Content of Work Package DP 3-WP14 – "Security Monitoring and Testing of Automotive Electronics"

3-WP14 – Security Monitoring and Testing of Automotive Electronics

Coordinator of the WP

Czech Technical University in Prague, doc. Jiří Novák, Ph.D.

Participants of the WP

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ŠKODA AUTO a. s.	– Ing. Jiří Blecha, Ing. Jaroslav Hrbek, Ing. Adam Šťáva
TÜV Süd	– Ing. Dalibor Zeman, Ing. Vladislav Kocián, Ing. Petr Lockenbauer

Main Goal of the WP

Provide a technology enabling identification of in-vehicle networks topology, network nodes and their relations. Use this knowledge to identify security critical protocols used for in-vehicle communication and implement automated test sequences focused on identified security threats.

Partial Goals for the Current Period

Detailed specification of particular results functionality, identification of suitable development tools and their practical limits (in terms of accurate communication timing, response times, data throughput …) to understand the final application limits.

Content of Work Package DP 3-WP14 – "Security Monitoring and Testing of Automotive Electronics"

3 – WP14 – 001 - Software framework for ECU test bus simulation with realistic implementation of security protocols.

The framework provides for a realistic rest bus simulation of ECU external communication environment on all physical communication interface types (including CAN, LIN, Ethernet …) at all required OSI model protocol layers. Framework is structured in order to allow easy insertion of new security oriented layers into the communication stack. An API providing for particular layers testing is defined and predefined test cases are implemented.

R - Software (CTU FEE + Škoda Auto + TÜV Süd) Project deadline: 06.2026

3 – WP14 – 002 - **Framework for security monitoring and communication security testing.**

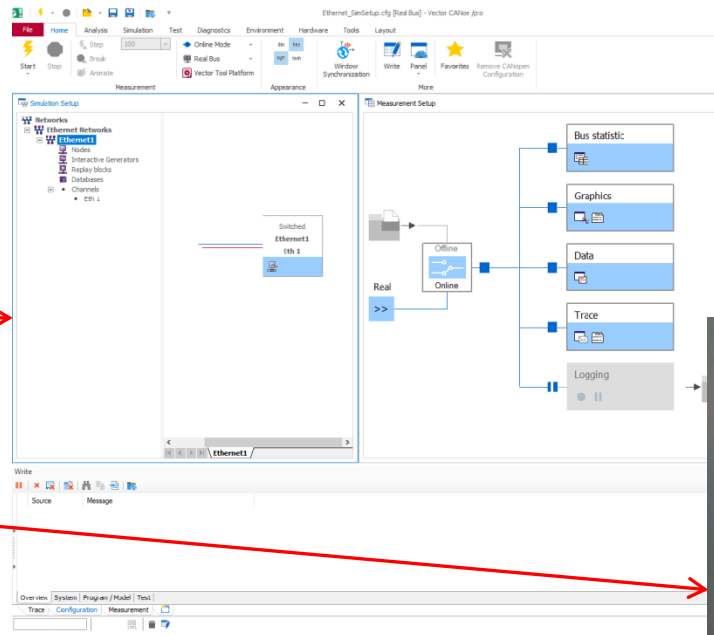
The framework provides for a communication monitoring on different physical communication interface types (including CAN, LIN, Ethernet …) at all OSI model protocol layers. It provides for filtering and logging of selected protocols (especially those security oriented) and their testing, including selected intrusive tests. For intrusive testing an API providing for message/packet injection is implemented.

R - Software (CTU FEE + Škoda Auto + TÜV Süd) Project deadline: 06.2026

Content of Work Package DP 3-WP14 – "Security Monitoring and Testing of Automotive Electronics"

Activities to reach 3 – WP14 – 001 - Software framework for ECU rest bus simulation with realistic implementation of security protocols.

