Introduction to FutureTPM
Project status and today's agenda

1st Workshop, 19th October 2018, Lisbon

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The FutureTPM project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 779391.

General Project Information

- Project reference: 779391
- Project start: 1st January 2018
- Duration: 3 years
- Total costs/EC contribution: EUR € 4,868,890
- 14 partners from 9 different European countries
- Website: www.futuretpm.eu

FutureTPM Mission

- Quantum-Resistant Trusted Platform Module (QR TPM)
- Full range of **implementation** environments
  - hardware-TPM (demonstrator)
  - software-TPM (demonstrator)
  - virtual-TPM (demonstrator)
- Formal **security analysis**
- **Run-time risk assessment** towards fine-grained trust based on the envisioned use cases

Why QR TPM?

- trusted computing
- hardware security
- QR TPM
- trusted platform module
- quantum-resistant cryptography

Current state: TPM's cryptographic algorithms

Cryptographic Co-processor
- Asymmetric encryption
- Symmetric encryption
- Signatures & DAA
- Message authentication code
- Hash functions
- Key exchange

TPM 1.2 supports
- RSA encryption
- RSA signature
- RSA-DAA
- SHA-1
- HMAC
- AES (optional)

TPM 2.0 supports
- Asymmetric encryption
  - RSA encryption and EC encryption
- Symmetric encryption
  - AES, SM4, Triple DES, …
- Signature
  - RSA signature and EC signature
- DAA
  - EC-DAA
- Message authentication code
  - HMAC
- Hash functions
  - SHA-1, SHA-256, SM3, …
- Key exchange
  - ECDH

When a large-scale quantum computer becomes a reality

Cryptographic Co-processor
- Asymmetric encryption
- Symmetric encryption
- Signatures & DAA
- Message authentication code
- Hash functions
- Key exchange

TPM 1.2 supports
- RSA encryption BROKEN
- RSA signature BROKEN
- RSA-DAA BROKEN
- SHA-1
- HMAC
- AES (optional)

TPM 2.0 supports
- Asymmetric encryption
  - RSA encryption and EC encryption BROKEN
- Symmetric encryption
  - AES, SM4, Triple DES, …
- Signature
  - RSA signature and EC signature BROKEN
- DAA
  - EC-DAA BROKEN
- Message authentication code
  - HMAC
- Hash functions
  - SHA-1, SHA-256, SM3, …
- Key exchange
  - ECDH BROKEN

Three types of TPM QR algorithms

- Symmetric algorithms
  - Hash, MAC, symmetric encryption
  - Existing algorithms will not directly be broken, but key/block lengths may need to be increased
- Conventional asymmetric algorithms
  - Encryption, signature, key exchange
  - Existing algorithms will be broken
  - Many QR algorithms have been developed (e.g., submissions to NIST PQC)
- Asymmetric privacy-preserving algorithms
  - Direct Anonymous Attestation (DAA)
  - Not in the scope of NIST
  - Not much research so far

Other post-quantum crypto projects

- **PQCRYPTO**
  - Design of high-security post-quantum PK systems
- **SAFECrypto**
  - Practical, robust and physically secure post-quantum crypto solutions
- **PROMETHEUS**
  - Quantum-resistant privacy-preserving cryptographic mechanisms

FutureTPM Mission

Mission: *Design a* ***QR TPM*** *covering the full range of* ***implementation environments*** *coupled with* ***formal security analysis*** *and* ***run-time risk assessment****, and evaluated under assumptions of realistic deployment scenarios*

- Design and development of a holistic TPM-based framework
- Threat security analysis for TPM cryptographic functionality
- Identification and implementation of a reactive, run-time risk assessment model
- Validation of applicability, usability, effectiveness and value of FutureTPM concept

