhancing inherent security features.
- Contribute to the long-term resilience of e-mobility infrastructure by securing Electric Vehicle Supply Equipment (EVSE) against emerging threats.

Contributions:

- Introduction of a novel system architecture specifically engineered to meet the outlined security and integration objectives.

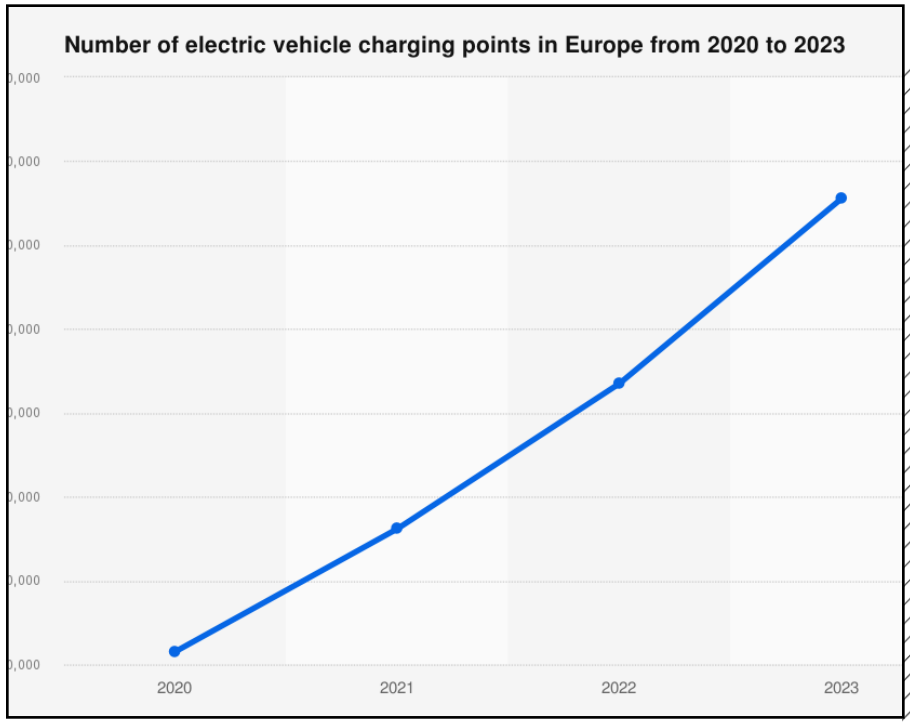
Introduction

Current trends in E-Mobility



Electric Vehicle Sales

Source: https://www.statista.com/outlook/mmo/electric-vehicles/europe#unit-sales



Charging Points in Europe

Source: https://www.statista.com/statistics/1537841/public-ev-charging-points-installed-worldwide-by-power-rating/

Threat Landsape

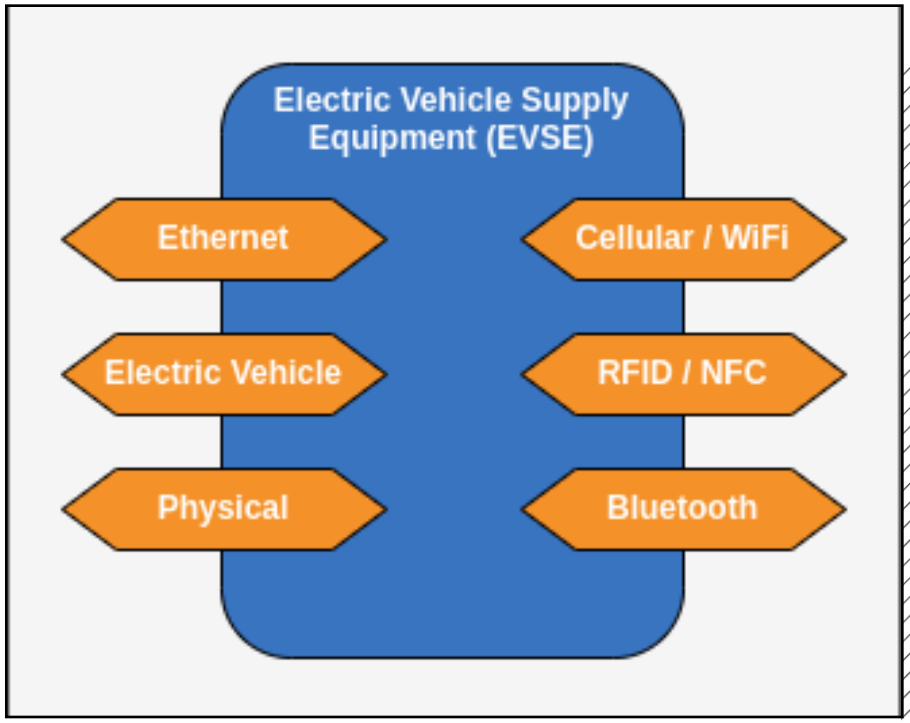
Attacks on charging infrastructure

Key Vulnerabilities

- Weak authentication & unsecured communication channels [14]
- Exploitable connected systems (IT/OT) [14], [15]
- Physical access interfaces (e.g., maintenance ports, RFID, Bluetooth) [4]
- Protocol-specific flaws (e.g., OCPP, MQTT) [16]