- detailed specification of result
  - application for security testing of single ECUs
  - realistic rest-bus simulation on all ECU interfaces
  - predefined set of security oriented tests at all layers
- selection of suitable tools
  - CANoe environment with suitable HW modules
  - VN56xx series hardware (support for CAN and Ethernet)
- selection of suitable programming tools for CANoe
  - Python interface – tested, but finally rejected (suits only for high-level application models)
  - CAPL (internal scripting language) and .NET are being evaluated



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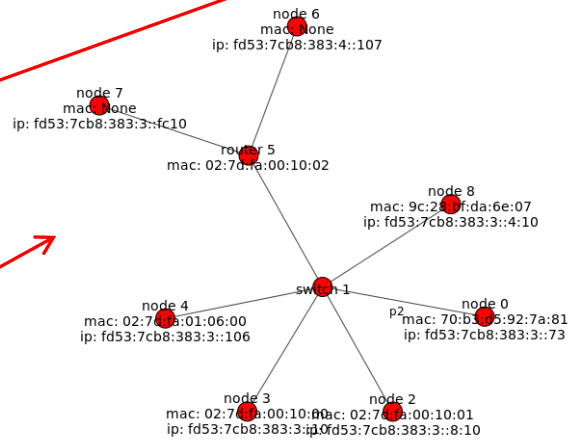
Activities to reach 3 – WP14 – 002 - **Framework for security monitoring and communication security testing.**

- detailed specification of result
  - application for vehicle certification process
  - automated analysis of in-vehicle networks topology (focused on Ethernet networks)
  - automated analysis of in-vehicle protocols (including automotive specific ones)
  - automated generation of test suite focused on security of detected in-vehicle protocols
- selection of suitable tools
  - off the shelf Ethernet switches, media converters for 100/1000Base-T1 Ethernet
  - GNU Linux + Python development chain
- in-vehicle network topology detection
  - analysis of logs taken from network segments
  - nodes classification and topology reconstruction



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Current State of Deliverables and Fulfillment of Goals

- 3-WP14-001 | Software framework for ECU rest bus simulation with realistic implementation of security protocols., R, VI./2026, CTU FEE 0.2; SA 0.6; TUV 0.2 – **in progress & no major delays:**
  - HW as well as SW platforms were selected (Vector's VN series modules and CANoe)
  - CANoe Python API was evaluated – does not suit for the final goal
  - .NET API and internal CAPL (CANoe scripting language) are being evaluated in order to identify platform limits in terms of communication timing accuracy, communication throughput in different scenarios …
  - Final API selection will be done at the end of year
- 3-WP14-002 | Framework for security monitoring and communication security testing., R, VI./2026, CTU FEE 0.3; SA 0.1; TUV 0.6 – **in progress & no major delays:**
  - HW as well as SW platforms were selected (of the shelf Linux computer with Ethernet media converters, Python for SW development)
  - Algorithms for network segment classification (in terms of end node types) were designed and implemented
  - Validation of above mentioned algorithms (based on known real as well as simulated network topologies) is in progress
  - Final validated version is expected at the end of year

Content of Work Package DP 3-WP14 – "Security Monitoring and Testing of Automotive Electronics"

List of Due Deliverables and Their Added Value

- 3-WP14-001 – Software framework for ECU rest bus simulation with realistic implementation of security protocols.
  - Due date 06/26
  - Provides for fast automated testing of known security threats at tier 1 component suppliers as well as final car manufacturers.
- 3-WP14-002 – Framework for security monitoring and communication security testing
  - Due date 06/26
  - Provides for "grey box" semi-automated monitoring and testing of security threats and their mitigation during vehicle homologation process.

Assessment of the Contribution of Deliverables

Both software framework or their parts can be used within the other work-packages for in-vehicle data communication monitoring and analysis, as a (online/offline) source of information for other research tasks.