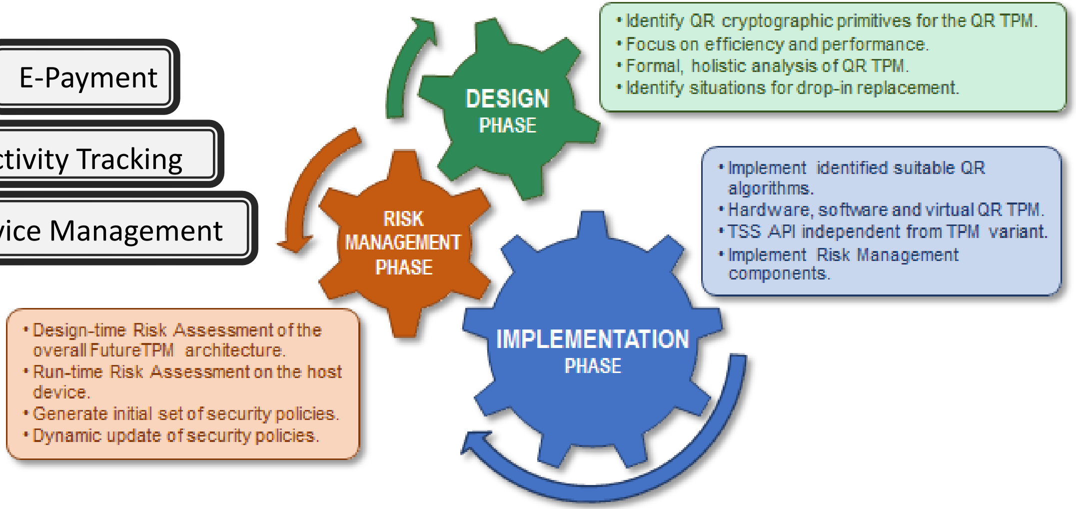
FutureTPM Mission (cont)

TPM as a major building block for enhanced security & privacy in various application domains

- Secure & Dependable Communication
- Authenticity and Integrity
- Privacy and Data protection
- Security Hardware
- Data consistency
- Security Architecture

- Performance & Efficiency
- Cost
- Security-Processes/ Management
- Security Evolution & Maintenance
- Security Metrics

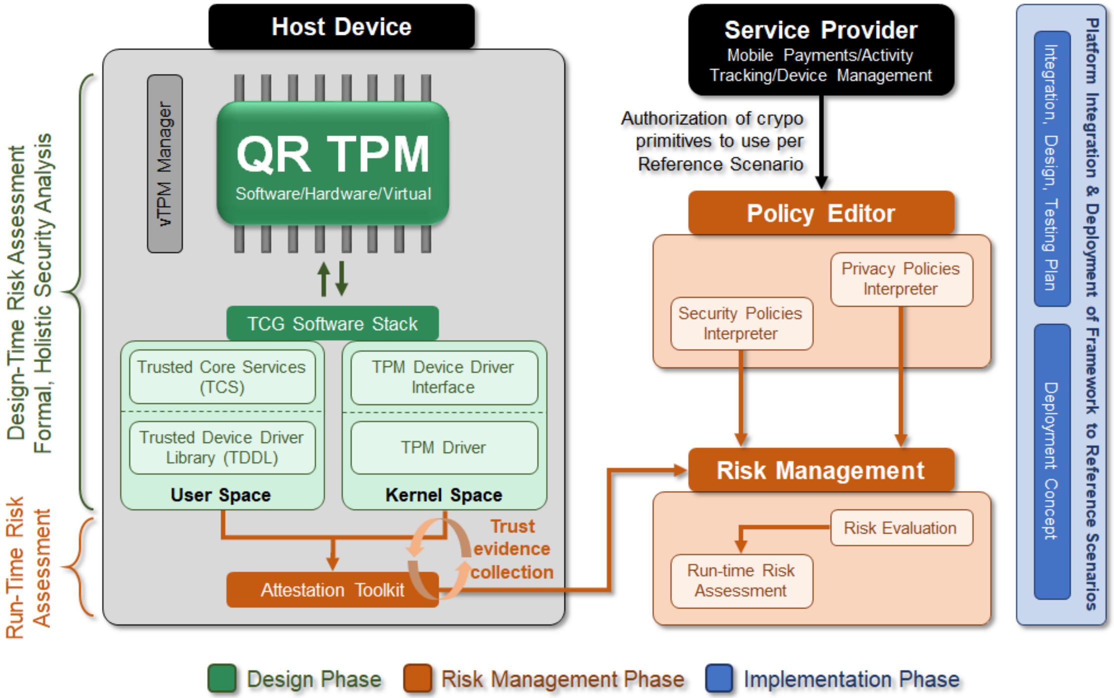
- E-Payment
- Activity Tracking
- Device Management



