

# A Testing Framework Architecture Concept for Automotive Intrusion Detection Systems

30.05.2017 - Automotive 2017

# Agenda

- Introduction
- Intrusion detection systems scope
- Problem statement
- Our approach
- Conceptional architecture
- Conclusion
- Outlook

# Introduction Speakers



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- Automotive security engineer at Audi AG
- ~ 15 years of experience in the automotive industry
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#### **Basic Tobias**

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# **Intrusion Detection Systems in In-Vehicle Networks** Scope



Mainly focusing on Network Intrusion Detection Systems (NIDS) and anomaly detection

## **Intrusion Detection Systems in In-Vehicle Networks** Evaluation



Evaluation during development phase is very difficult as real data <u>and</u> attacks do not exist!

# **Intrusion Detection Systems in In-Vehicle Networks** Automotive protocols



- There is a large variety of protocols to consider !
- Some protocols are automotive only !

#### Problem Statement

- In-vehicle network traffic not publicly available for use
- Automotive network topologies differ from OEM to OEM
- Sharing of information, especially during development phase, is prohibited and often part of intellectual property (IP)
- New technologies (e.g. Ethernet, CAN-FD) and protocols (e.g. SOME-IP) can't easily be evaluated
- Malicious traffic barely exists
- Complexity of in-vehicle attacks is different to existing attacks

### **Our approach** Preparation

- Malicious traffic
- Valid traffic
- Evaluation metrics

#### NIDS Evaluation Requirements

- Automotive attack scenarios
- Applicable in real vehicles

#### Attack Requirements

- Support for required protocols
- Support for required technologies
- Use case coverage
- Realism

- Available tools
- Supported platforms
- Available libraries
- User perspective

#### Network Traffic Requirements

Miscellaneous

### **Our approach** Evaluation of existing Tools

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	PCAP Replay	Multiple Interface Handling	Scripting	Layer 2 Support	IPv6 Support	Automotive Protocols	Generate Mixed Traffic	Priority Handling	Capture Traffic	Packet modification	Packet sending interval	Automation
Tomahawk	1						1					✓
<b>Bit-Twist</b>	✓			✓			✓		✓			✓
Hping2							1					✓
Hping3			1				1		✓			✓
Nemesis				✓	✓		✓					✓
Ostinato	1	(•	1	1	1		1		1		(✔)	
packETH	1			1	1		1				1	
Yersinia				1			(•		1			
netsniff-ng	✓			1	1		1		✓			
pktgen	1	(⁄)	1	1	1		1		1			1

# Existing tools don't cover the necessary requirements!

#### **Our approach** Practical example



### **Our approach** Practical example



#### **Architecture Concept**

Custom Scenario Settings	
SD1FB1FBnSD2FB2SDnFB3Pre-defined SDSelf Defined Scenario Description (SD)	User Layer
FB LogicFB1FB LogicFB2FB LogicFBnFB ParamsFB ParamsFB ParamsFB ParamsFB ParamsFunction Blocks (FB)	Dev. Layer
Core API	
Frame Interaction Config Parser	
Data Handler Statistics Management	
Core	
Frame Prioritization Statistics	
Interface Mapper Network Abstraction	
Framework	Dev. Laver
	☐ Svstem Laver
Raw Sockets Kernel Modules	
CAUN :: CAUNT :: ETHO Host Specific Interfaces	L

# **Our approach** Summary

- Architecture only based on open source components
- Support of several network interfaces (Ethernet, CAN, WiFi, USB, ...)
- Separation of use case logic, operating system dependancies and network stacks
- Create realistic automotive traffic for Network Intrusion Detection Systems (NIDS)
- Providing If-Than-Else Functionality
- Separation of network topology information and use case description
- Encapsulate logic in function blocks
- Enable simple fuzzing functionality
- Sharing implementations, setups and (if possible) datasets with the community

#### Conclusion

#### Feasible:

- If-than-else functionality
- Scene description
- Capsulating functionality
- Using open source software only
- Concept architecture implementation



#### Challenging:

- Parallelism
- Message/Interface priorities
- Timing
- Library support of protocols



#### Outlook



First prototype called (anxiety) using python3 Publication of the source code on a collaboration plattform (pending)



Final master thesis available soon on the university of Darmstadt website containing:

- Detailed descriptions
- Performance measurement



Publication of a follow up document about the implementation and evaluation of the prototype (currently working on it)

# Thank you