Content of Work Package DP 3-WP14 – "Security Monitoring and Testing of Automotive Electronics"

Assessment of the Formal/Administrative Goals of the Work Package

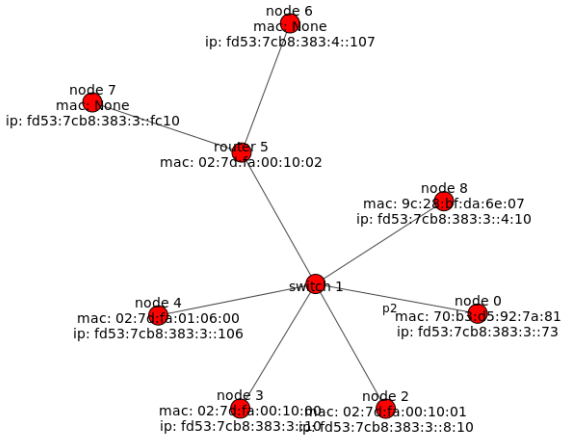
- Work-package budget at all three participating bodies is being spent according to the plan with minor changes following the TACR rules
- At CTU the income from commercial activities exceeds planned project requirements
- All the work-package deliverables due date is 06/2026; the current level of development guarantees completion on the scheduled date

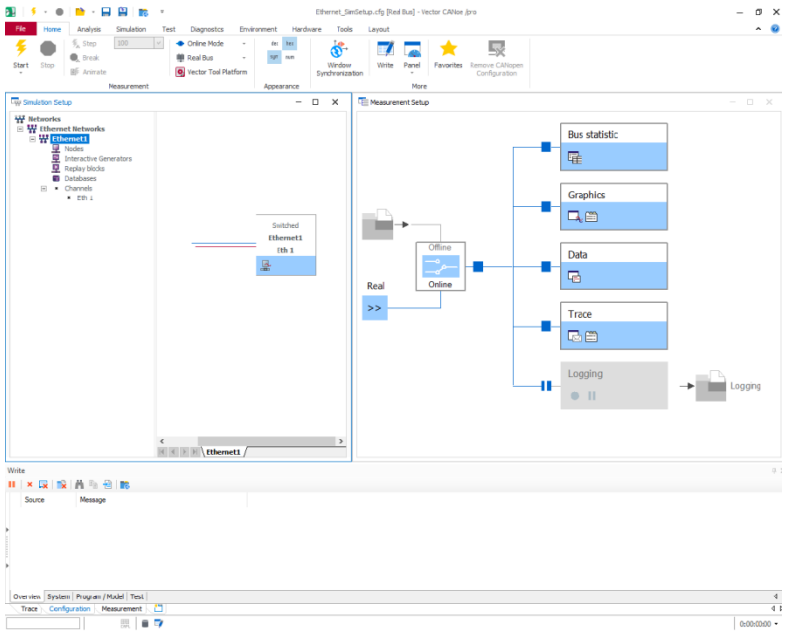
Acknowledgment

This research has been realized using the support of Technological Agency, Czech Republic, programme National Competence Centres II, project # TN02000054 Božek Vehicle Engineering National Centre of Competence (BOVENAC).

Výtah z prací 2023-2025 na 3-WP14 – "Monitoring a testování vozidlové elektroniky zaměřené na kybernetickou bezpečnost"

(ČVUT – Jiří Novák – jnovak@fel.cvut.cz)





Framework pro bezpečnostní analýzu a testování vnitřních komunikací vozidla

- automatizovaná analýza logů ze segmentů vnitřní sítě vozu
- rekonstrukce topologie vnitřní sítě a typů jednotlivých síťových zařízení

Framework pro realistickou rest-bus simulaci pro řídicí jednotky s důrazem na bezpečnostní protokoly.

- volba a pořízení SW a HW nástrojů pro realizaci
- testy variant použití těchto nástrojů s důrazem na dosažitelné parametry (přesnost v čase, propustnost …)
- Python API nevyhovuje, testuje se CAPL a .NET

Results of 3-WP14 – "Security Monitoring and Testing of Automotive Electronics" – Achieved 2023 - 2025