Reactive security mechanisms & updates

FutureTPM Conceptual Architecture

- **FutureTPM QR Design:**
  - QR Crypto Primitives
- **FutureTPM Implementation:**
  - HW, SW, VM-based
  - Secure Storage, Attestation
- **Risk Management:**
  - Risks, threats, assets, attack types, vulnerabilities, control elements
  - Fine-grains security policies
- **Security Modelling:**
  - Threats (physical/software/remote) to be considered

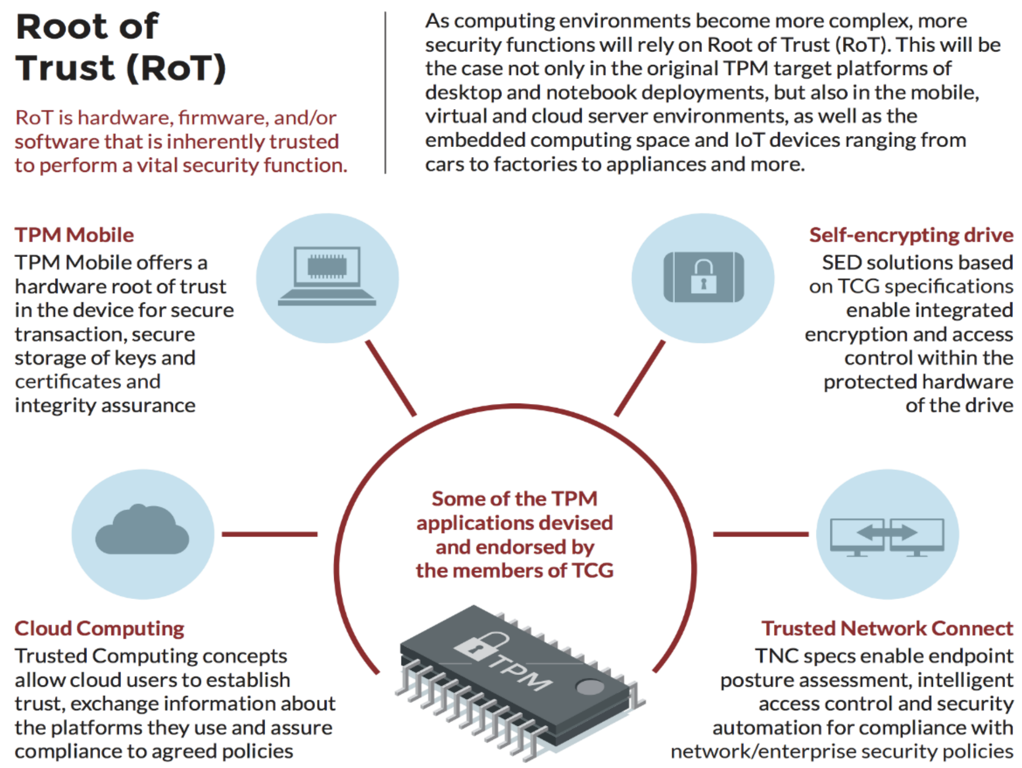


TPM Services

- **Attestation**
- **Protected Storage**
- **Platform Authentication**
- **…**

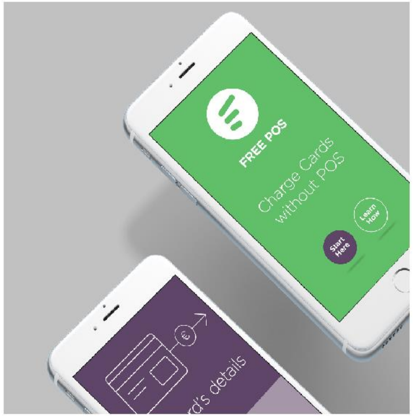
Cryptographic Primitives

- Hash functions
- Block ciphers
- Digital Signatures
- Public-key Encryption & Key Exchange
- Direct Anonymous Attestation



Secure Mobile Wallet and Payments

- Use of **FreePOS** application as a testbed developed by **INDEV, GR**
  - One of the top finance apps in Greece – tens of thousands active users
  - **Hardware-based TPM**
- **Token- based** authentication
  - *Depends on OS level security*
- OAuth 2.0 with PCI compliant services



- **Confidentiality**
  - TPC key storage persistency -> token storage
- **Integrity**
  - HMAC digital signatures for financial data integrity
- **Authentication**
- **Key Exchange**

