

Improving application fuzzing via QR codes

- What happens if we provide applications with malicious QR codes?
- We have a tool to automatically test it! But, some improvements are needed:
- > better malicious code generation, possibly using feedbacks (fuzzing)
- > improving the stability of the virtualization testbed (coding)
- > investigate novel strategies (function call hooks)
- Contact person: Denis Donadel (donadel@math.unipd.it)



Can we attack channel hopping mitigation against DoS?

- Channel hopping is usually employed to prevent DoS in wireless communications
- It is a simple but effective solutions... or isn't it?
- Investigate state-of-the-art channel hopping strategies and attack them
- Contact person: Denis Donadel (donadel@math.unipd.it) and Alessandro Brighente (alessandro.brighente@unipd.it)



Acoustic communication



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- Acoustic communications to evade network security policies

- The use of acoustic communications as a hidden channel of communication can offer a useful tool to evade security policies implemented in ICT or industrial environments.
- Evaluate if the cyber security standards consider this kind of attack and if not, which countermeasures can be suggested.
- Create a testbed that considers how acoustic communications may violate at least one of the following scenarios:
 - offices of a company (IT scenario);
 - computers in a company's production line (OT scenario).

- Contact person:

Simone Soderi (simone.soderi@unipd.it)

Gabriele Orazi (gabriele.orazi@unipd.it)



PoC of an Intrusion Response System (IRS)

- Intrusion Detection Systems (IDS) can detect anomalies in a network
- Intrusion Prevention Systems can stop certain packets to mitigate attacks
- What if an attack is still successful?
- Development of a simple IRS which collect data from IDS/honeypots/syslogs and can react to alerts to block or slow down the attacker
- Contact person: Denis Donadel (donadel@math.unipd.it)



An LLM-based assistant for sysadmins

- Can we employ LLMs to assist the job of technical figures like sysadmins?
- Development of an assistant fine-tuned to answer specific technical requests and able to put the problem in the context of a specific network
- Contact person: Denis Donadel (donadel@math.unipd.it)



- ECU fingerprinting in a Black Box Reverse Engineer manner

- Understand the CAN Bus packet format and how the content could be differentiated
- Classify the different ECUs and understand content format to extrapolate data
- Contact person: Tommaso Bianchi (tommaso.bianchi@phd.unipd.it) and Francesco Marchiori (francesco.marchiori@math.unipd.it)



- Remote Keyless Entry Attack and Defenses

- Enumerate and analyze attacks and defenses present in literature for the remote keyless entry in cars
- Contact person: Tommaso Bianchi (tommaso.bianchi@phd.unipd.it)



Cryptography



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Break Quantum KD Signal Algorithm

- Signal proposes its own hybrid QKD algorithm (now at version 2)
- In the project we want to analyze it and verify it using Tamarin
- Can be extended for a possible thesis project (e.g. reproduce their results with ProVerif/CryptoVerif or provide a better version of it)
- Contact person: Tommaso Bianchi (tommaso.bianchi@phd.unipd.it)





Find exposed Uninterruptible Power Supplies on the wild

- ...and then try (not) to hack them!
- Research which protocols and ports are employed by UPS and what other characteristics are peculiar to these devices
- Employ Shodan (or similar tool) to detect UPS in the wild
- Look for known vulnerabilities in these systems
- Contact person: Tommaso Bianchi (tbianchi@math.unipd.it) and Denis Donadel (donadel@math.unipd.it)



EPZ privacy



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StravaGANte

- Strava is a social network where athletes (mostly runners and cyclists) post their activities
- Start and ending points are sensitive geolocation (it can be private house, office...)
- Current methods of Endpoint Privacy Zones (EPZ) anonymization are not safe enough
- The project is about developing an innovative and robust method for EPZ generation using GANs
- Contact person: Gabriele Orazi (gabriele.orazi@unipd.it)



STRAVA



Firefox Web Browser - 11:11:03

20231107_SPRITZ@U... 20231211_SPRITZ... [CNS] Student Project...

