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“Machines” on wheels

Standardizing cyber security in commercial vehicles

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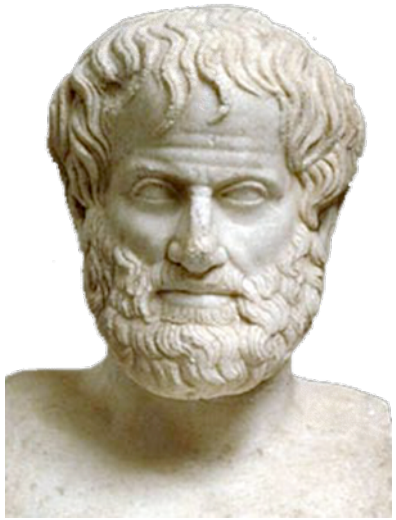
Presentation outline

- Cyber security is nothing new
- Experiences in automotive applications
- EC regulation on securing the measured load
- DIN 4630: Secured telematics
- Cyber-security engineering

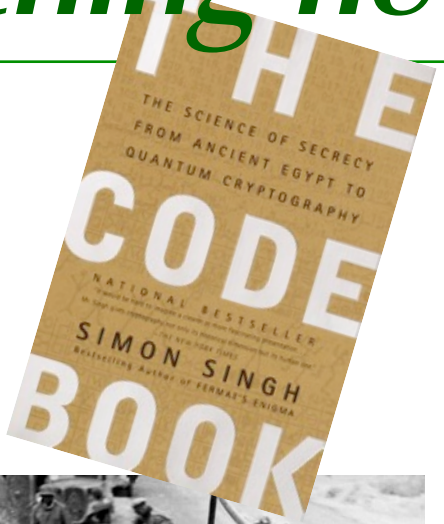


Takeaway: “The whole is greater than the sum of the parts.” (Aristotle)

Security and duty vehicles

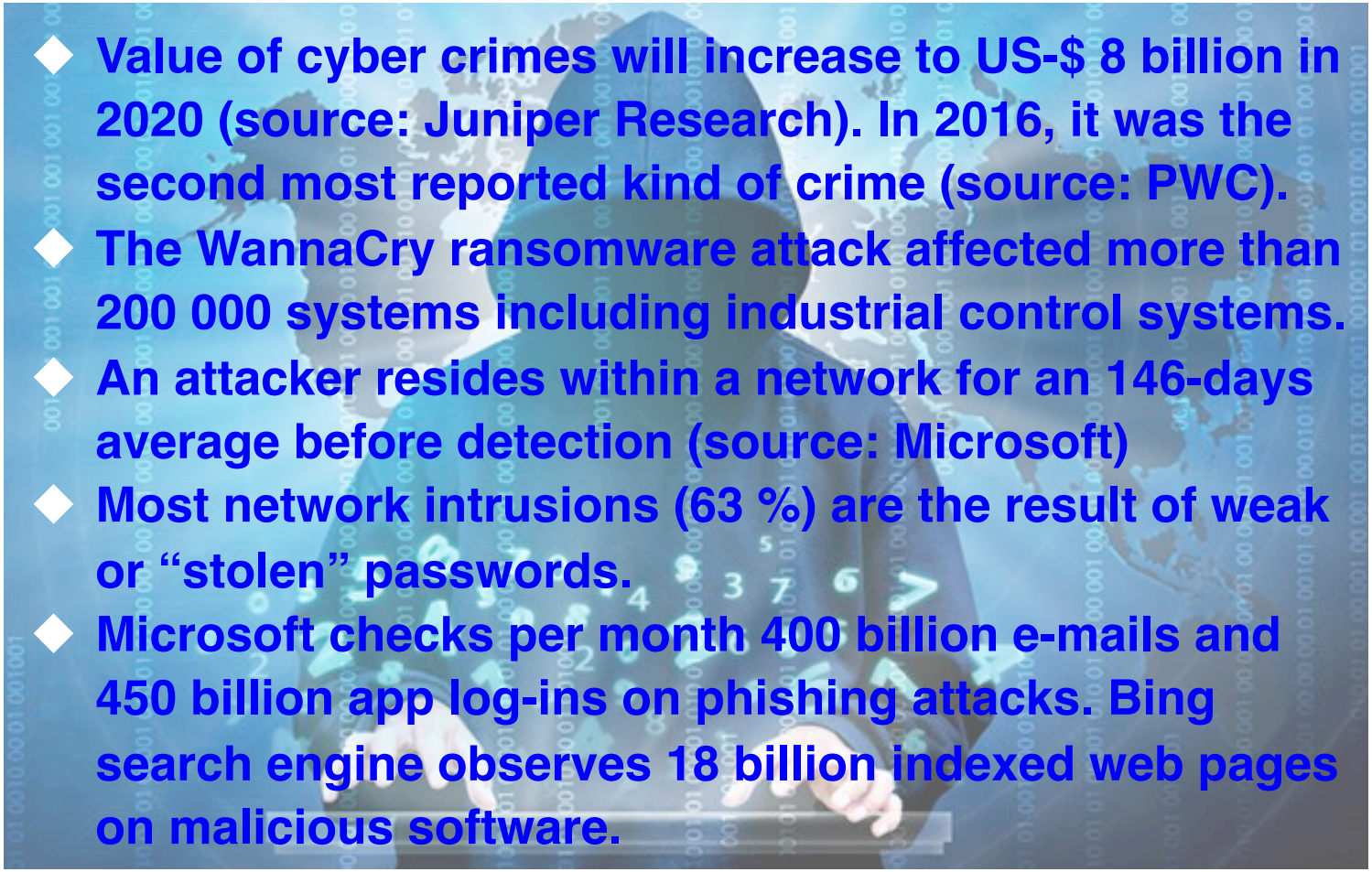
Takeaway: Automated and autonomous machines need secure networks.

Cyber security is nothing new



Takeaway: Do not re-invent the wheel.

Cyber crimes and defense



- Value of cyber crimes will increase to US-$ 8 billion in 2020 (source: Juniper Research). In 2016, it was the second most reported kind of crime (source: PWC).
- The WannaCry ransomware attack affected more than 200 000 systems including industrial control systems.
- An attacker resides within a network for an 146-days average before detection (source: Microsoft)
- Most network intrusions (63 %) are the result of weak or “stolen” passwords.
- Microsoft checks per month 400 billion e-mails and 450 billion app log-ins on phishing attacks. Bing search engine observes 18 billion indexed web pages on malicious software.