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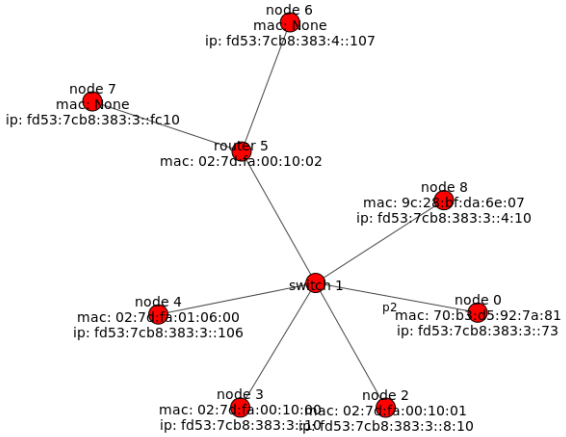

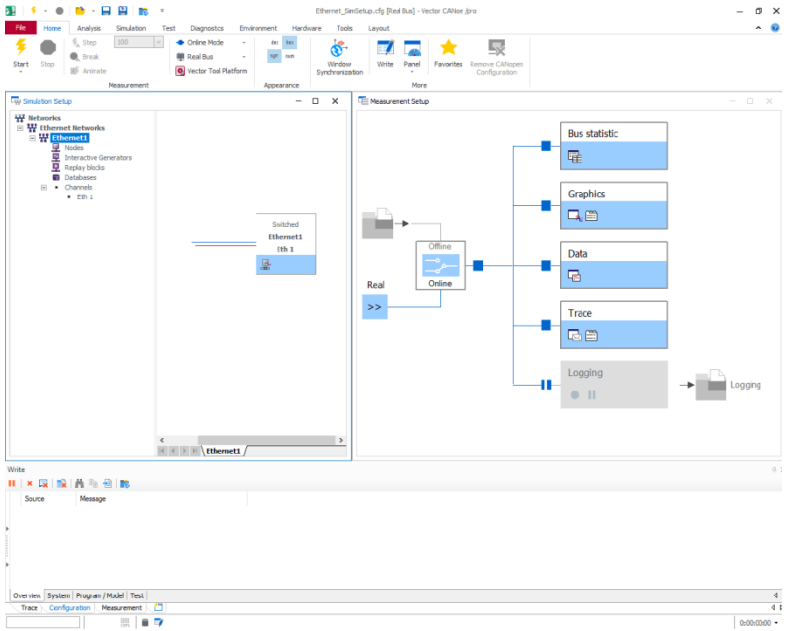

Framework for security analysis and testing of in-vehicle communication

- automated internal vehicle network segments logs analysis
- reconstruction of internal network topology and particular network node types

Framework for realistic rest-bus simulation for ECUs with focus on security related protocols.

- selection and acquisition of SW and HW tools
- tests of variants of the use of these tools with a focus on achievable parameters (accuracy in time, throughput...)
- Python API does not suit, CAPL and .NET are being tested

Výtah z prací 2023 na 3-WP14 – "Monitoring a testování vozidlové elektroniky zaměřené na kybernetickou bezpečnost"

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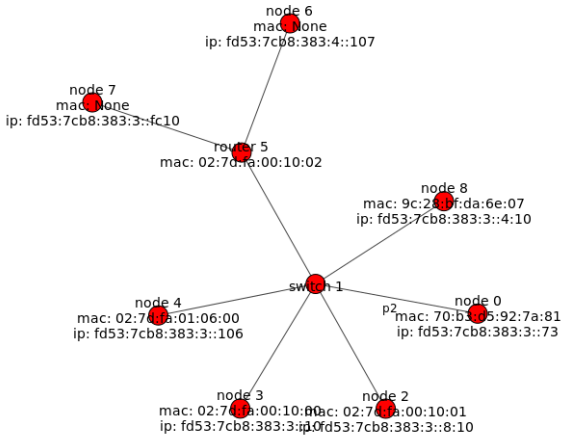

