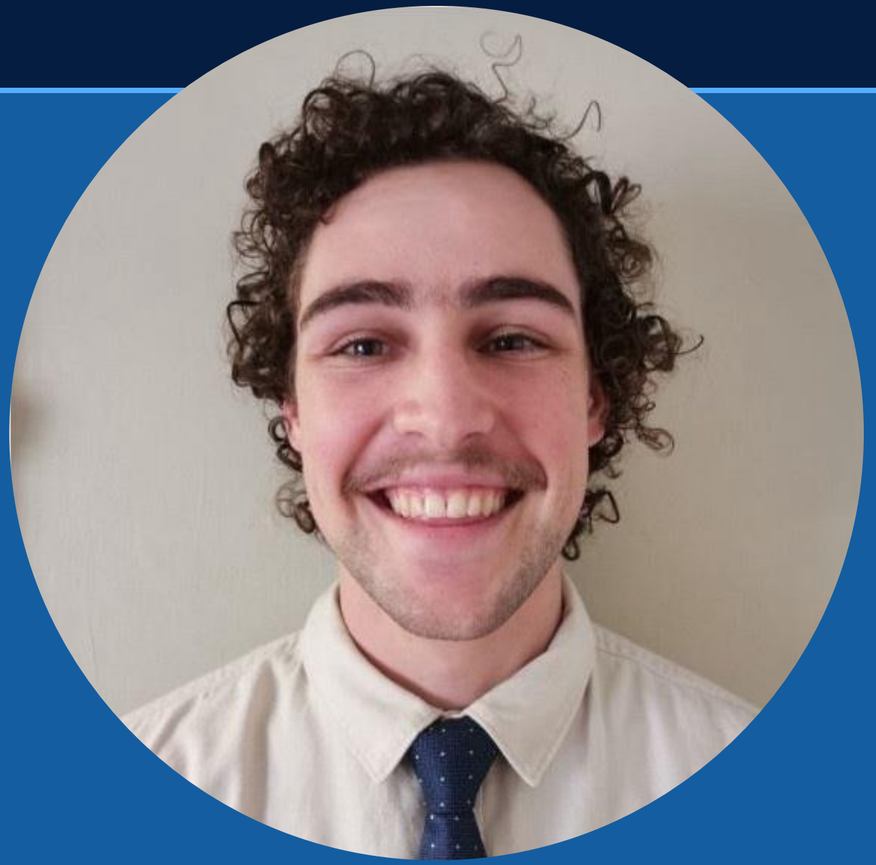
EMV Cards, Data Preparation and the Future of Secure Payments



Willem F. De La Bat

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ON THE AGENDA..

- Current state of EMV payment cards and their production process.
- Deeper dive into data preparation for the payment industry.
- The future of secure payments.
- The rising influence of quantum computing.
- The evolution of cryptography standards.

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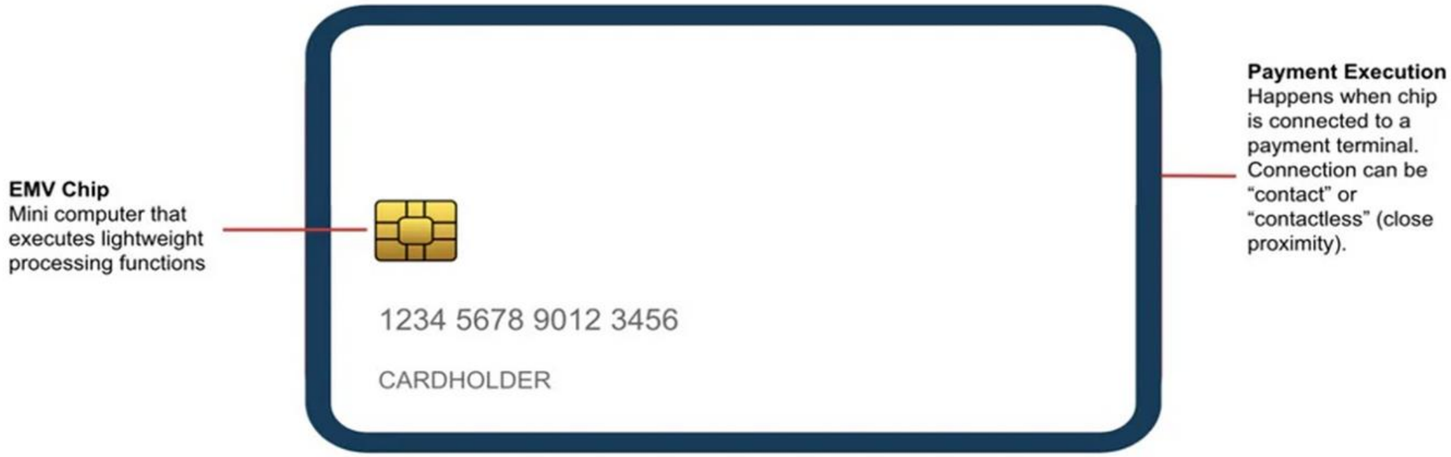
WHAT IS EMV?