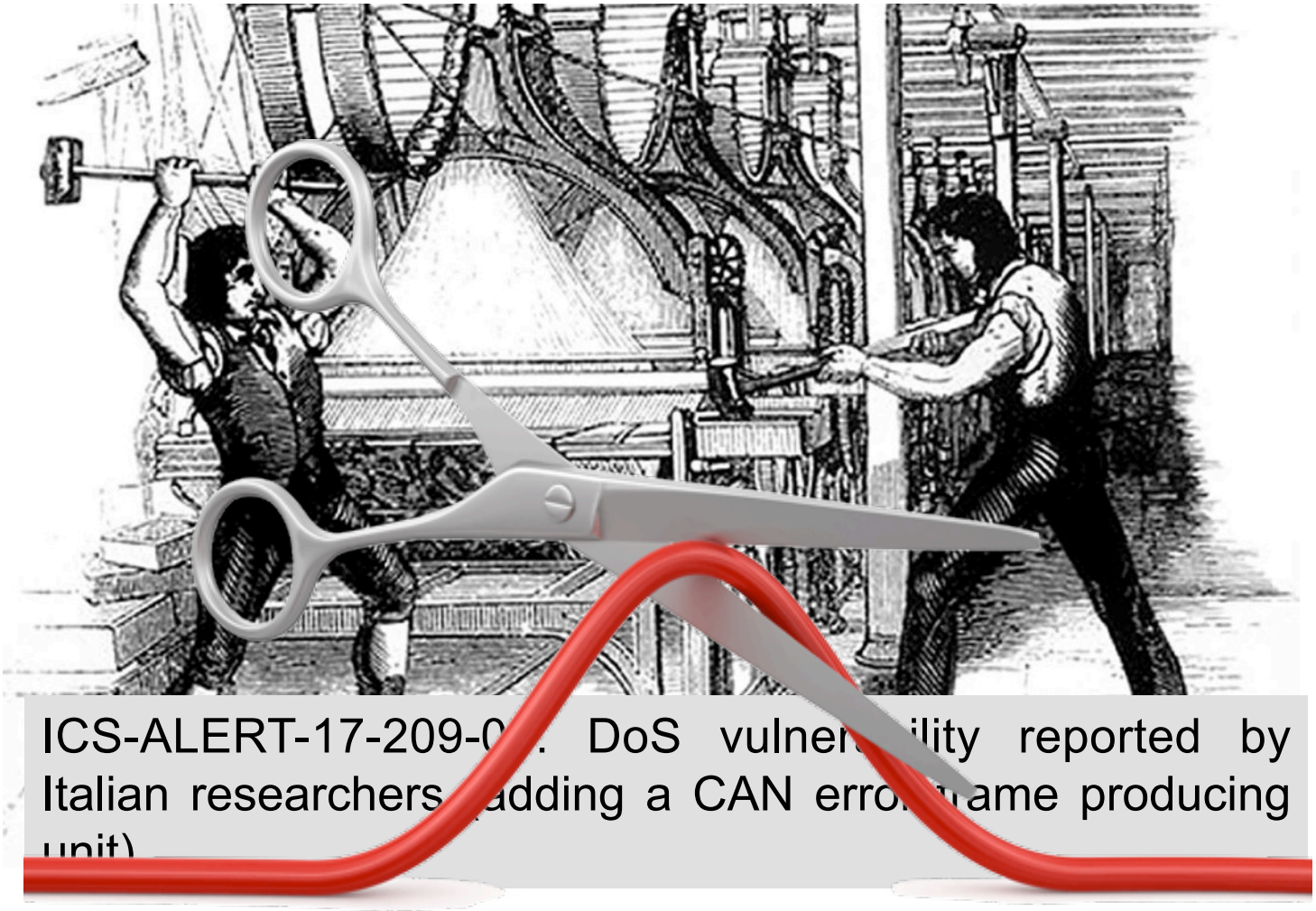
Takeaway: Cyber crime is a big business like illegal drugs.

Vulnerabilities and attacks

- *Direct-access attack:* Unauthorized user gaining physical access
- *Backdoor:* Bypassing normal authentication or security checks
- *Denial-of-service (DoS) attacks:* Making the machine or network unavailable
- *Eavesdropping:* Listing to a private conversation (e.g. monitoring electro-magnetic transmissions)
- *Spoofing:* Masquerading as a valid entity
- *Tampering:* Malicious modification of products
- *Phishing:* Acquiring sensitive information (e.g. passwords, keys)
- Etc.

Takeaway: The weakest link in the chain breaks.

Denial-of-service attacks



ICS-ALERT-17-209-0[illegible]. DoS vulner[illegible]ility reported by Italian researchers [illegible]adding a CAN erro[illegible]ame producing unit)

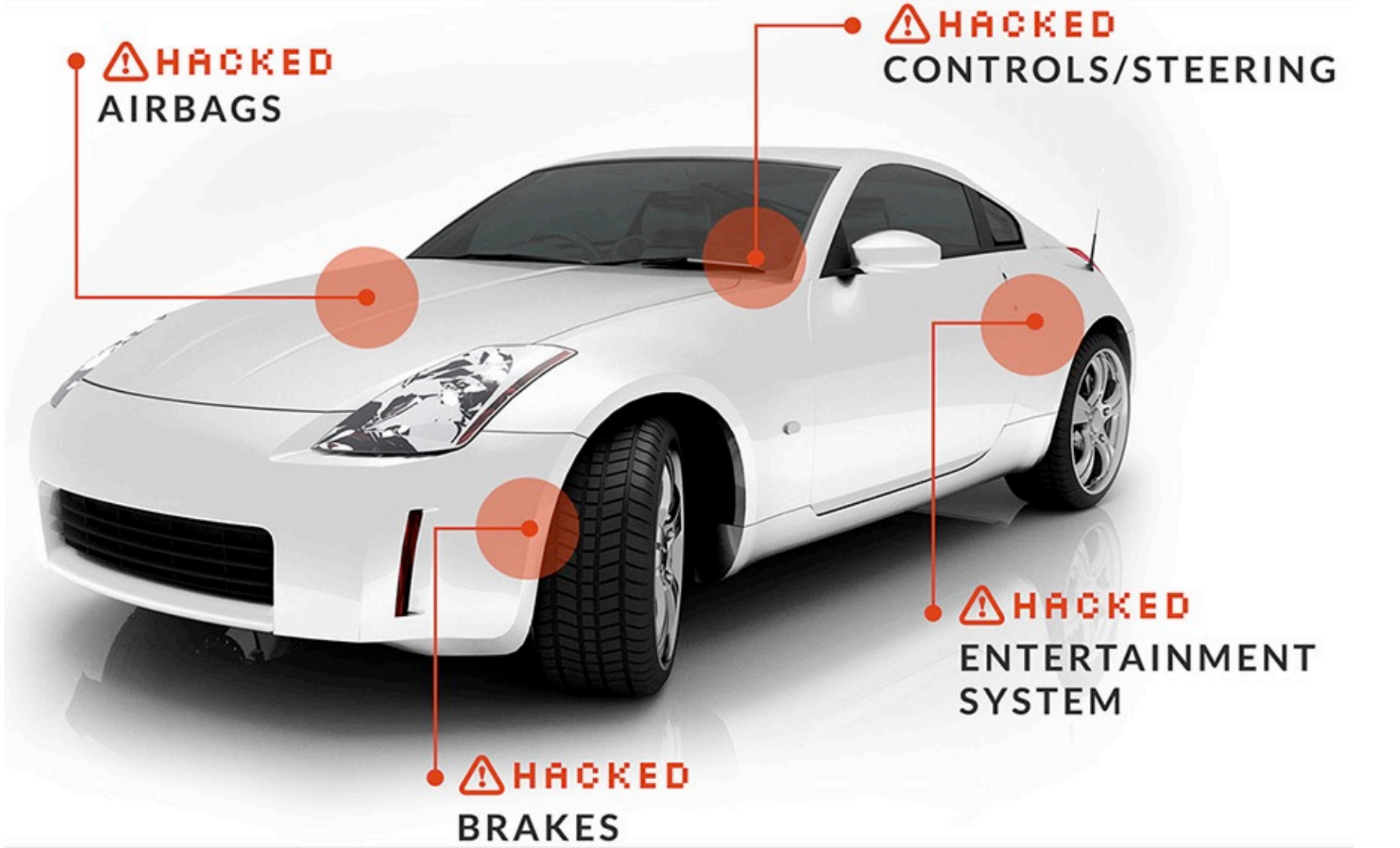
Takeaway: Protect your properties. Limit the access.

Limit the access

Do not map the JTAG protocol unsecured to the CAN interface, for example.

Takeaway: Protect all (!) “doors” and “windows”.

Automotive experiences



Takeaway: Lock doors, windows, hood, trunk, and all other interfaces!