Potential Threats & Risks

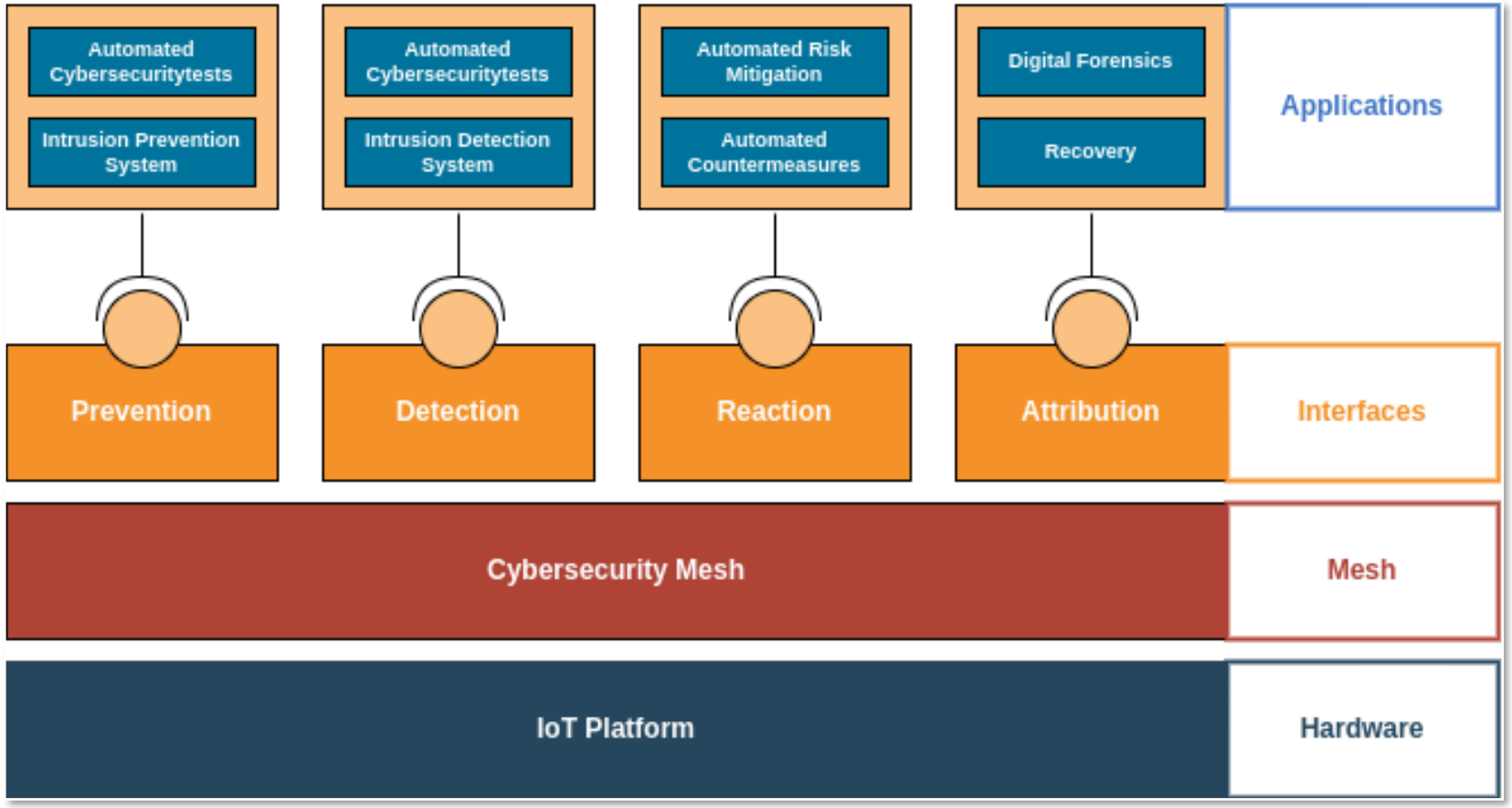
- Data theft, fraud, and ransomware [16]
- Denial-of-Service attacks [14]
- Power grid destabilization (local → national scale) [15]



