FutureTPM H2020 PROJECT: Secure Mobile Wallet and Payments

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Future Proofing the Connected World: A Quantum-Resistant Trusted Platform Module

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Mobile Wallet and Payment

- Offers convenience compared to traditional wallet
- Security Challenges
- Only 23% of security experts believe that mobile payments are currently sufficiently robust
- Need and proof for secure and trusted transactions

Security Challenges

- Existing Threats identified by ENISA:
  - **Mobile user threats** – installation of rogue and malware applications, phishing and social engineering
  - **Mobile device threats** – unauthorized access, lost or stolen device
  - **Mobile payment application and wallet threats** – reverse engineering, tampering with the payment application and the use of rootkits
  - Merchant threats – Point of Sale (POS) malware, Man-in-the-Middle (MiTM) and replay attacks
  - Payment service providers' and Acquirers threats – payment system compromise and data connectivity compromise
  - Payment Network Providers Threats – token service compromise and denial of service
  - Issuers Threats – payment authorization process compromise, token data compromise
  - Mobile Payment Applications Providers threats – compromise of sensitive data, compromise of user profile managed in the cloud, token compromise and denial of service attacks
- Threats arising form Quantum-Computing
  - Crypto-primitives are broken (TLS, asymmetric crypto in general)

“As-Is” Scenario

- Actively developed and highly ranked application
- Tens of thousands active users
- Social auth – verified phone number is required
- Token based auth with FreePOS service
- OAuth 2.0 with PCI compliant services
- Conducts actual monetary transactions
- Depends on OS level security (No TPM present)

Sensitive Data Stored

- **FreePOS token** that authenticates between the client and the service
- **Bearer token** required to authenticate with the PCI compliant services
- **Transaction metadata** in local DB

Testing infrastructure has been deployed

- Authorized accounts (along with phone numbers)
- Authorized credit card details
- Infrastructure mirrors the production
- Same tokens are generated, with the exact same methods

TPM Functional Requirements

- Confidentiality
  - TPC key storage persistency will be used for token storage (NVRAM)
  - Symmetric Encryption will be used for database (SQLite) encryption
- Integrity
  - HMAC digital signatures will be used

The above need to be considered in the QR Domain.

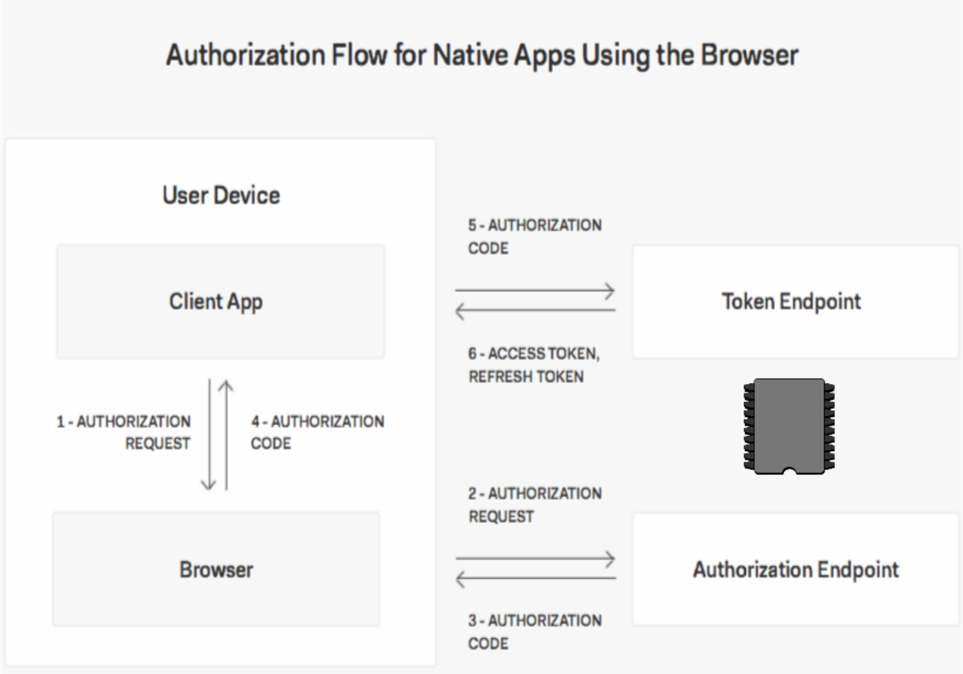
"To-Be" Reference Scenario

- **User Identification:**
  - The client is going to store all important credentials within the TPM:
    - OAuth Bearer tokens
    - FreePOS authentication tokens
- **Financial Data Confidentiality and Integrity**
  - Local storage metadata will utilize the TPM for encryption and signing

User Identification

- The application stores two discreet types of tokens on the device's main storage:
  - the FreePOS token that authenticates between the client and the business logic;
  - the bearer token required to authenticate with the PCI compliant services.
- Anyone with root privileges could gain access to the tokens

Authorization Flow



Financial Data Confidentiality and Integrity

- The application stores on an encrypted local SQLite DB
  - the users' past financial transactions,
  - along with any associated metadata.
- Keys stored on the device and the encryption is performed via third party libraries
  - Anyone with root privileges could gain access to the actual data
- TPM is necessary to store the keys

Qualitative Metrics

Id	Metric	Target Value	(M)andatory / (G)ood to Have / (O)ptional
1	Store OAuth bearer tokens in the QR TPM	Supported	M
2	Store Authentication tokens in the QR TPM	Supported	M
3	Encrypt the local database using keys generated by the QR TPM	Supported	M
4	Sign the local database using the QR TPM	Supported	M

Basic investigated TPM functionalities

- Key management
- Key hierarchy
- Encryption
- Key Derivation Function (KDF)
- HMAC signatures

QR Transition

- Symmetric Crypto
  - Encryption
    - AES128 → AES256
  - Key Derivation Function (KDF)
    - SHA256 → SHA512
  - HMAC signatures
    - HMAC/SHA256 → HMAC/SHA512/SHA3
    - qTESLA
- Asymmetric crypto
  - Key exchange protocols between device and service provider
    - QR New Hope key exchange protocol or
    - Hybrid key exchange protocol
      - QR New Hope – device side
      - Traditional crypto – service side

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