Connected Vehicles
Security, Privacy, and Economics

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The Speaker

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Speaker

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Digital Forensics Alumni
CyCon
International Conference on Cyber Conflict
ISSE
E-PRIVACY
IET Events
PSC

2011
2013
2013-2016
2016
2017

Standards

UNINFO
CS-ICG
CEN/CENELEC/ETSI

Cyber Security Coordination Group

2011

Introduction

Marketing notwithstanding, having permanently connected vehicles is not a good idea...

Privacy & Data Protection: has anyone given their consent when you bought your car?
(And still, modern cars are impressive (big) data generators)

Cybersecurity: not exactly considered among design parameters...
Figures

- According to an IHS report connected vehicles in 2022 will be 82.6 M, up from 13.8 M in 2013.
- (how long until all vehicles are online?)

"connected car systems will yield approximately $14.5 billion in revenue from automotive data [...] by 2020."

*IHS Automotive, 2013.*
Where all this money is coming from?

"Big Data assets found in the connected car—diagnostics, location, user experience/feature tracking, and adaptive driver assistance systems/autonomy...”

- IHS
Data Wars

Winterkorn 2014 (@ VDA Congress):

"We seek connection to Google's data systems, but we still want to be the masters of our own cars,"

Or… data (and revenues) are our property (not Google’s, and not the clients’ either)

Traditional manufactures are very well aware of the economic value of big datasets.
Under the hood

Modern vehicles carry with them not one but several data networks, a veritable mini-internet on wheels

Connected vs. Autonomous – Autonomous vehicles do not need a permanent connection to work, but they will be as well.

Aside: much of what we are discussing applies to lorries, agricultural machines, etc. even if those domains present some peculiar stakeholders and characteristics
Under the hood

CAN bus (controller area network)

Specialized bus for automotive applications CAN-C e CAN-IHS)

- Sensors and actuators
- Engine Control Module
- Body Control Module
- Interfaces and gateways

Credit: canbuskit.com
Under the hood

CANbus is the leading networking technology sensors, actuators, computing. Actuators can now control totally the vehicle and the gap with true autonomy is closing fast
Under the hood – Closing the Gap

Tesla announces all production cars now have fully self-driving hardware
Ways in...

- Infosec in vehicles relied traditionally on lack of physical access: OBD interfaces were the only access way (OBD is mandatory in Europe since 2001-2003, as EOBD).
- Now cheap OBD wireless dongles are easy to come by and can be accessed via app...
- USB ports.
- Short distance wireless:
  - Bluetooth / Wifi / Radio / Infrared
- Long range wireless:
  - LTE 4G Modem → 5G
Cyber Safety

Huge attack surface

No more need for access to the OBD port, being in the vicinity is enough, and not even that if the car is connected to the Internet...

Some critical points beside access:

- Hard / Impossible to update or patch software
- Lack of awareness – both of the user but from the designers as well (see infotainment systems connected to essential systems).
Cyber Safety

FCA Jeep Cherokee (1.4 Million vehicles recalled in 2015)
- Radio connected to (both) CAN buses
- Uconnect (SO QNX) – connected both to critical systems and wifi/bluetooth interfaces
Beyond Safety

Mitsubishi Outlander PHEV Hybrid

- AP Wifi. Same password for all cars, and conveniently available in the manual...

- sssid simple formats allowed attacker to **geolocalize** every car (through “crowdsourced wardriving” services)

- Once inside the internal network it was possible to reverse engineering the message protocol used by the app and… turn off the alarm, among other things...
Beyond Safety

Nissan Leaf
– App “Nissan Connect”
- VIN Number was enough for authentication
- And you can find it…
**Big Data**

**Raw Data**: rpm, distribution, fuel level, instant speed, acceleration, GPS position, water temp, engine power, fuel pressure, oil pressure, oil level, tire pressures, throttle position, temperatures, instant torque, steering angle, turbo position…

**Calculated Values**: fuel consumption, mean speed, mean acceleration, code violations (speed + GPS), “driving style”

**Others**: phone cells, dash cam videos, music preferences…
Control & Controllers

Who controls the use of these data?
A whole lot of stakeholders...

VDA Principles (2014):

- Vehicle-related data: the manufacturer.
- Personal Data (address, usage, infotainment): the user.
- Infotainment and maintenance data should be subject to deletion by the user.
Control & Controllers

Consent mechanism is clearly inadequate for cars and almost always services are not available if consent is not given.

Blurred lines between personal data and simple technical data.
Stakeholder 1/6

Not so brief list of actors involved

- Owner, driver (may not be the same person)
- Manufacturer
- Insurance companies and experts
  - Fees based on driving style
  - Damages evaluation and incident reconstruction
Stakeholder 2/6

- Leasing companies
- Governments, government agencies, and the EU
  - Tax agencies – Interested in the owner, the vehicle and its use (personal or work)
  - Other administrations
  - eCall. Data actually used and transmitted, another connection not accessible to the user
Stakeholder 3/6

- The Police
  - Accident Reconstruction
  - The car as a witness (against the driver in some cases). Data are seen by the Courts as “objective”, more reliable than human witnesses. e.g. GPS, accelerometers, speed, seat and belts sensors...
  - Can you refuse access?
Stakeholder 4/6

- Fire Brigade, EMTs, rescuers, hospitals and health
  - Interested to number of people involved (seats) and gravity (belts on or off)
- Legal system
  - Lawyers, Courts, Expert Witnesses
- All suppliers of services connected to cars.
Stakeholder 5/6

- Employers and fleet managers
- Road assistance
  - raw data useful in order to make repairs on the road
  - transmission to other subjects
- Rental companies
- Car sharing
Stakeholder 6/6

- Taxi companies
- Repair shops
  - Independent and in-house
  - Integration with personal data in possess of the manufacturers...
  - Body shops
The Economics

- The automotive sector is undergoing a deep transformation
- Entry barriers are lower, the boundaries are blurred: spaces and opportunities for new actors
- High innovation rate, shorter development cycles, new technologies
- Mobility itself is changing
  - New models of ownership
  - Integrated systems (ITSs)
- Laws and regulations
Open Issues...

...for privacy and data protection

- Classification, consent
- Necessity and Proportionality
- Seemingly irrelevant or non-personal data can be used for individual profiling
- Personal data (places, journeys, phone calls etc)
- Hard to individuate the controller and processors
- Retention and disposal
- Different jurisdictions fracture the market (EU GDPR Vs. Non-EU)
Open Issues...

...for safety and security

• Convenience over security, when it comes to vehicles it’s dangerous for your physical well-being.

• Economic mechanisms that operate against information security. Hard to solve (security & safety by design)

• Standards and regulations
Security – Possible Solutions

- Design software with fail modes from the ground up, incorporate hardware failsafe systems
- Manual override (it should be always possible to override the automation)
- Authentication! (at least for driving systems)
- Air-gapping critical systems
And Privacy?

- Simpler privacy policies
- Better control of the data, functions to delete / manage data, even for technical telemetry
- Vertical regulations for data protection
- Actually, very little to do when the main stakeholder is the state (or the Union)
Thanks for Your Time.

Questions?

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