Why cyber security matters

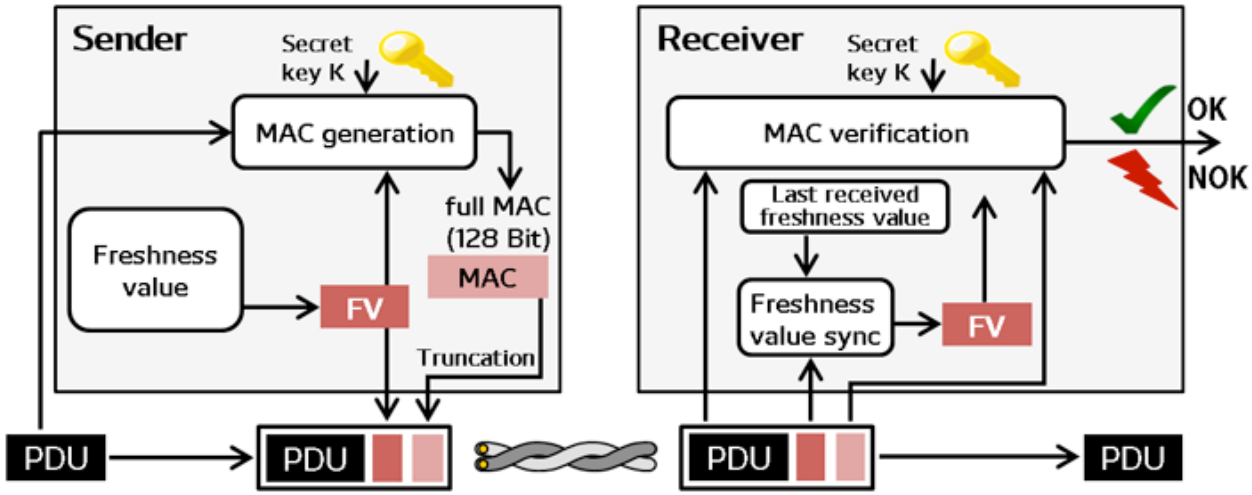
- FCA recalled 1,4 million cars after the Jeep hack.
- Security researchers detected a series of vulnerabilities in in-vehicle network designs, in particular maleficent CAN-based messages could be injected causing for example brake ECUs to enter service mode or to disable the brake system.
- The carmakers are very concerned about “fleet” attacks, because they make them to be susceptible to blackmails.

Takeaway: Recalling of cars can be costly, to be blackmailed, too.

ISO 14229-1: Seed and key

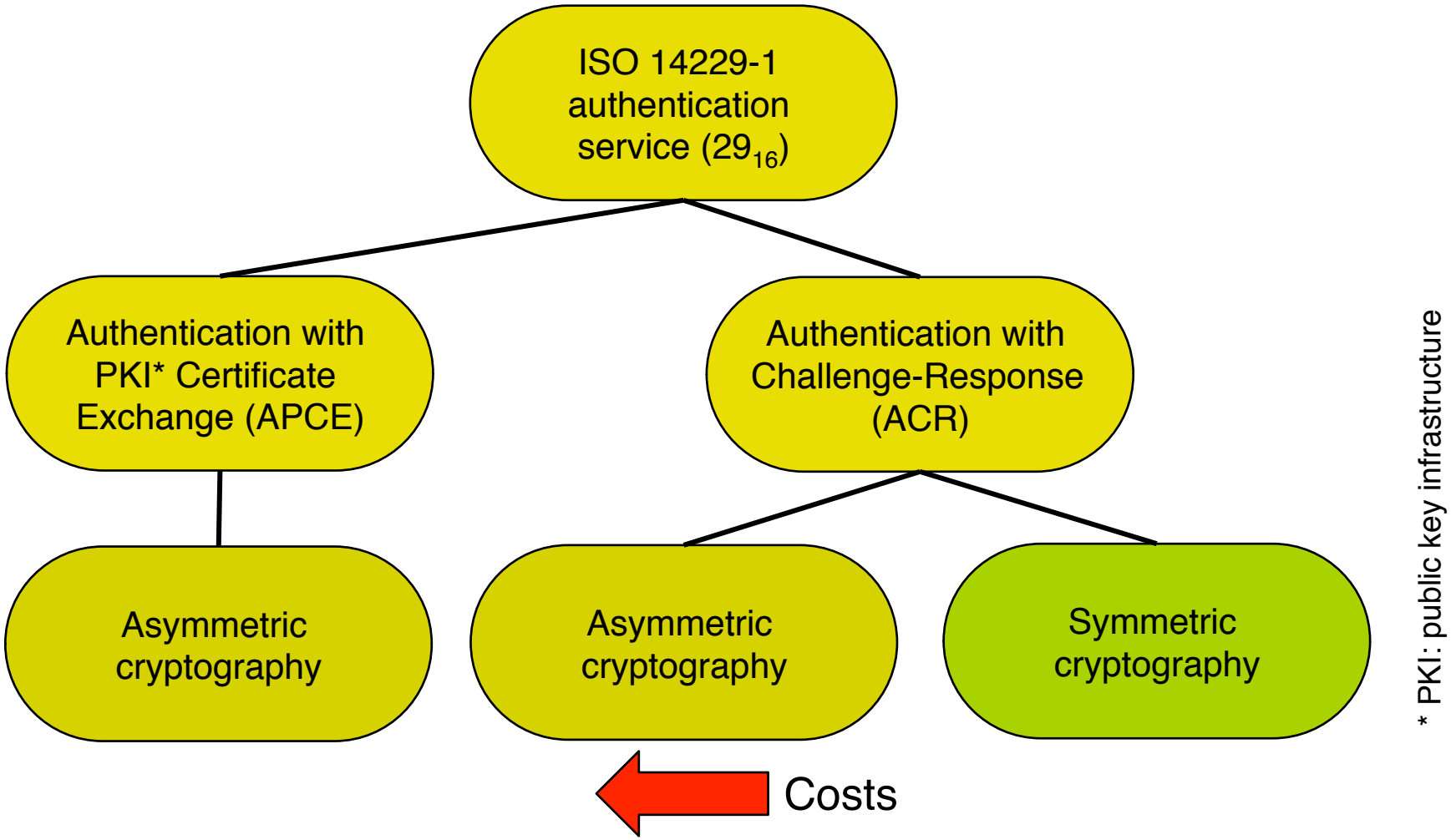
The chosen approach complies with Autosar SecOS:

- Client (test tool) requests the “seed” from the server (car ECU),
- Server sends the “seed”,
- Client sends the “key” (appropriate for the “seed” received),
- Server responds that the “key” is valid and that it is unlocked.



Takeaway: The OBDII is secured on application level and transport layer.

