Monthly Research

Research Trend of Automobile Security

FFRI,Inc.
http://www.ffri.jp

Agenda

- The following security conferences were held in Oct. and Nov. 2015.
  - SyScan360 2015 (China, Beijing)
  - Black Hat Europe 2015 (Netherlands, Amsterdam)
  - 13th escar Europe (Germany, Cologne)
- In this report, we introduce some presentations related to automobile security.

Car Hacking: Witness Theory to Scary and Recover From Scare

SyScan360 2015
[2015.10.21-22, China, Beijing]

- Presented by Jinhao Liu, who discovered vulnerabilities of Tesla and BYD in 2014 and 2015.

- There is a vulnerability in the cloud service provided by BYD, so it was possible to steal passwords.

- This problem is similar to “OwnStar” which have been presented at the DEFCON 23.
  - This problem is more dangerous because no special device is required.

Remote Exploitation of an Unaltered Passenger Vehicle

- Presented by Charlie Millar and Chris Valasek.
- It is detailed version of the “Jeep Hack” at Black Hat USA 2015.
- The Jeep Hack had a major impact on the automotive industry.
  - Many people had mentioned it in the escar Asia 2015.
- For specific details, see their white paper.

Self-Driving and Connected Cars: Fooling Sensors and Tracking Drivers

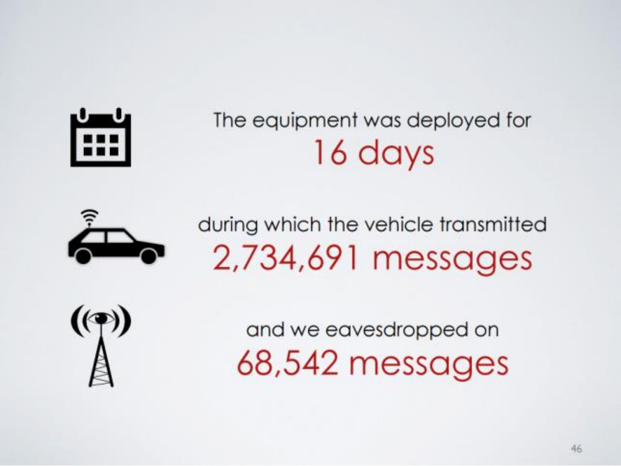
Black Hat Europe 2015
[2015.11.10-13, Netherlands, Amsterdam]

- Presentation about attacking cameras and radar (LIDAR) for autonomous car technology by Jonathan Petit.
- The experiment target are cameras which used to lane departure warning and rear collision warning, pedestrian warning.
  - The cameras do not work if light of wavelength 650mn is irradiated.
- Also, radar (LIDAR) could allow spoofing by injecting a reflected signal which is disguised as the original signal.

Self-Driving and Connected Cars: Fooling Sensors and Tracking Drivers (cont’d)

Black Hat Europe 2015
[2015.11.10-13, Netherlands, Amsterdam]

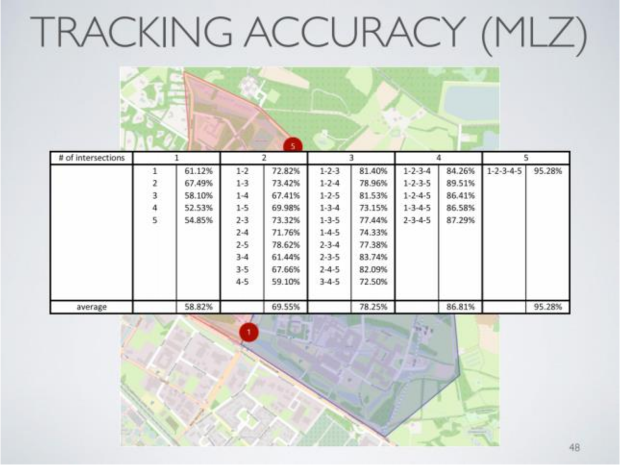
- A vehicle tracking result was shown by sniffing of IEEE 802.11p which is a key technology of connected car.
- A car was tracked with installing the stations in vehicle and intersections.
  - The results showed that the car was tracked highly accurately by sniffing of messages.



The equipment was deployed for
16 days

during which the vehicle transmitted
2,734,691 messages

and we eavesdropped on
68,542 messages



TRACKING ACCURACY (MLZ)

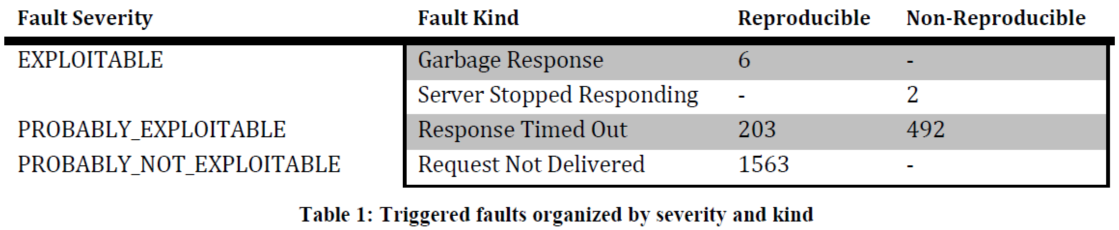
# of intersections	1		2		3		4		5	
	1	61.12%	1-2	72.82%	1-2-3	81.40%	1-2-3-4	84.26%	1-2-3-4-5	95.28%
	2	67.49%	1-3	73.42%	1-2-4	78.96%	1-2-3-5	89.51%		
	3	58.10%	1-4	67.41%	1-2-5	81.53%	1-2-4-5	86.41%		
	4	52.53%	1-5	69.98%	1-3-4	73.15%	1-3-4-5	86.58%		
	5	54.85%	2-3	73.32%	1-3-5	77.44%	2-3-4-5	87.29%		
			2-4	71.76%	1-4-5	74.33%				
			2-5	78.62%	2-3-4	77.38%				
			3-4	61.44%	2-3-5	83.74%				
			3-5	67.66%	2-4-5	82.09%				
			4-5	59.10%	3-4-5	72.50%				
average		58.82%		69.55%		78.25%		86.81%		95.28%