https://docs.google.com/presentation/d/16k-bckUu3pq47HGicKtElnVgHh3IPHqBtRv-L3ECA4/cd2/p1s1

Hi Gmail Drive Google Calendar MacOSes STEM MoodleMath

31211_SPRITZ Student Project Proposals

Modifica Visualizza Inserisci Formato Diapositive Dispositi Strumenti Estensioni Guida

Adatta Sfondo Layout Tema Transizione

Vehicles Security

Hyperloop cybersecurity

- In this project we will study the security of the novel Hyperloop system
- The project does not contain an implementation part, instead is more focused on a high level security analysis
- Contact person: Denis Donadel (donadel@math.unipd.it) and Alessandro Brighente (alessandro.brighente@unipd.it)

On the feasibility of DoS on vehicles

- It's a fact that you can easily flood a CAN bus in a vehicle sending packets with a low ID, but how much is it effective?
- Research different DoS strategies on vehicle network
- Conduct experiments measuring efficacy of DoS under different parameters
- Develop a easy-but-effective countermeasure
- Contact person: Denis Donadel (donadel@math.unipd.it)

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EPZ privacy



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- Contact person: Gabriele Orazi (gabriele.orazi@unipd.it)



Arxiv-leaks



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Retrieve redacted data and insight from Arxiv

- ArXiv is a popular platform to upload papers before publication
- Latex source is required, and not always comments, extra images, and other informations are removed before uploading
- What information can we get out of these extra informations?
- The idea of the project is to scrape and analyse huge preprints looking for redacted data, insightful comments, and other significant patterns
- Contact person: Denis Donadel (denis.donadel@unipd.it)
and Gabriele Orazi (gabriele.orazi@unipd.it)



Threat Intelligence Sharing



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- Large language models (LLMs) have the potential to revolutionize the way cyber threat intelligence (CTI) is gathered, analyzed, and shared
 - Objective:
 - to use LLM to identify, track evolution of new malware samples, social engineering tactics
 - addressing the privacy concerns associated with sharing sensitive threat intelligence data, proposing strategies for responsible sharing (using Federated learning and Blockchain)

Contact: Vinod P., vinod.puthuvath@gmail.com



Adversarial ML



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- Generate adversarial examples for an adversarially trained model
 - You will be provided with an adversarially trained model and try to create adversarial examples for it.
 - Prerequisites: Python, Python for AI (not in depth, willingness to learn is enough)
 - Contact person: Stefanos Koffas (s.koffas@tudelft.nl)



- Test different backdoor attacks in deep learning (source specific vs source agnostic, clean-label vs dirty-label, multiple triggers same label, multiple triggers multiple labels) against SOTA backdoor countermeasures
 - Prerequisites: Python, Python for AI (willingness to learn is enough)
 - Contact person: Stefanos Koffas (s.koffas@tudelft.nl)



Drones/UAVs



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Rescue UAVs under attack

- The project involves the identification and exploit of onboard sensors to rescue a compromised UAV (e.g. Images, path ecc...)
- Attack definition
- Onboard sensors identification and Testbed creation
- Possible Machine Learning application
- Contact person: Giulio Rigoni (giulio.rigoni@uniroma1.it)



Safe UAV's backward journey (windy scenario)

- Extensive Real flights/Testbed creation with UAVs in windy situations
- Development of Machine Learning models
- Contact: Giulio Rigoni (giulio.rigoni@uniroma1.it)



UAV Remote Attestation Survey

- Searching literature for recent scientific articles
- Writing of a survey



IDAP (Identity Dialer Acquisition Protocol)

- Dialers can fool (relevant) people on phone calls to carry masquerades
- Additional vulnerability given by audio deep-fakes
- Develop a (scalable) biometric system to verify identities



Tattoo identification

- Europol enforced challenge
- Investigators shared query tattoos as significant intel
- Detection and identification of suspects



Contact Person: Saverio Cavasin

saverio.cavasin@phd.unipd.it

Android Security

Solving the Android Semantic Gap

- Existing dynamic analysis techniques that intercept invocations of the Android API Framework can be easily bypassed
- An alternative approach would be to trace the system calls, but there is a semantic gap between a sequence of system calls and the original invoked Android API
- We would study how to build this knowledge and fix this gap
- Contact Person: Eleonora Losiouk
eleonora.losiouk@unipd.it