Cryptography options

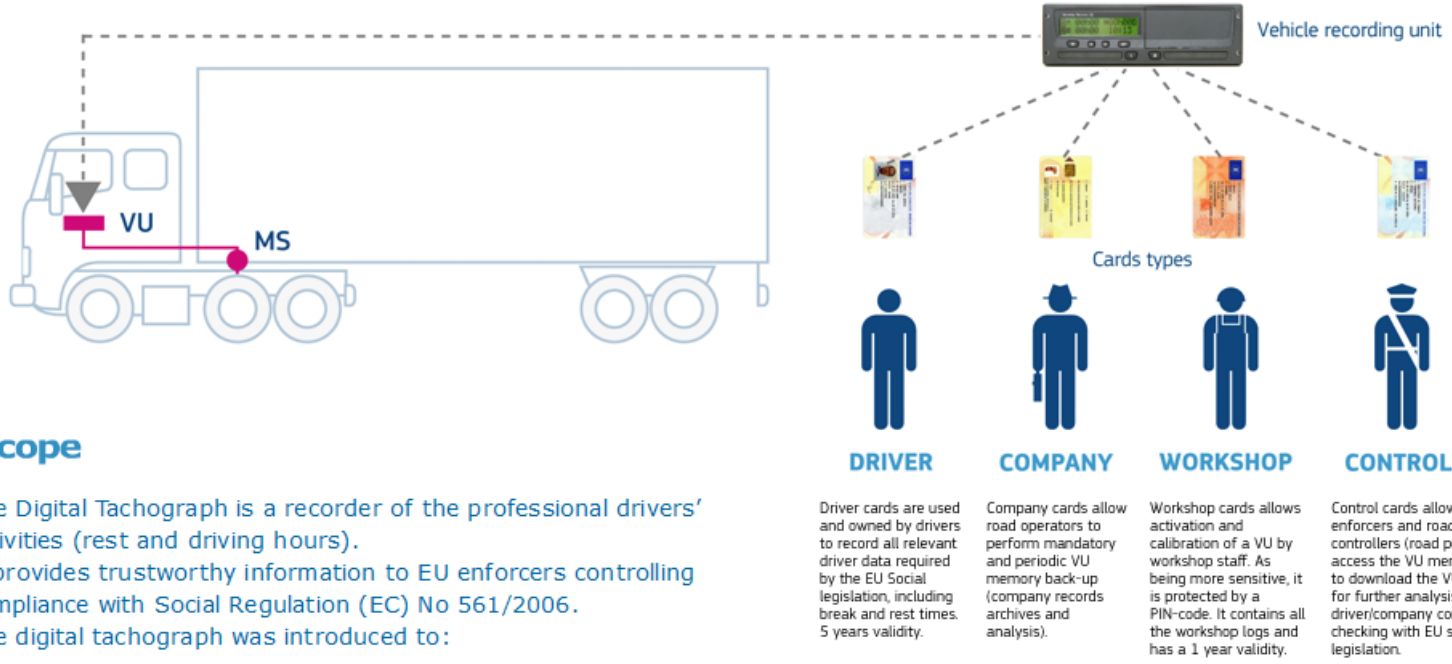


Takeaway: Generic external test tools needs to implement all options.

ISO 26021 series: Password

Takeaway: Do not use “weak” passwords, add other security provisions.

ISO 16844 series: Tachograph



Scope

The Digital Tachograph is a recorder of the professional drivers' activities (rest and driving hours).
It provides trustworthy information to EU enforcers controlling compliance with Social Regulation (EC) No 561/2006.
The digital tachograph was introduced to:

Objectives

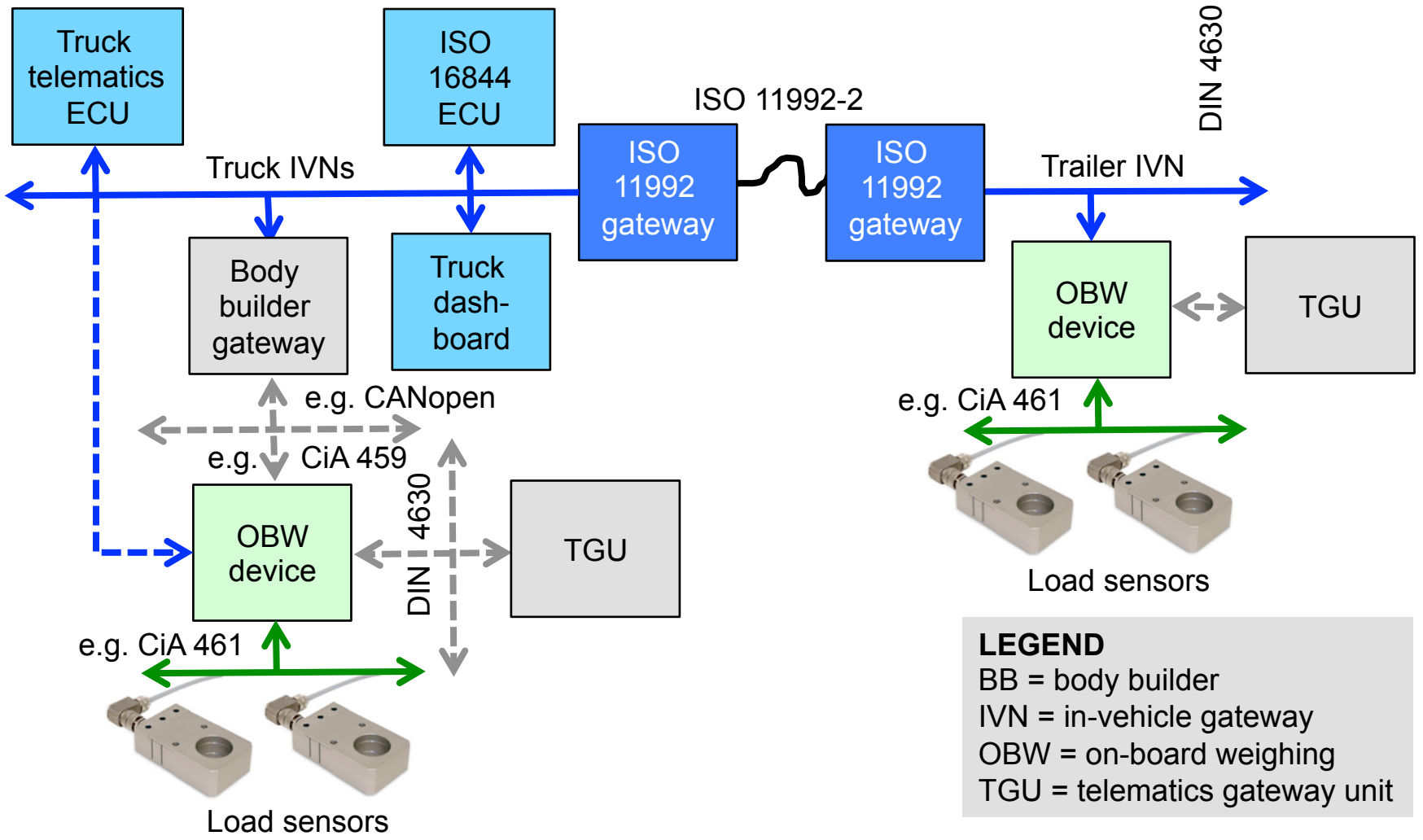
- Increase road safety, by controlling the activity of the drivers (limiting daily driving hours)
- Ensure minimum working conditions standards for professional drivers
- Guarantee fair competition between EU transport companies

Technical Requirements

In order to fulfill these objectives the digital tachograph requires a motion sensor paired with it and smartcards which are used to control secure access to the device and its data for drivers, law enforcers, companies and workshops.

