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AURIX KNOWLEDGE LAB 2024

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Post-quantum cryptography - ESCRYPT CycurHSM for TC4xx

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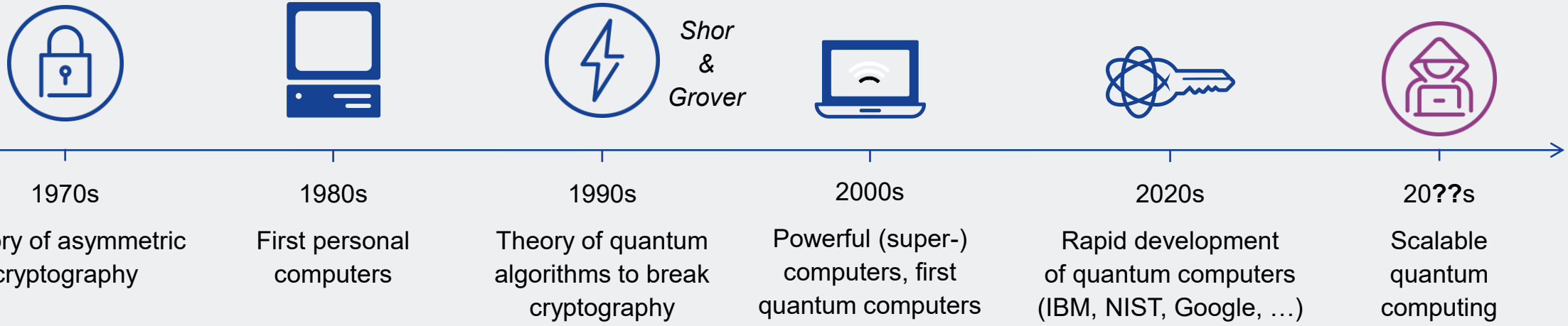
ETAS

Evolution of quantum computing

The quantum threat



Increasing system complexity

Increasing connectivity

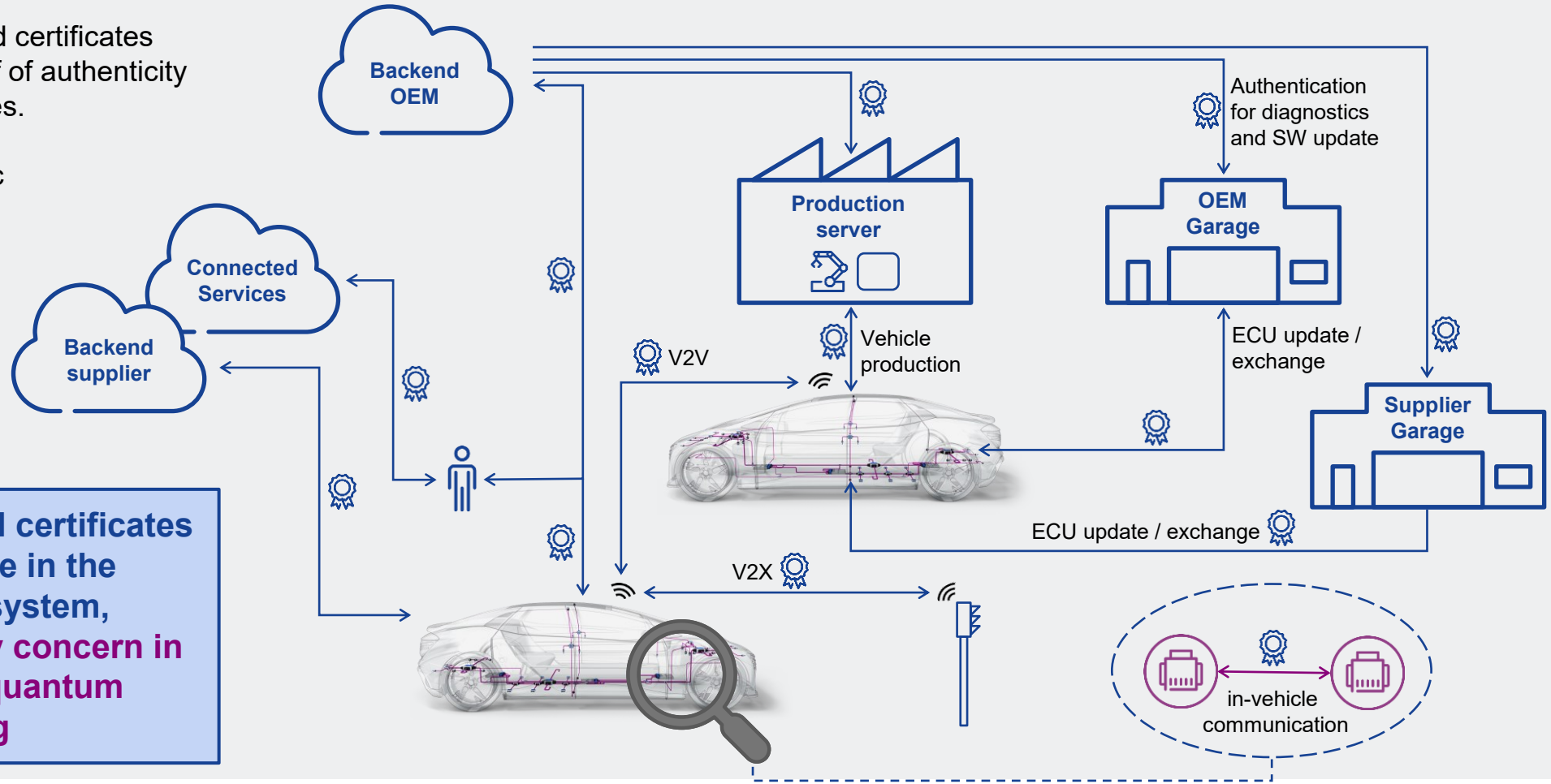
Increasing advances in quantum computing