Measurements of Interactions among Android Apps

- Android apps are sandboxed, but they can interact among each other with Android framework
- We want to measure how and which apps interact among each other
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eleonora.losiouk@unipd.it



Machine-learning for Audio



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- Creating profiles from audio clips

- Area of interest: Machine Learning (ML)
- Topic: Training an ML model on audio clips to create user profile
- Prerequisite: Some knowledge on ML and programming
- Contact person: Ankit Gangwal (CiaoAnkit@gmail.com)



- NFT Playground

- Area of interest: Data mining
- Topic: Data collection, analysis, and numerical statistics
- Prerequisite: Simple python programming for data scraping and analysis
- Contact person: Ankit Gangwal (CiaoAnkit@gmail.com)



Anomaly Detection on IoT Networks



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Creation of a network traffic dataset based on real IoT hardware

- Area of interest: computer networks, IoT, data analysis
- Topic: creation of an IoT network traffic dataset comprehensive of various types of attacks
- Prerequisite: programming skills, networking, packet sniffing
- Contact person: Giacomo Quadrio (giacomo.quadrio@unipd.it)



Survey on most frequent IoT attacks

- Searching scientific literature about the topic
- Writing of a survey
- Contact person: Giacomo Quadrio (giacomo.quadrio@unipd.it)



Homomorphic encryption in IIoT



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-Objective: To enhance IIoT privacy

- Analysis of lightweight homomorphic encryptions for IIoT
- Privacy-classification of IIoT transactions using smart contract
- Using zero-knowledge proofs for data sharing in IIoTs

-Impact of project: 1) Enhanced security/privacy application development
2) New knowledge-base
3) Blockchain applications

Pre-requisite: Good if you know C++, Python, Knowledge of mathematical functions, basic knowledge of IIoT, cryptography

Contact person:

Gulshan Kumar

gulshan.kumar@unipd.it

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- Design on Novel Adversarial Attacks
 - *The study of novel threats to for AI applications*
- Web Analyses & Attacks
 - We analyze phenomenon on websites
- General Info
 - Contact person: Luca Pajola luca.pajola@spritzmatter.com
 - Prerequisites: good knowledge of theoretical AI and practical programming skills



Malware Detection



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- Malware visualization

- Malware visualization is a technique used to transform malware files into visually interpretable representations, such as images or graphs
- Key limitations: Loss of information in the conversion process, lack of context and interpretation, limited ability to capture dynamic behavior, etc.
- Objective:
 - to design specific XAI techniques that can effectively explain the decision-making processes of malware detection and classification models,
 - adversarial attacks aim to manipulate data or model inputs to mislead the model into making incorrect predictions. Understanding how XAI can be used to defend against such attacks

Contact: Vinod P, vinod.puthuvath@gmail.com



Jamming Tool Development



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Title: Jamming tools on wireless network simulator

Target: To implement a more convenient library that could be used on existing wireless network simulators (e.g., NS-3 and Contiki-NG).

Requisites: C/C++, wireless network protocols

Contact person: Shuo Wang

Email: shuo.wang@phd.unipd.it



More IP and E2EE

- IP retransmissions and accounting
 - Blackbox analysis of IP retransmissions on traffic accounting (metered connections, such as mobile ISPs)
 - Literature review and on-field tests
 - Contact: Enrico Bassetti, bassetti@di.uniroma1.it



- E2EE contact verification ceremonies
 - Current ceremonies to verify contacts in end-to-end encrypted chats are complex, and vulnerable to MitM/impersonation
 - Have you ever verified one of your conversations?
 - Design a human-friendly e2ee contact verification ceremony
 - Contact: Enrico Bassetti, bassetti@di.uniroma1.it





Detection of Location Spoofing Attacks in Air-Traffic Communication: Leveraging Physical Layer and Space Tessellation