Source:https://www.blackhat.com/docs/eu-15/materials/eu-15-Petit-Self-Driving-And-Connected-Cars-Fooling-Sensors-And-Tracking-Drivers.pdf

Don’t Fuss about Fuzzing: Fuzzing in-Vehicular Networks

13th escar Europe
[2015.11.11-12, Germany, Cologne]

- Presented by Stephanie Bayer at ESCRYPT GmbH
- An idea and result of fuzzing for UDS (Unified Diagnosis Services).
    - UDS is an international standard for vehicle diagnostic protocol (ISO14229).
- They showed a stateful fuzzing which sending various pattern messages based on UDS specifications and the response from ECU.



Fault Severity	Fault Kind	Reproducible	Non-Reproducible
EXPLOITABLE	Garbage Response	6	-
	Server Stopped Responding	-	2
PROBABLY_EXPLOITABLE	Response Timed Out	203	492
PROBABLY_NOT_EXPLOITABLE	Request Not Delivered	1563	-

Table 1: Triggered faults organized by severity and kind

Source:https://www.escar.info/images/Datastore/2015_escar_EU_Papers/3_escar_2015_Stephanie_Bayer.pdf

Common Security Flaws in Connected Cars Systems

13th escar Europe
[2015.11.11-12, Germany, Cologne]

- Presented by ARGUS Cyber Security, Inc.
- It showed reverse engineering and discovered vulnerabilities of ECU firmware.
- The following vulnerabilities have been discovered.
  - Data leakage from RAM by a vulnerability in the boot loader
  - Known vulnerability in open source library
  - Code injection vulnerability in Operation System
  - Updating microcontroller firmware from application processor
  - Hardcoded JTAG password into the firmware

Summary and Discussions

- Threats in cloud and mobile services
  - Recently vehicles can use telematics service in cooperation with cloud and mobile app.
  - Some of mobile apps can control the vehicle remotely.
    - E.g. open door or start the engine
  - Therefore, security is necessary also in cloud and mobile app.
    - Web security and secure coding for Android/iOS apps are important.

Summary and Discussions (cont'd)

- Security testing approaches for automobile
  - Fuzz tesing
    - Vulnerability research by fuzz testing will not be easy.
    - Ordinary car sometimes shifts to fail-safe mode when it receives an abnormal CAN messages.
    - It might be easy to find vulnerabilities by fuzz testing upper protocols such as the UDS.
  - Penetration testing
    - Fostering of security experts is not easy because it requires time and cost.
    - Some security companies have provided already.
    - However, there is no criteria for these costs and test items.

Summary and Discussions (cont’d)

- Wireless communication for autonomous car
  - OTA update and V2X are the most innovative technologies for in the near future.
  - Therefore, security measures are required to protect safety and privacy naturally.
  - Encryption and authentication are very important for OTA update and V2X communications.
    - We are concerned about increase of attack vectors by evolution of the wireless technology.

References

SyScan360 (https://www.syscan360.org/en/)

- Car Hacking: Witness Theory to Scary and Recover From Scare
  - https://www.syscan360.org/slides/2015_EN_AutomotiveCyberSecurity_JianhaoLiu_JasonYan.pdf

Black Hat Europe 2015 (https://www.blackhat.com/eu-15/)

- Remote Exploitation of an Unaltered Passenger Vehicle
  - http://illmatics.com/Remote%20Car%20Hacking.pdf
- Black Hat USA 2015 Survey Report
  - http://www.ffri.jp/assets/files/monthly_research/MR201508_Black_Hat_USA_2015_Survey_Report_JPN.pdf
- SELF-DRIVING AND CONNECTED CARS: FOOLING SENSORS AND TRACKING DRIVERS
  - https://www.blackhat.com/docs/eu-15/materials/eu-15-Petit-Self-Driving-And-Connected-Cars-Fooling-Sensors-And-Tracking-Drivers.pdf
  - https://www.blackhat.com/docs/eu-15/materials/eu-15-Petit-Self-Driving-And-Connected-Cars-Fooling-Sensors-And-Tracking-Drivers-wp1.pdf
  - https://www.blackhat.com/docs/eu-15/materials/eu-15-Petit-Self-Driving-And-Connected-Cars-Fooling-Sensors-And-Tracking-Drivers-wp2.pdf

13th escar Europe (https://www.escar.info/escar-europe.html)

- Don’t Fuss about Fuzzing: In-Vehicular Networks
- Common Security Flaws in Connected Cars Systems

* Requires user registration in order to view and download the slide (FREE)

Contact Information

E-Mail : research—feedback@ffri.jp
Twitter : @FFRI_Research