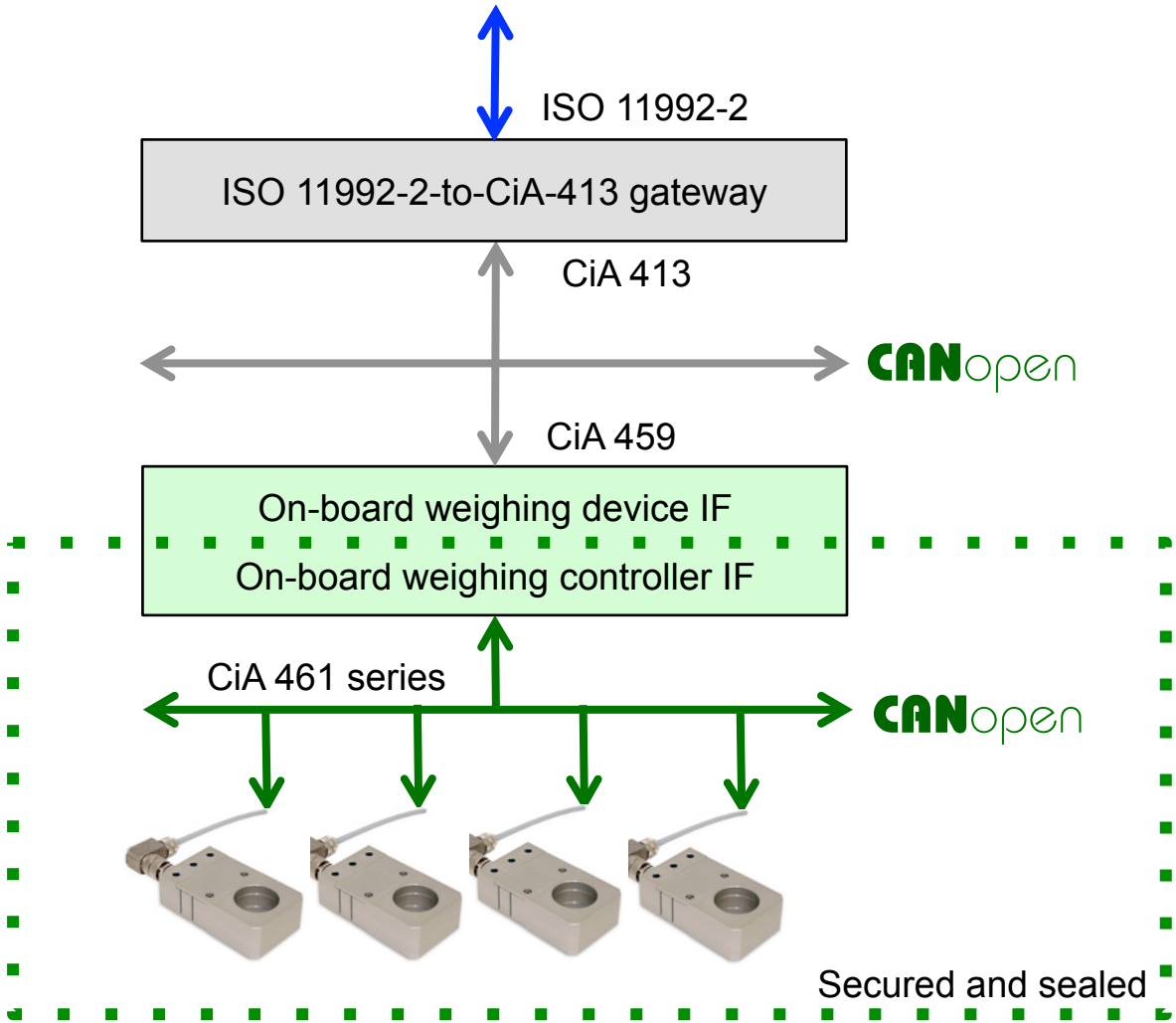
Takeaway: Start with securing the sensor data.

EC on-board weighing



Takeaway: Cyber security is a system design issue.

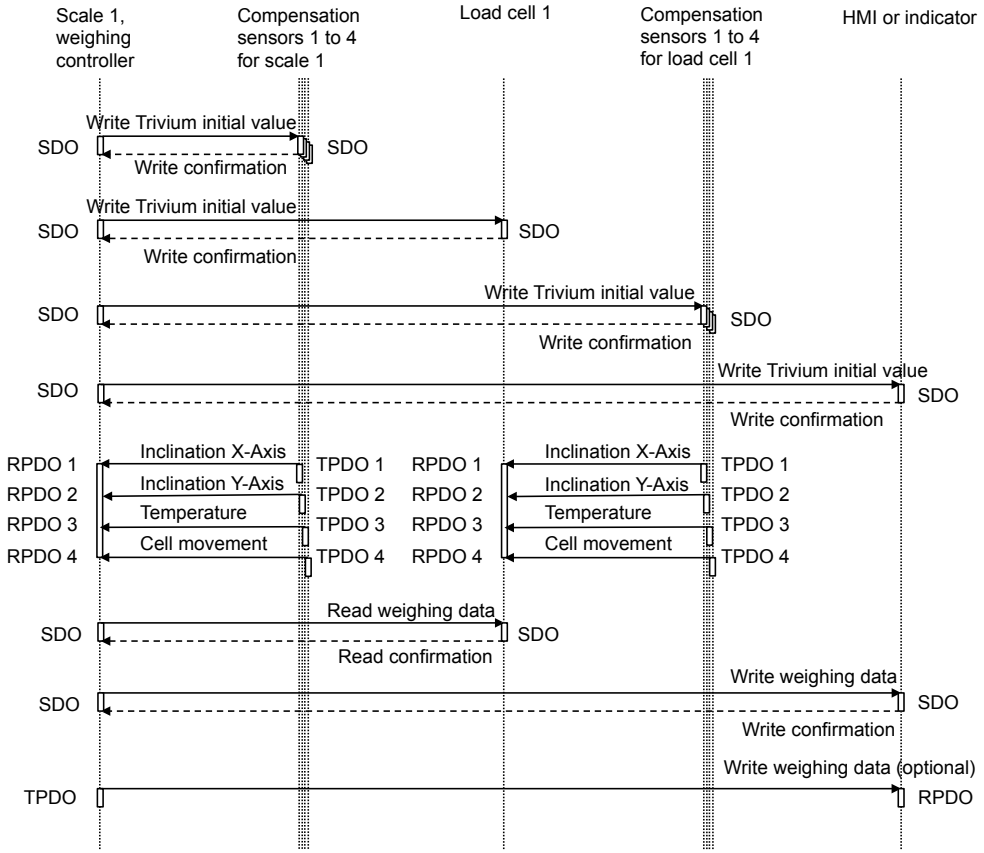
On-board weighing system



Takeaway: Use securely connected sensors.

CiA 461 series security

The OBW* controller writes the same Trivium key to all devices in the weighing system before sealing it in a secure environment.