Fields of Application in the Automotive Security

Example communication flow for a future car

Digital signatures and certificates used to provide proof of authenticity for all these use cases.

→ Flow of cryptographic information/material



Digital signatures and certificates play a central role in the automotive ecosystem, but are main security concern in the presence of quantum computing

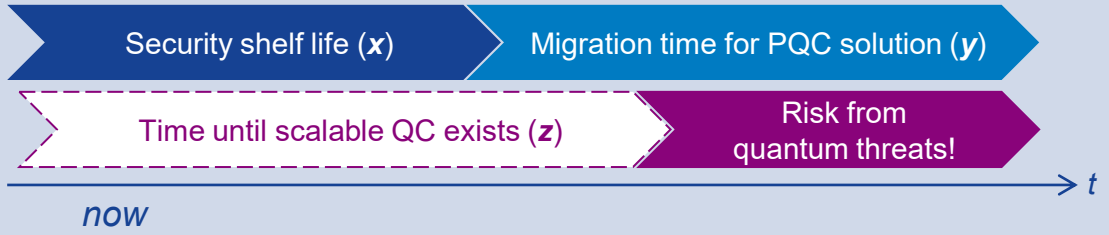
When do we handle the situation?

A decision based on limited information

Mosca's Theorem: Time to react (t)

- Your product lifetime (x) and migration time (y) **is foreseeable**
- Time until scalable Quantum Computing exists (z) **is uncertain**

Do not let quantum technology get ahead of your timeline!



Act now!

- **First standardized algorithms are available**
  - NIST selection of encryption and signature schemes (2022)
  - Early selection of stateful signature schemes
- **Recommendations of national institutes already exist**
  - BSI Handlungsempfehlung / Technische Richtlinie
  - AVID PQC Migration Handbook [4]
  - NIST Migration Project [5]
- **Remaining problems**
  - Algorithm selection is ongoing and difficult, there is **no scheme that fulfills all requirements**
  - General confidence in cryptography can only grow over the years

ETAS recommendation:
"Act now and wait"

Security threats based on quantum computing

Current trends in automotive security based on quantum computing

Reduced security due to quantum computing

– Lowers the security level of AES by factor 2

– Easy to break all existing asymmetric crypto algorithms (ECC, RSA)

Updated OEM specifications

– Major OEM‘s (e.g. Daimler) include Post Quantum Cryptography(PQC) in their security requirements for future vehicles