- *Develop a robust one-class classifier-based system of detecting ADS-B location spoofing attacks by employing anomaly detection through Deep learning models.*
- *Contact person:*
 - *Alessandro Brighente (alessandro.brighente@unipd.it),*
 - *Sitora Salaeva (sitora.salaeva@phd.unipd.it)*



5G and 6G Networks



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Location Tracking Defences

- Location tracking is an issue in 5G networks which may bring to severe attacks
- Design solutions to protect the location information of users
- Consider also D2D scenarios, which are harder to defend
- Contact Person: Alessandro Lotto
- alessandro.lotto@phd.unipd.it



Authentication in Roaming

- Roaming is one of the trickies aspect of 5G
- 1. Develop a methodology to authenticate roaming users
- 2. Extend BARON to the roaming scenario
- Contact Person: Alessandro Lotto
- alessandro.lotto@phd.unipd.it



CyberSecurity And Social Networks



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- Opinion Inference on social media

- Social Media Data (Twitter)
- Techniques for users' opinion inference in polarized debates
- Requirements: familiarity with social networks
- Contact person: Alessandro Galeazzi
alessandro.galeazzi@unipd.it



- Coordinated Behavior in online debates

- Twitter datasets on different topics
- Analyze the presence and impact of coordinated behavior
- Requirements: familiarity with social network
- Contact person: Alessandro Galeazzi - Giovanni Da San Martino
alessandro.galeazzi@unipd.it





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Adversarial ML

- Explore the behavior of ChatGPT when it behaves like a terminal.
 - Investigate whether we can affect its output with malicious commands.
 - Prerequisites: LLM Jailbreaks (only willingness to learn is enough)
 - Contact person: Stefanos Koffas (stefanos.koffas@unipd.it)



- Implement dynamic backdoor attacks in computer vision.
 - Investigate if using a trigger with a neutral background creates a dynamic backdoor.
 - Prerequisites: Python, Python for AI (or willingness to learn)
 - Contact person: Stefanos Koffas (stefanos.koffas@unipd.it)





1. Secure Protocol for IoVs Communication Components (V2V, V2S, V2I, V2R, V2P)

- Design cryptographic protocol for secure authentication and communication among Internet of Vehicles components.
- Requirements: Basic Cryptography.
- Contact person: Harsha Vasudev
- (drharshavasudev@gmail.com, harsha.vasudevanpillai@unipd.it).



2. PQC -based Protocols for IoVs/VANETs.

- Design protocol using Post-Quantum Cryptography.
- Requirements: Basics of PQC techniques.
- Contact person: Harsha Vasudev
- (drharshavasudev@gmail.com, harsha.vasudevanpillai@unipd.it).



Distributed Ledger Technology



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-Objective:

- Analysis of timestamp attacks on Tangle
- Implementation of Noise protocol for port security in IOTA
- Privacy analysis of DLTs
- Tangle application in healthcare and supply chain management
- Tangle application in remote attestation

-Impact of project: New skills development, Demand of go-language in IT field.

Pre-requisite: Knowledge of networks, security, DLTs and IOTA
GO language (for IOTA), Java, Python

Contact person: Rahul Saha (rsahaaot@gmail.com, rahul.saha@unipd.it),

Authentication



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Physical Layer Device authentication

- There are a lots of methods for user authentication, but not many for devices
- Which are the features that better allow to authenticate a specific device?
- Attacks and/or solutions for device authentication
- Contact Person: Alessandro Lotto
- alessandro.lotto@phd.unipd.it



Behavioral touch-based authentication

- Behavioral auth. is a prominent user continuous auth. methodology
- Develop an (ML) algorithm for touch-based authentication for displays
- Contact Person: Alessandro Lotto
- alessandro.lotto@phd.unipd.it



Drones/UAVs



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FPV data persistency/authenticity

- Analyze the state of the art for data persistency/authenticity and find a solution suitable for drones images transmissions, necessary in contexts like humanitarian and rescue missions
- Contact person: Giulio Rigoni (giulio.rigoni@uniroma1.it)