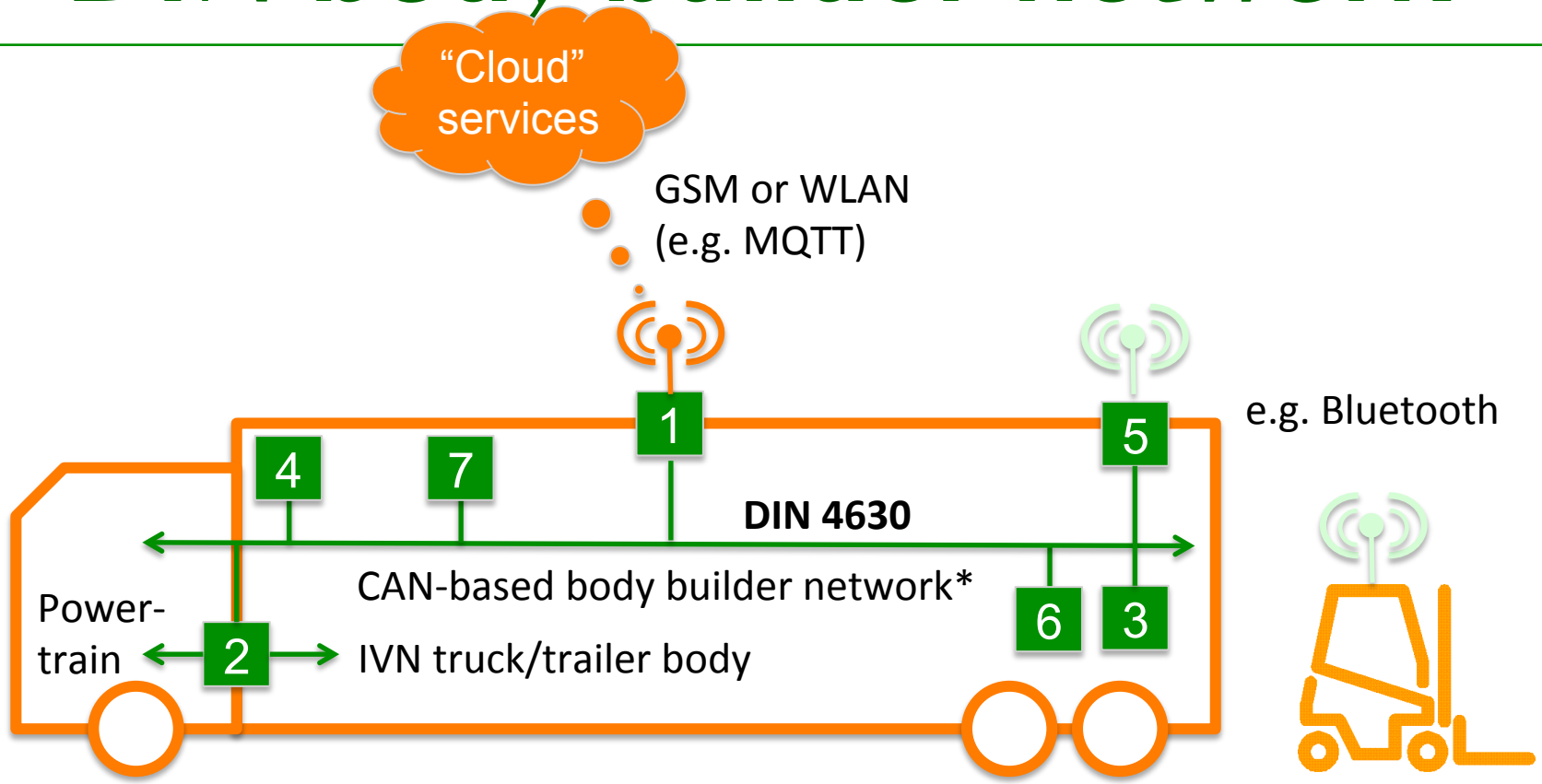


Sequence diagram for encrypted data (source: CiA 461)

* OBW: on-board weighing

Takeaway: Sealed sensors/controllers do not need further authentication.

DIN body builder network

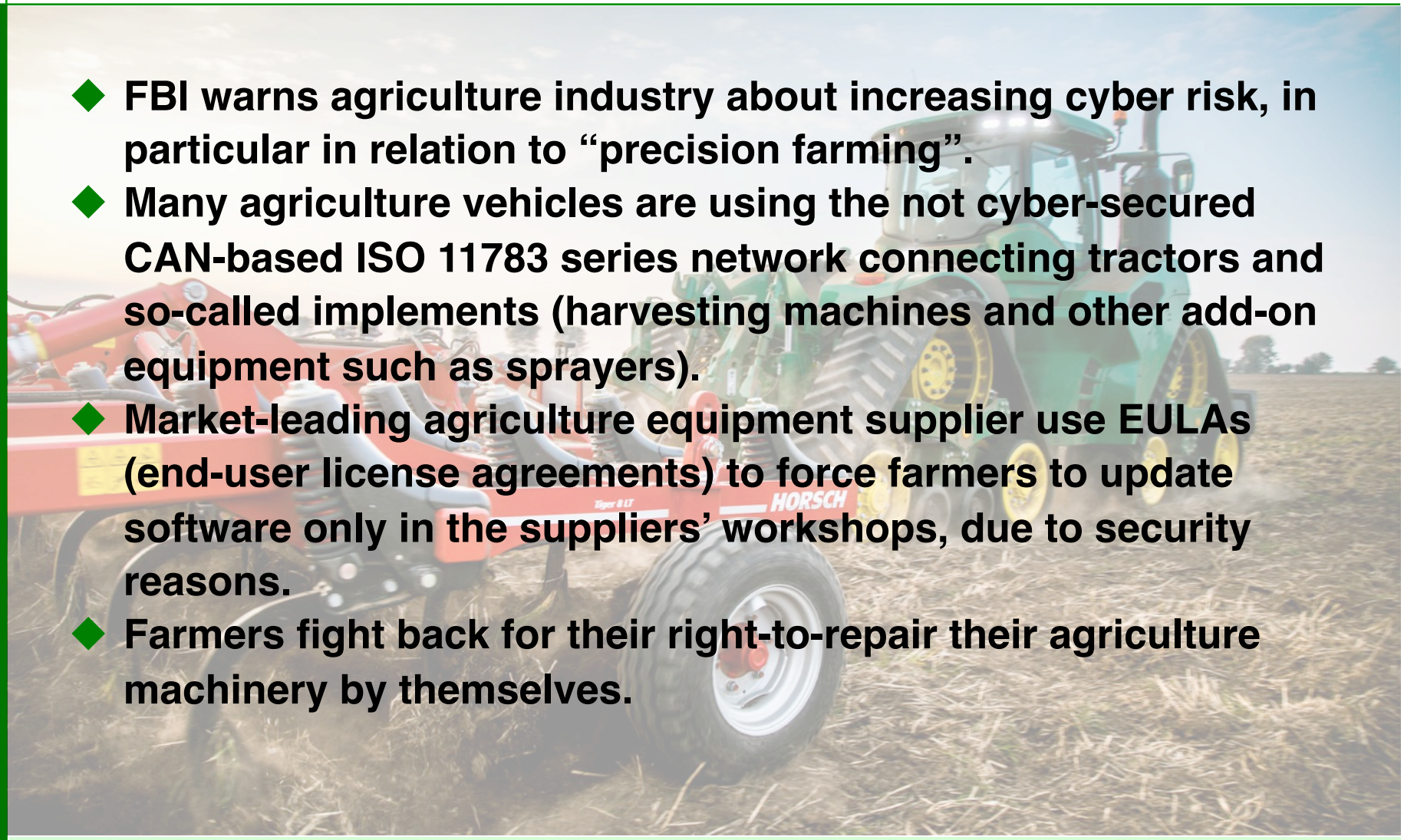


LEGEND

1 Telematics gateway unit (TGU)
2 In-vehicle network gateway (IGU)
3 Loading tailgate unit
4 Refrigerating unit
5 Nomadic device gateway
6 Tipper lorry
7 other body control unit (BCU)
* CANopen or SAE J1939

Takeaway: There are different security requirements (e.g. geo-fencing).

