Security Challenges for Cooperative and Interconnected Mobility Systems

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DITCM
Dutch Integrated Testsite Cooperative Mobility

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Context: Trends

Automotive innovation in software

(estimate is that this will be 80%*)

- More microprocessors and sensors in the vehicle

Increased connectivity

- Telematics systems by Kia, Daimler and BMW
  - Integrate map-based, vehicle diagnostics, and e-call (mandatory as of 2015)
- Interfaces: internet or ad hoc networks
- Interconnected in-vehicle systems

UVO eServices – KIA

MBRACE2 – Daimler

BMW ConnectedDrive – BMW

* R.N. Charette, "This car runs on code", IEEE spectrum, Feb. 2009

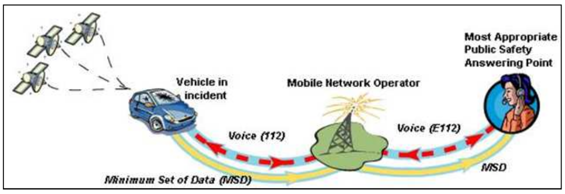
Context: Cooperative and Interconnected mobility systems

- Cooperative Driving results in*:
  - Less traffic congestion
  - Less traffic accidents
  - Less CO_2 emission

mobility: cooperative driving

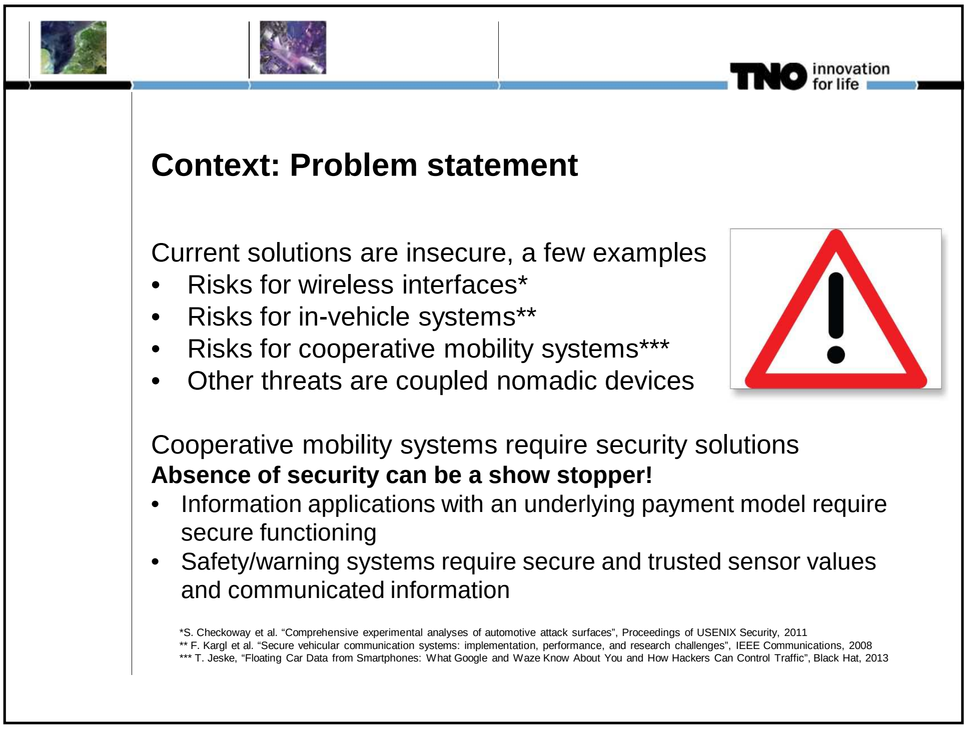
safety: collision warning → mitigation → avoidance

comfort: cruise control, advanced cruise control, speed advice


Vehicle in incident
Mobile Network Operator
Most Appropriate Public Safety Answering Point
Voice (112)
Voice (E112)
MSD
Minimum Set of Data (MSD)

safety: e-call system

*TNO report 2008-D-R0996/A: "Smarter and better – the benefits of intelligent traffic"



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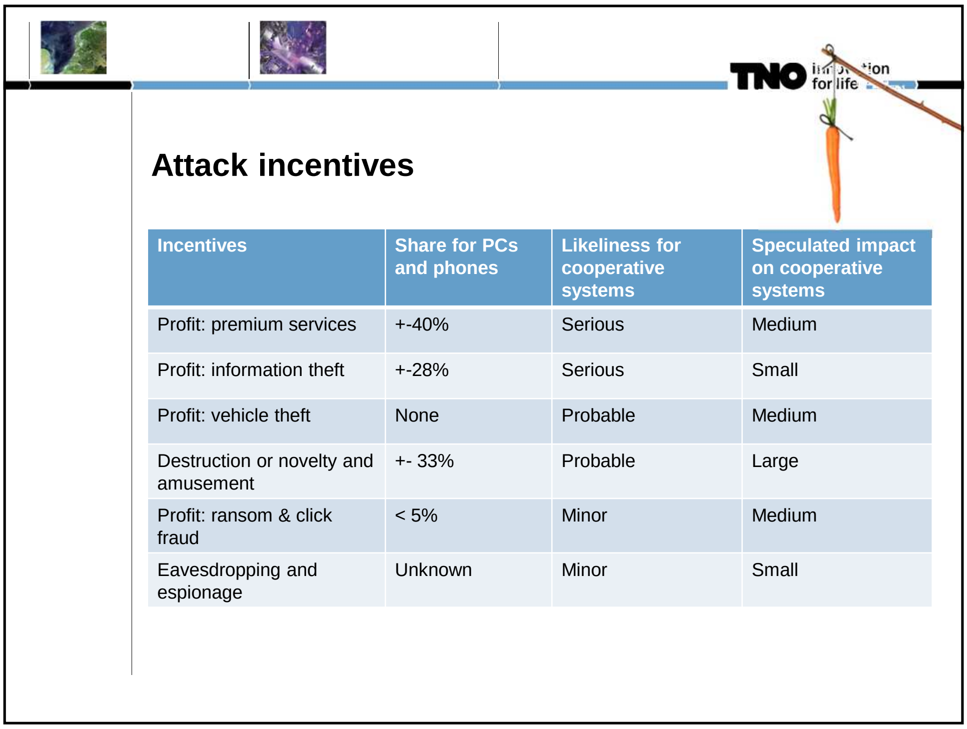
Context: Problem statement