Multilateration vs GPS spoofing

- Study the application of the multilateration technique regards a fleet of UAVs for safety purposes
- Contact person: Giulio Rigoni (giulio.rigoni@uniroma1.it)



Adversarial Attacks

Attacks on License Plate Recognition Systems

- Optical Character Recognition (OCR) is just a part of the pipeline
- Real world scenario LCR has many challenges (e.g., noise, orientation, angle of view, lightning, ...)
- Also, black box scenario(?)
- See what are the most effective attack vectors and how it is possible to affect the pipeline
- Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it), Saverio Cavasin (saverio.cavasin@phd.unipd.it)

Hero bird saves guy from \$300 fine





- Advanced Persistent Threat classification

- *Advanced Persistent Threats (APT) represent malicious groups that establish a persistent presence in a networks with the aim of stealing information*
- *CTI researchers maps their tactics and techniques to prevent further intrusions and share them in natural language reports*
- *From data of known intrusions, classify the most probable APT*
- *Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it), Vinod P. (vinod.puthuvath@gmail.com)*





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IP security

- Security of custom IP stacks
 - Suitable for embedding in Internet-of-Things, such as lwIP
 - Userland libraries, such as Google gVisor (the "Container Security Platform"), software defined networks (SDN)
 - Course/extra project: test/adapt/port IPv6 attacks in literature
 - Contact: Enrico Bassetti, bassetti@di.uniroma1.it



- Multi-path TCP and MP-QUIC
 - Learn the state-of-the-art papers about MP-TCP and MP-QUIC
 - Multiple directions: analyze existing MP-TCP attacks against MP-QUIC, develop a blackbox fuzzer, differential fuzzing, etc.
 - Contact: Enrico Bassetti, bassetti@di.uniroma1.it



Automotive Security



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- Quantum-Safe Cryptography in Connected Vehicles
 - Assess the vulnerability of current cryptographic protocols in connected vehicles to quantum attacks, propose Quantum-safe alternatives
 - Investigate the impact of quantum computing on existing encryption algorithms
 - Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it)

bluewind



- Authenticating ECUs through CAN bus physical signals
 - CAN lacks any kind of message authentication
 - Extracting features from the physical CAN signals (fingerprinting)
 - Possible internship with company to gather dataset
 - Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it)



Membership Inference Attack (MIA)



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Modeling the distribution of distinguishable metric for non-member data

- *Target*: find a suitable metric to make the **member data (training data)** as the extreme values (outliers) of the **non-member data (test data or data from similar or different distributions)** distribution
- *Proposal (key steps)*:
 1. Acquire the knowledge of MIAs and Extreme Value Theory
 2. Design functions to display the metric distribution of the data
 3. Try previous metrics in MIAs
 4. Find a new metric
- *Requirements*: Basic Python, Basic Machine Learning, Skilled Statistics (especially, Extreme Value Theory)
- *Contact person*:
Anderson Rocha (anderson.rocha@unipd.it)
Jiaxin Li (jiaxin.li@unipd.it)



Automotive Security



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Resilience Testing for Connected Vehicles

- Develop methodologies for resilience testing to assess how well connected vehicles can withstand and recover from cyber-attacks
- Implement scenarios that simulate cyber-attacks on various components of connected vehicles, including communication networks, ECUs, and sensors
- Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it)

bluewind



Cyber Threat Intelligence on Automotive

- Evaluate the effectiveness of threat intelligence sharing platforms specific to the automotive industry
- History of vulnerabilities, countermeasures and intelligence related to the automotive industrial process

Contact person: Francesco Marchiori (francesco.marchiori@math.unipd.it)



Covert channels



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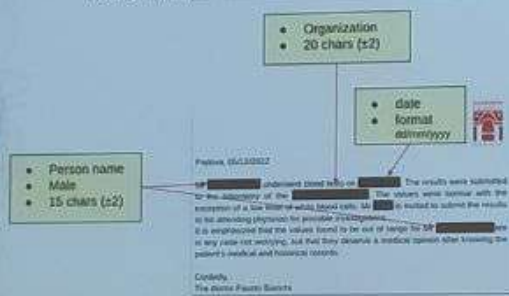
Solution for Covert Channel in Federated Learning systems