Agriculture hacking

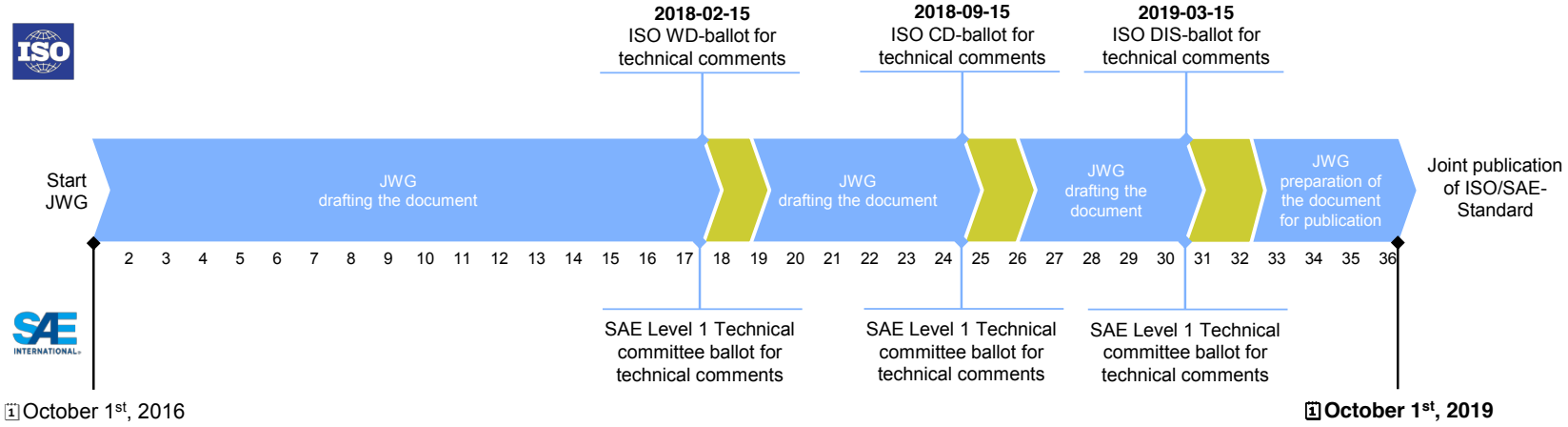


- FBI warns agriculture industry about increasing cyber risk, in particular in relation to “precision farming”.
- Many agriculture vehicles are using the not cyber-secured CAN-based ISO 11783 series network connecting tractors and so-called implements (harvesting machines and other add-on equipment such as sprayers).
- Market-leading agriculture equipment supplier use EULAs (end-user license agreements) to force farmers to update software only in the suppliers’ workshops, due to security reasons.
- Farmers fight back for their right-to-repair their agriculture machinery by themselves.

Takeaway: There could be conflicts between suppliers and end-users.

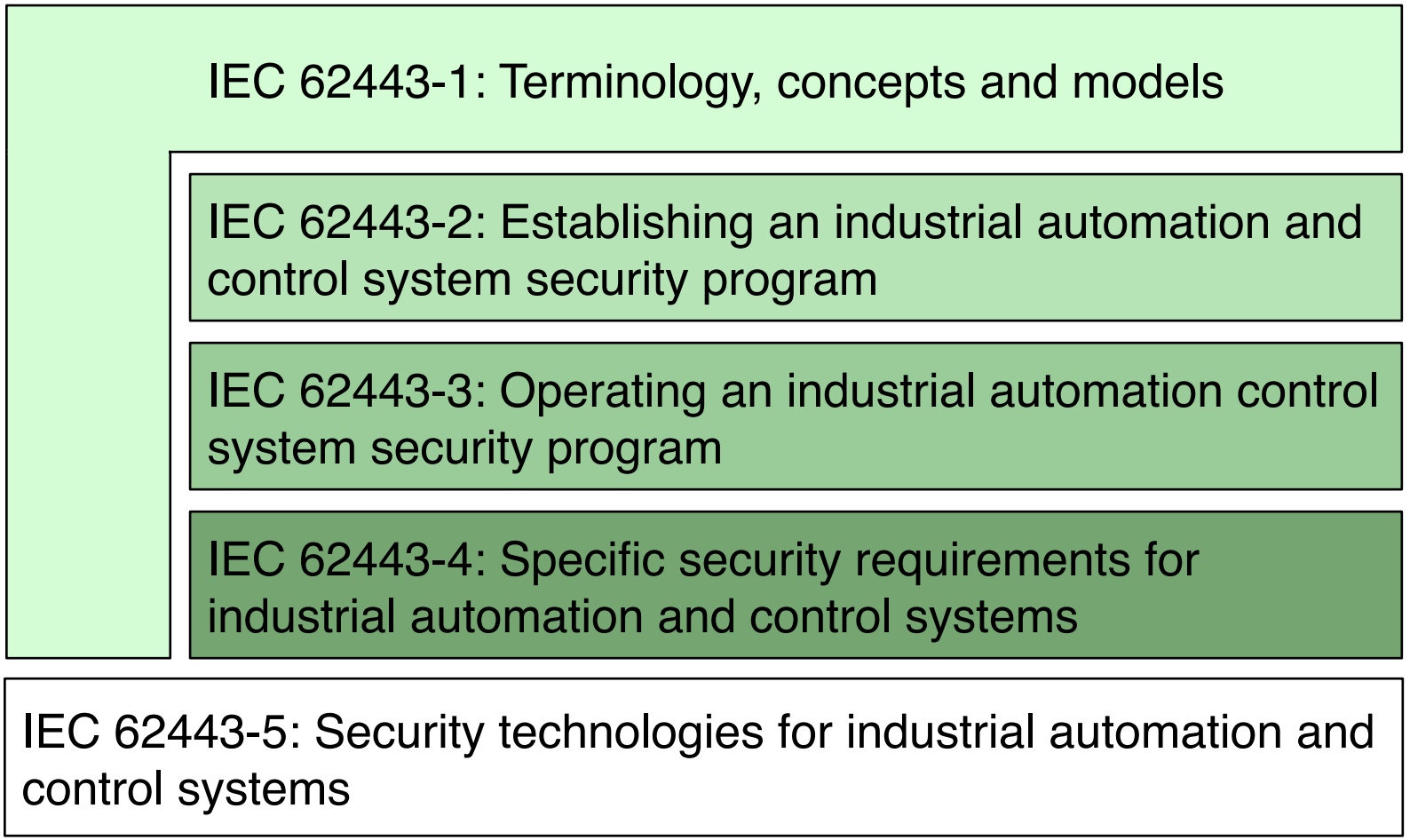
ISO/SAE 21434 series

- Experts from ISO and SAE are developing jointly a cyber security process framework standard series.
- This framework is tailored from the ISO 26262 functional safety process framework.
- This framework includes a common language for communicating and managing cyber security risk among stakeholders.
- This framework does not prescribe specific technology or solutions related to cyber security.



Takeaway: Standardizing cyber security engineering is necessary.

IEC 62443 series



Takeaway: Should be ISO/SAE 21434 and IEC 62443 harmonized?