EVSE Interfaces

System Architecture

ReSiLENT System Overview



System Architecture

IoT Platform

Modular Hardware Unit

- Embedded directly into the EVSE
- Hosts software responsible for core EVSE functionalities:
  → Communication with electrical components, Charge Point Management System (CPMS), and Electric Vehicle (EV)

ReSiLENT System - bidirectional communication between EVSE software and the ReSiLENT security system:

- **System observability** (logs, network traffic, etc.) for anomaly detection and threat monitoring
- **Response mechanisms**, enabling real-time countermeasures

Cybersecurity Mesh

Concept for improved threat detection

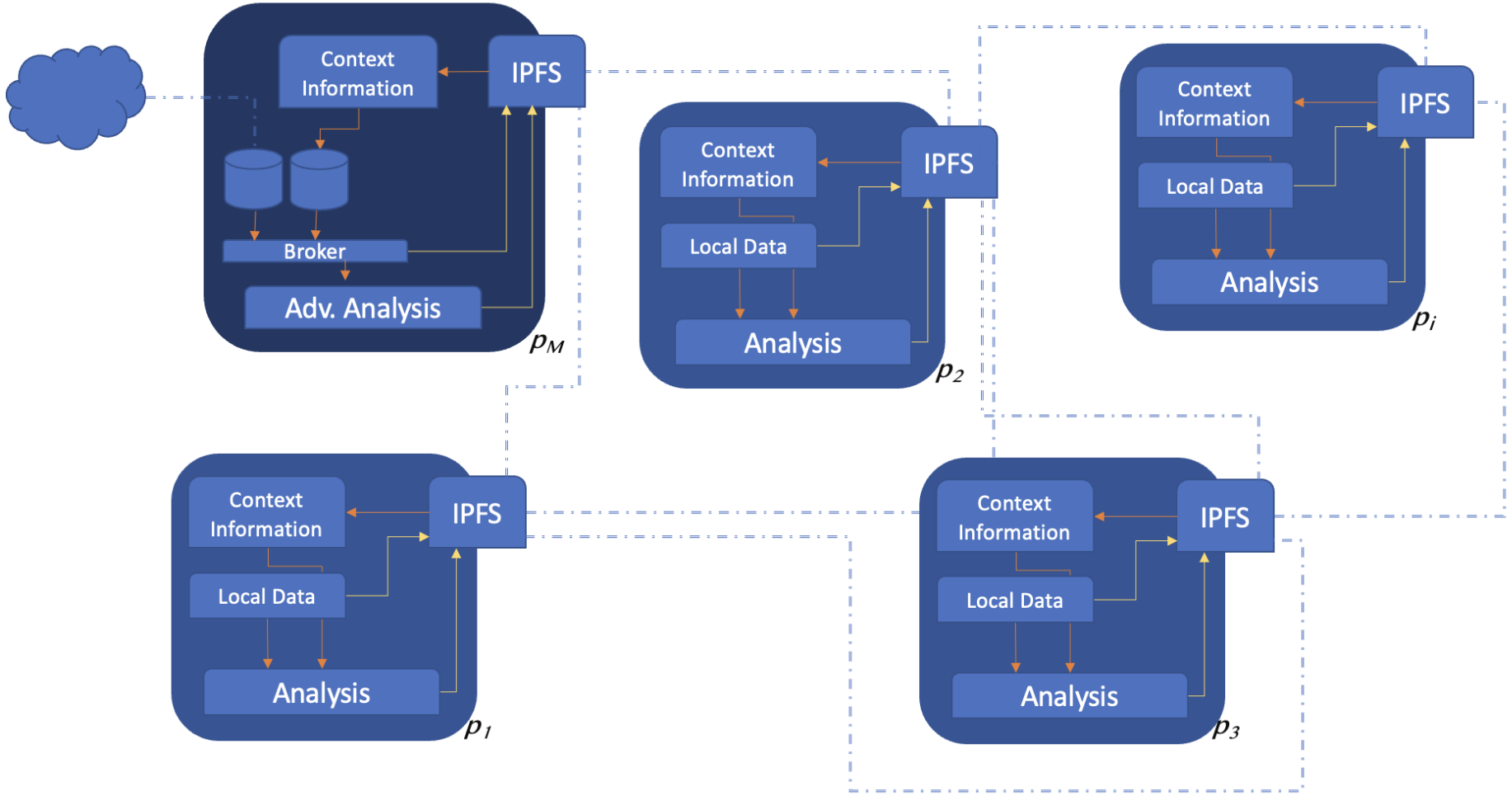
Our Approach: A Cybersecurity Mesh for EVSE