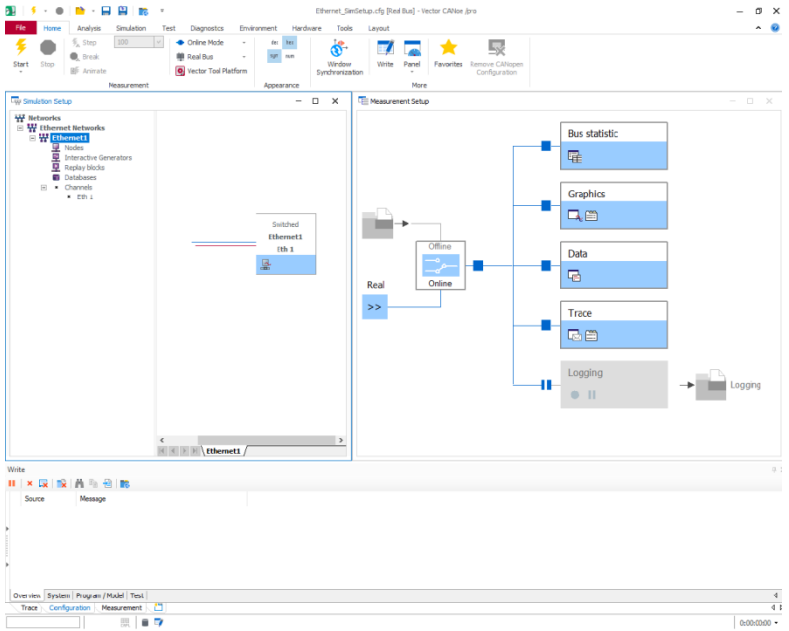

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Results of 3-WP14 – "Security Monitoring and Testing of Automotive Electronics" – Achieved 2023

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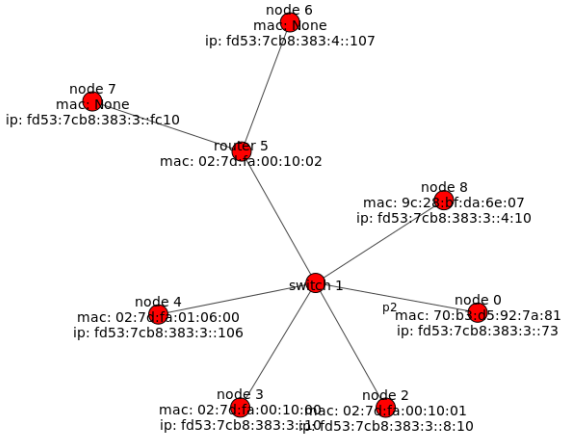

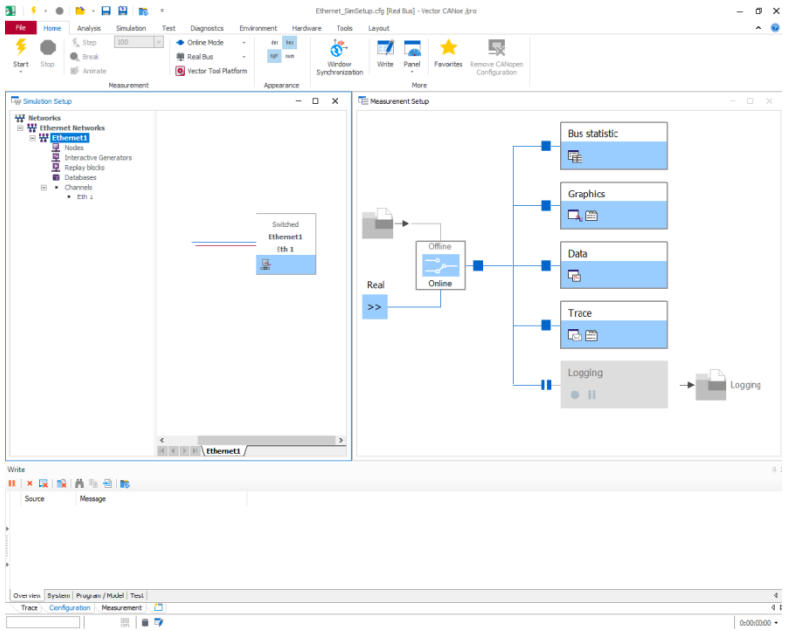

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