HLP* (“data link”) security

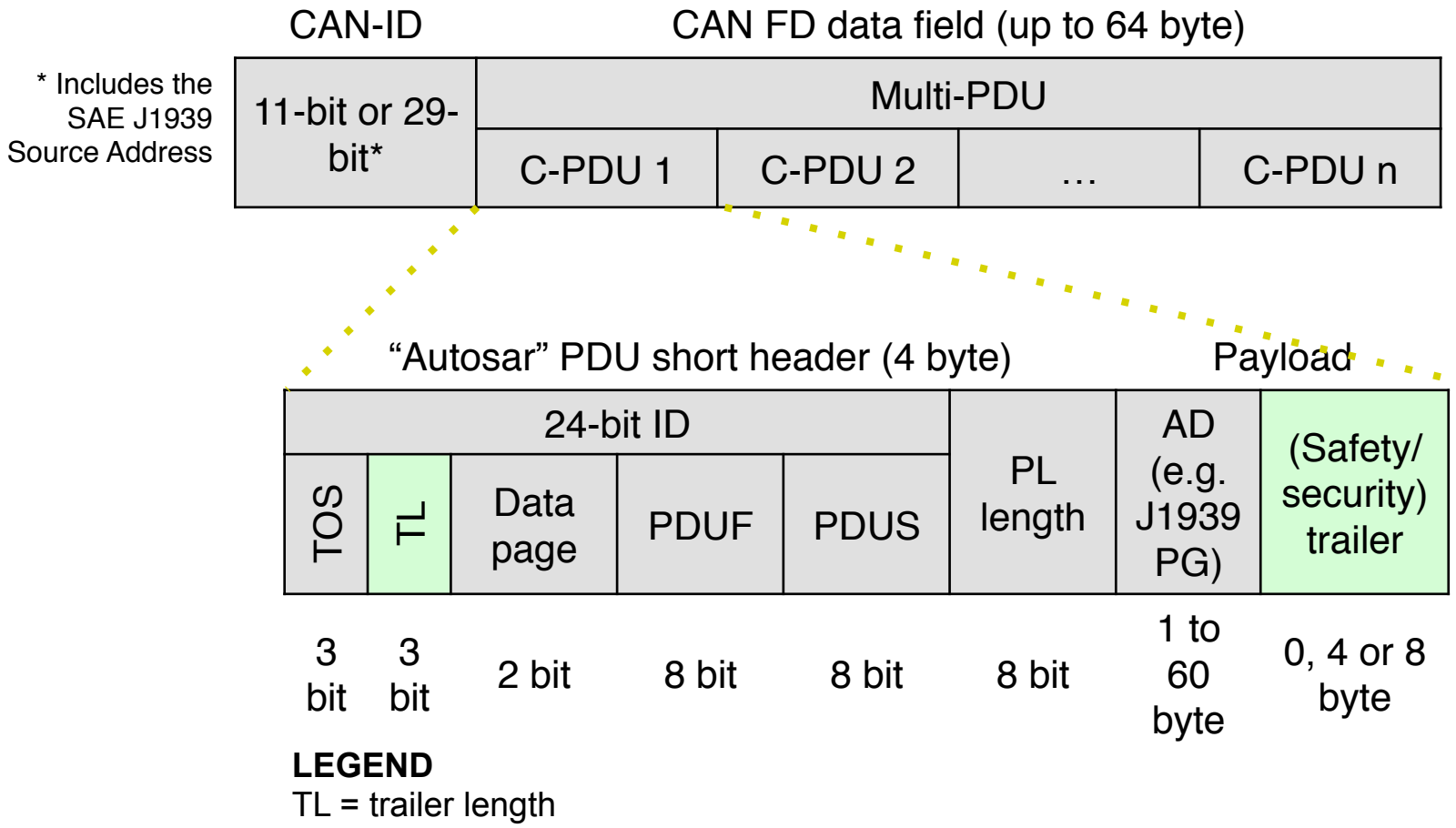
- ISO 15764:2004 specifies for road vehicles an extended “data link” security.
- It is based on cryptographic methods that include encryption, digital signatures, and message authentication codes (MACs).
- It provides a description of services to establish ECUs as trusted parties in respect of one another and to protect against specific threats.
- It is applicable to all network technologies between pairs of ECUs capable of storing and processing secret data so that unauthorized third parties are denied access to it.
- Parameters are provided to select the desired level of security.
- It is used for example by the ISO 16844 tachograph standard.

* HLP: higher-layer protocol

Takeaway: ISO 15764 is a proven generic encryption standard.

SAE J1939-21 on CAN FD

- **CiA 602-2, CAN FD for commercial vehicles – Part 2: Application layer**

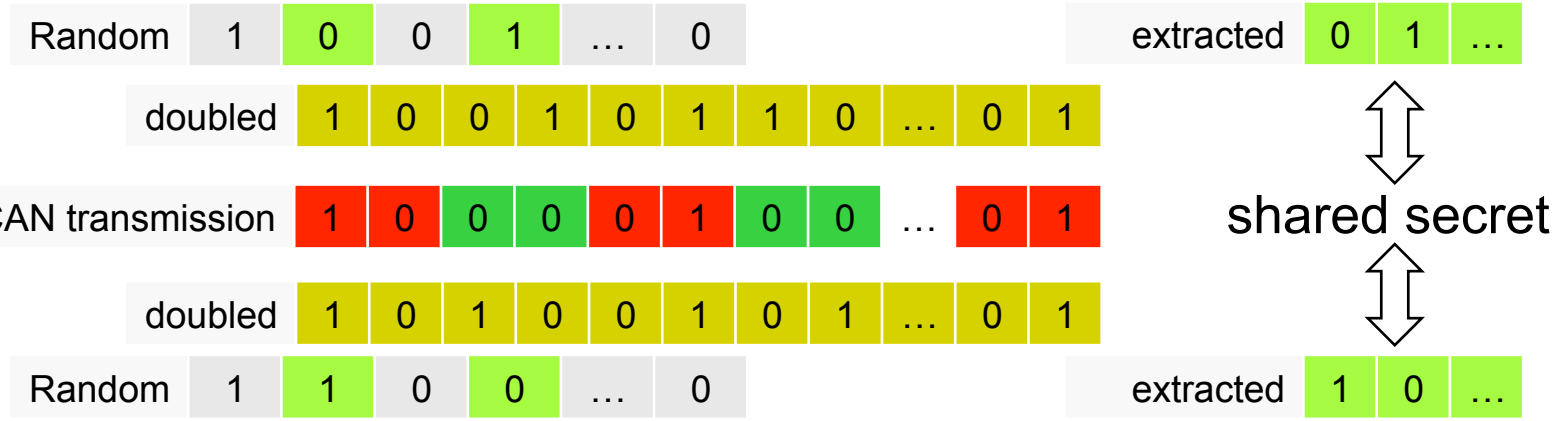


Takeaway: CAN FD provides sufficient payload length for security.

CAN data link security

CAN supports security out-of-the box for initial key exchange

- Everybody can transmit but nobody knows, who it is.
- Diffie-Hellman (DH) key exchange* can be speed-up.



* The initial key can be used to encrypt subsequent communications using a symmetric key cipher (prior to public key methods like DH, cryptographic keys had to be transmitted in physical form such as key lists for the Enigma).

Takeaway: A CAN node fingerprint can only be identified by oscilloscopes.

Smart CAN transceiver

* Preventing spoofing attacks makes transferring a stolen cryptographic key useless, as the compromised node or the man-in-the-middle is not able to send the CAN data frame successfully.

- Hardware filtering of CAN data frames (white list) to be transmitted, in order to countermeasure spoofing attacks*
- Destroying CAN data frames by means of Error frames, which are owned by this node, in order to countermeasure spoofing attacks*
- Limiting the use of bandwidth (e.g. to 5 %), in order to countermeasure DoS attacks

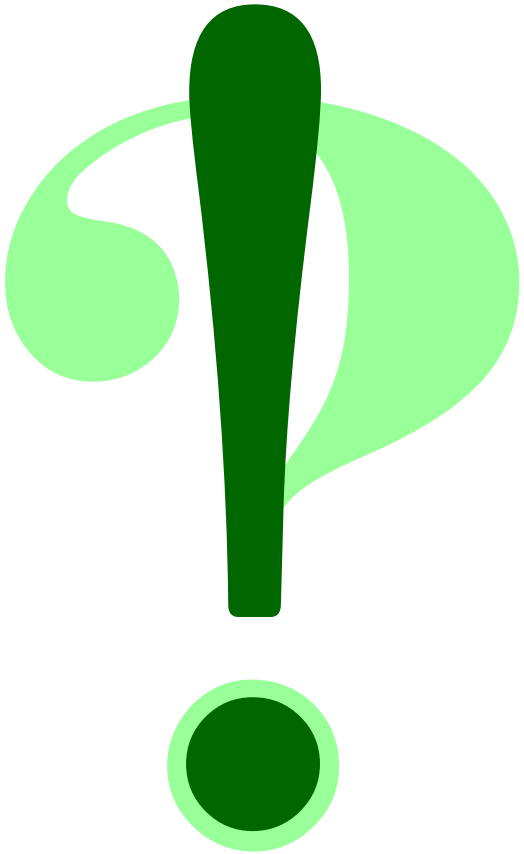
Takeaway: Security in hardware can improve the overall security.

Summary

- **The whole is greater than the sum of the parts: Cyber security is a system design issue.**
- **Each cyber security case is unique: Individual assessments are necessary.**
- **Cyber security is highly political: Laws and regulations should protect the "weakest" stakeholders (e.g. the right-to-repair).**
- **Do not re-invent the wheel: Laws and regulations can be simplified by referencing the appropriate cyber security related standards.**

CAN

Questions and answers



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