Current solutions are insecure, a few examples
- Risks for wireless interfaces*
- Risks for in-vehicle systems**
- Risks for cooperative mobility systems***
- Other threats are coupled nomadic devices

Cooperative mobility systems require security solutions
Absence of security can be a show stopper!
- Information applications with an underlying payment model require secure functioning
- Safety/warning systems require secure and trusted sensor values and communicated information

*S. Checkoway et al. "Comprehensive experimental analyses of automotive attack surfaces", Proceedings of USENIX Security, 2011
** F. Kargl et al. "Secure vehicular communication systems: implementation, performance, and research challenges", IEEE Communications, 2008
*** T. Jeske, "Floating Car Data from Smartphones: What Google and Waze Know About You and How Hackers Can Control Traffic", Black Hat, 2013



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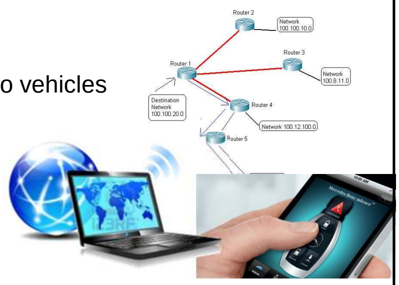
Attack incentives

Incentives	Share for PCs and phones	Likeliness for cooperative systems	Speculated impact on cooperative systems
Profit: premium services	+-40%	Serious	Medium
Profit: information theft	+-28%	Serious	Small
Profit: vehicle theft	None	Probable	Medium
Destruction or novelty and amusement	+- 33%	Probable	Large
Profit: ransom & click fraud	< 5%	Minor	Medium
Eavesdropping and espionage	Unknown	Minor	Small

Mobile internet communication

Problems and solutions

- Always-on data-connections added to vehicles
  - Update software
  - Real-time routing information
  - Web browsing
  - Remote vehicle control



Security risk factors

- An internet uplink opens up previously closed systems
  - Safety critical system becomes vulnerable
  - Potential to harm national security
  - Long life cycle poses a challenge that is unrivalled by IT devices

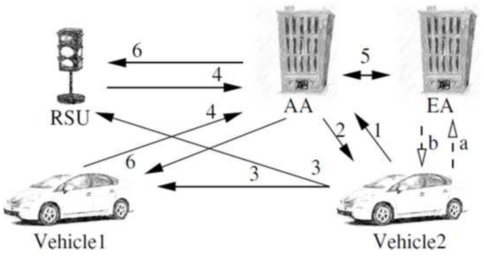
Vehicular Ad Hoc Networking

Problems and solutions

- Rapidly changing topology and unorganized nature
- ETSI performed a vulnerability and risk factor analysis in 2010
  - Counter measures and improvements formulated
- Certificate based communication are proposed

Security risk factors

- Data integrity
- Insecure positioning
- Response latency



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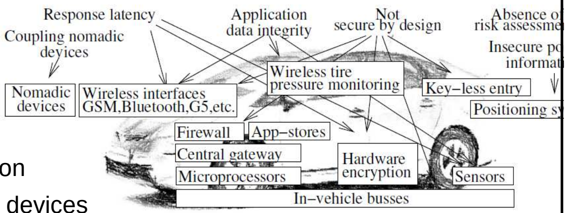
In-Vehicle Systems

Problems and solutions

- Hardware encryption modules
- Firewalls
- Software upgradeable
- Coupling with nomadic systems

Security risks

- Secure by design
  - Ductile
  - Graceful degradation
- Coupling of nomadic devices
- Lack of risk factor analysis



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Discussion

Dilemmas

- Data protection vs. information sharing
- Private sector vs. public sector
- Stimulate the economy vs. improve the security

Organizational challenges

- Education in cyber hygiene for maintenance
- OEMs should prepare for massive recalls
- Change of vehicle safety laws
- Backward compatibility between algorithms
- Log behaviour for accountability
- Licence revocation might be needed

Conclusions

Security for interconnected and cooperative mobility systems will become important in the coming year

- Crucial for acceptance and successful introduction of cooperative mobility systems

- Most serious incentive is profit
  - Biggest threat is destruction and novelty
- Biggest security risk factors
  - Application data integrity validation
  - Insecure positioning
  - Systems are currently not secure by design
- Dilemmas and organizational challenges should be addressed

Questions?

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