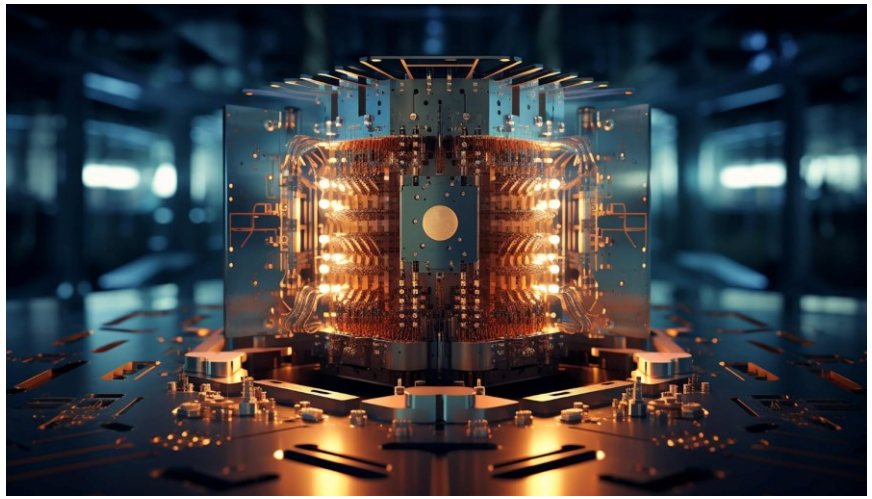
Leads to the need for

– New crypto algorithms prepared for quantum computer attacks

– Crypto agile solutions to ensure robust security throughout the long lifetime of ECU’s

– Several PQC algorithm candidates selected by NIST

  – Hash tree based, Code based, Lattice based => Major processing load for hashing (SHA2-256, SHA3,..)



What actions can we start with?

Resolutions using ETAS security expertise and product portfolio

Consulting services:

- Project partner in funded research project FLOQI (Full Lifecycle PQ PKI)
  - Analysis, research, development, benchmarking towards a quantum computer-resistant public key infrastructure(PKI)
- Guidance for management (workshops, recommendations on points of action, establishment of a timeline, etc.)
- Development of specific technical quantum safe solutions (analysis of specific systems, design of migration and transition solutions e.g., for PKI or key management)

Software solution:

- ETAS offers a cryptographic library i.e. ESCRYPT CycurLIB which already supports
  - PQC CRYSTALS-Dilithium (PQC Signature Algorithm)
  - CRYSTALS-KYBER (PQC Key Exchange)
- Sphincs+(PQC Hash based signature): Outlook 2025

PQC algorithms accelerated by Aurix TC4x security cluster

Escrypt CycurHSM 3.x + Aurix TC4x solution

Cyber security satellite (CSS) for parallel computation*

- Parallelization of HW accelerators to avoid performance bottlenecks by
  - Increasing throughput
  - Minimizing latency

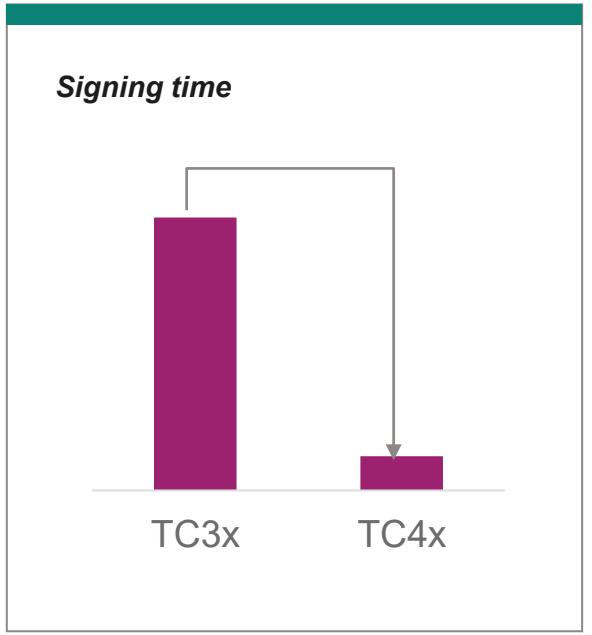
Cyber security real-time module (CSRM) for performance increase*

- Up to 15x more performance vs. ARM M3 TC3x HSM
- CSRM as trusted secured HW environment supporting new security standards (e.g. ISO 21434)

Hardware accelerated solutions for NIST selected PQC algorithms

- PQC CRYSTALS-Dilithium (PQC Signature Algorithm)
  - AES-256 HW acceleration using TC4x
- Sphincs+(PQC Hash based signature)
  - SHA2-256 HW acceleration using TC4x
  - SHA3 HW acceleration using TC4x
- CRYSTALS-KYBER (PQC Key Exchange)
  - AES-256 HW acceleration using TC4x

RSA 2048 on TC3x vs. PQC Dilithium 2 on TC4x*



8x faster

*Source: Webinar - Next level security using ESCRYPT CycurHSM on AURIX™ TC4x devices

ETAS offers sophisticated security solutions for PQC optimized using Infineon TC4x HW accelerators

Any Questions?