- ReSiLENT introduces a **Cybersecurity Mesh Architecture**
- Links individual EVSE units as **nodes** in a distributed, collaborative security network
- Each node collects, processes, and **shares context-aware data**

Goal: **Leverage collective intelligence** to improve threat detection and resilience

Cybersecurity Mesh

Peer-to-Peer Communication using the InterPlanetary File System (IPFS)



Cybersecurity Mesh

InterPlanetary File System (IPFS)

IPFS Protocol Stack

- Enables **P2P communication** *and* resilient, distributed data access
- Decentralized file storage: files are stored on each node and retrieved by **hash**, not URL (content addressability)
- No centralized server required

Data sharing with Pub/Sub Model

1. Nodes subscribe to topic-based channels (e.g., network-traffic, threat-reports)
2. After publishing a file, the node **sends a lightweight notification**
3. Interested nodes pull the file if subscribed to that topic

Cybersecurity Applications

Security Domains

Distributed data usage for enhancing security applications in the following domains:

- Detection
- Reaction
- Prevention
- Attribution

Goals: Enhance security by utilizing **contextual insights** from distributed nodes

Cybersecurity Applications

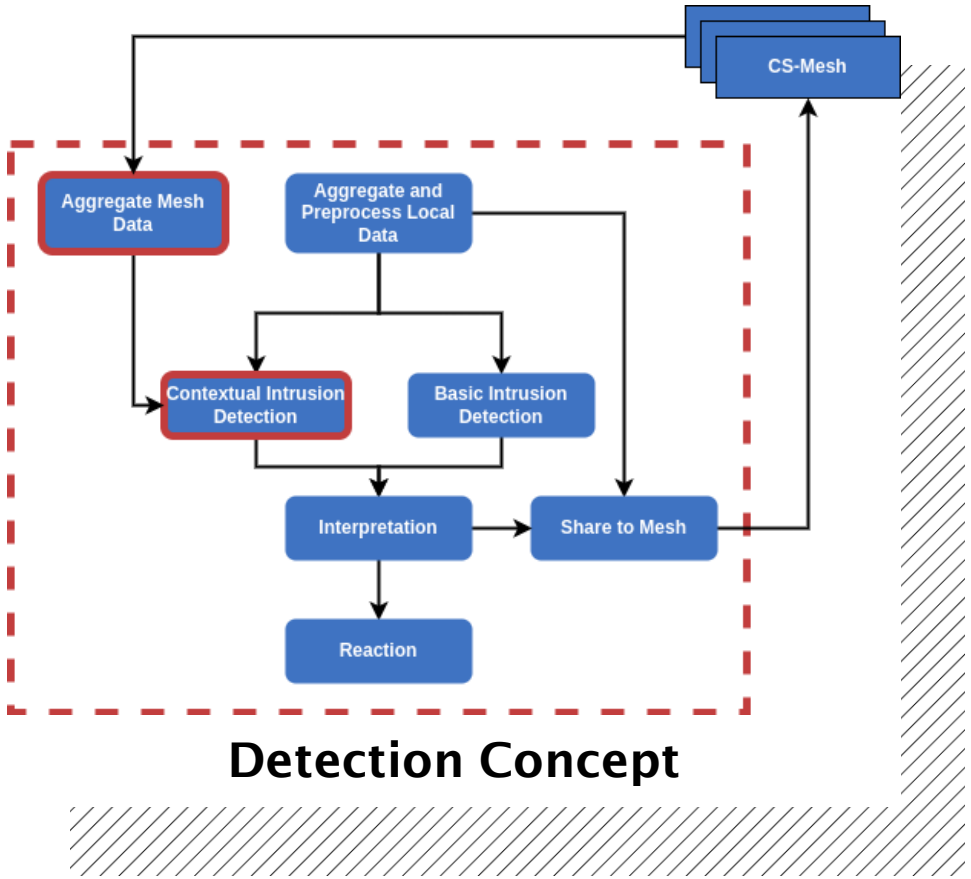
Detection

Basic Intrusion Detection

- Signature- and behaviour-based intrusion detection for system, network, and charging sessions

Contextual Intrusion Detection

- Complementary
- Consensus-Oriented
- Comparative



Detection Concept

Conclusions and Future Work

Ongoing implementation and validation

- **Implementation** of detection and reaction mechanisms is in progress
- Metrics and results will be measured to assess the efficacy of the system
- Objective: **Validate improvements in threat detection** and refine based on observed results

Contact

Feel free to contact us

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