Personal Activity and Health Kit Data Tracking

- Use of **S5 Tracker** application as a testbed developed by **SUITE5 Data Intelligence Solutions, UK**
- **Data Anonymization** and **Privacy Preservation**
  - *Generation of "User Personas"*
  - **Software-based TPM**
- **Privacy**, confidentiality and security at the edge
  - Direct Anonymous Attestation
- **Data Integrity**
  - HMAC digital signatures for financial data integrity
- **Secure Data Sharing**
  - No data leakage

Device Management

- **Secure management** of network infrastructures by HWDU
  - Integrity of identified devices
  - **Virtual-based TPM**
- **Device Identification:**
  - *TPM key generation and persistent storage*
- **Software Integrity**
  - TPM Platform Configuration Registers (PCRs)
- **Data Integrity and Confidentiality**
  - Key usage TPM policies

2 Phase Testing

- **1st Phase Testing:**
  - Internal, small-scale, lab-test
  - **M18** (MS4) - first release of SW-based TSS + QR TPM + RA framework
  - **M21** (MS5) - first release of FutureTPM framework
  - **M24** – 1st Demonstration Phase + 2nd FutureTPM Workshop
- **2nd Phase Testing:**
  - Internal, large-scale, hybrid test
  - **M27** (MS7) – Final release of FutureTPM framework (including all TPM implementations)
  - **M33** (MS8) – 2nd Demonstration Phase + 3rd FutureTPM Workshop

08:30 - 09:00	FutureTPM Workshop Registration	
Session 1 - Welcome and Introduction to FutureTPM Workshop		
09:00 - 09:20	Introduction to FutureTPM Project status and today's agenda	Liqun Chen & Thanassis Giannetsos (University of Surrey)
09:20 - 10:00	The Future of Trusted Computing	Steve Hanna (Trusted Computing Group)
10:00 - 10:40	NIST Cryptographic Standards for Trusted Platform in Quantum Era	Lily Chen (NIST - National Institue of Standards and Technology)
10:40 - 11:00	Coffee Break	
Session 2 - The use of Trusted Computing towards Enhanced Security and Privacy		
11:00 - 11:20	Comprehensive Remote Attestaion for Device Management	Roberto Sassu & Silviu Vlasceanu (Huawei)
11:20 - 11:40	Empowering Trust and Security on Sharing Personal Activity Data A FutureTPM Use Case	Thanassis Giannetsos (University of Surrey)
11:40 - 12:00	Secure Mobile Wallet and Payments	Fanis Sklinos (Indev Software SA)
12:00 - 13:00	Lunch Break	
13:00 - 13:20	A Platform Manufacturer´s View of TPMs	Carey Huscroft (HP Labs)
13:20 - 13:45	Thales and Trusted Computing	Adrian Waller (Thales UK)

Session 3 - Other EU Initiatives towards QR Crypto		
13:45 - 14:15	Results of PQCrypto (ICT-645622)	Tanja Lange (University of Eindhoven)
14:15 - 14:45	SAFEcrypto: Secure Architectures of Future Emerging Cryptography	Adrian Waller (Thales UK)
14:45 - 15:15	PROMETHEUS or how to provide Quantum-Resistant Privacy-Preserving Cryptographic Mechanisms	Sébastien Canard (Orange)
15:15 - 15:45	Using and Breaking Hardware Security Anchors	David Oswald (University of Birmingham)
15:45 - 16:00	Coffee Break	
Panel Discussion		
16:00 - 16:45	Innovating with Trusted Computing: The Journey towards the Implementation of a Quantum-Resistant TPM	**Moderator:** Liqun Chen **Panelists:** Lily Chen, Steve Hanna, Christian Hanser, Carey Huscroft, Tanja Lange, Adrian Waller
Session 4 - Quantum-Resistant TSS Implementation		
16:45 - 17:05	PQC TSS and PQC TPM - a Prototype	Andreas Fuchs (Fraunhofer SIT)
17:05 - 17:25	Implementation of the FutureTPM QR Hardware TPM Demonstrator	Christian Hanser (Infineon)
17:25 - 17:45	PQ Direct Anonymous Attestation	Paulo Martins (INESC-ID)
17:45 - 18:00	FutureTPM Workshop Closing Remarks	Liqun Chen & Thanassis Giannetsos (University of Surrey)

FutureTPM Grant Agreement No. 779391

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