- FL systems can be turned into covert channels to implement a stealth communication infrastructure;
- Based on the POC of the attack, we want to develop the countermeasure to solve the issue;
- The solution might involve Differential Privacy or Anomaly Detection techniques.
- *Contact person:*
Simone Soderi (simone.soderi@unipd.it)
Gabriele Orazi (gabriele.orazi@unipd.it)
Jiaxin Li (jiaxin.li@studenti.unipd.it)



Context Driven Un-redaction of documents

- Redaction is used to hide and obfuscate sensitive and personal information in documents (PII).
- Are we really protecting PII? How much information is still leaking? How much we can infer from the context?
- The aim is prove the ineffectiveness of current redaction techniques.
- Main subject: NLP (specifically, Named Entity Recognition)
- Contact person: Gabriele Orazi (gabriele.orazi@phd.unimod.it) and Francesco Marchiori (marchiori@math.unimod.it)



Drones Startup Safety Check

Upon starting up, drones execute a protocol to check all components and that everything is ok

How does it work? Can we spoof some of the messages?

- Contact Person: Alessandro Brighente

- alessandro.brighente@unipd.it



Driving Behavior Authentication

- There currently exists many datasets and solutions to identify drivers based on how they drive
- Write a survey on the best practices and compare them
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Deep Fake



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1 shot attack

- 1 picture is all you get (drone shot, smartphone camera, etc)
- Use generative methods to synthetically boost your information
- Best devices to acquire / best strategies to exploit



Camaleonet

- Missing/kidnapped/on-the-loose people can hide their look/get old
- Generative models can help to train a more robust detector



Generative blackmail attack

- Generate harmful images to retrain/tune state of the art open source models
- Use open access data of vulnerable people to transfer the learning to those models
- How extended/counterable is the harm you can generate?



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Privacy and Anonymity



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Tracking users in Wi-Fi

- Probe requests are packets needed to connect to a wi-fi network
- MAC address randomization is not sufficient anymore, use reduced sets.
- How much should we reduce and is that actually effective?
- Contact Person: Alessandro Brighente
- alessandro.brighente@unipd.it



Is Easy-Connect Really Secure?

- Easy connect allows for zero touch device provisioning
How much information does it need and how secure is it?
- Contact Person: Alessandro Brighente
 - alessandro.brighente@unipd.it





Identification of Polyglot Code

- Current security solutions in supply chain need to identify the programming language used by a specific software component
- Can they detect languages in a polyglot code?
- Contact Person: Alessandro Brighente
- alessandro.brighente@unipd.it



Creating Rules for Secure Testing

- A maturity model defines the security posture of a company
- However, we should provide them with correct indications on what they need
- Develop a framework to autonomously tell them what they need
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- alessandro.brighente@unipd.it



5G and IoT Security



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Jamming IoT Devices

- IoT devices transmit on different channels to avoid interference
- In this project you will develop a module able to follow the channel sequence and interrupt the communication
- Contact Person: Alessandro Brighente
- alessandro.brighente@unipd.it



End-to-end attack to 5G networks

- The core network is responsible for device localization and tracking
- In this project, you will develop an end-to-end simulation of the 5G system using open source software, and testing attacks to its localization capabilities
- Contact Person: Alessandro Brighente
- alessandro.brighente@unipd.it





Anomaly Detection and Intrusion Detection Systems

- The candidate will develop an Anomaly Detection System. The tests will be implemented in a real-life ICS environment
- Multiple lines of analysis: Network Traffic, Physical process etc...
- Contact person: Federico Turrin (turrin@math.unipd.it)



Industrial Encrypted Traffic Analysis

- Extension of the well-known approach of encrypted traffic analysis on the Industrial domain
- Contact person: Federico Turrin (turrin@math.unipd.it)



PQC and PUF Integrated Methods for CAN.

- *Integrate Post-Quantum Cryptography and Physically Unclonable Functions to design secure protocol.*
- Requirements: Basic knowledge of PQC techniques.
- Contact person: Harsha Vasudev
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