- EMV stands for Europay, Mastercard, and Visa.
- EMV is the global standard for secure payment card transactions.
- Chip-based technology is used to secure transactions, replacing magnetic stripes.
- EMV cards generate dynamic cryptograms for each transaction, making it much harder for fraudsters to replicate card data.
- As of the end of 2023, 13.7 billion EMV cards in circulation. (EMVCo,2023)



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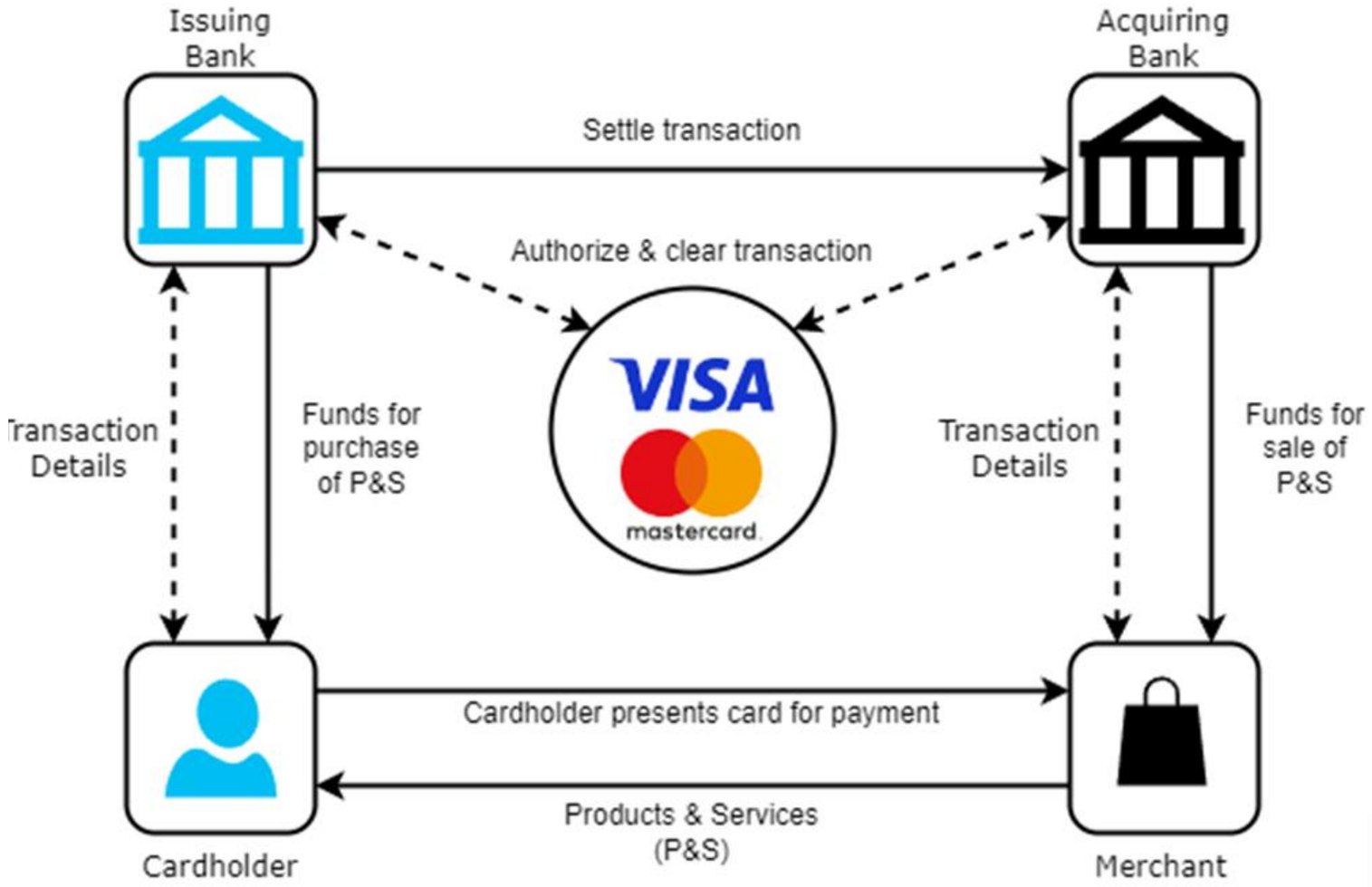
HOW DOES AN EMV TRANSACTION WORK?



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EMV CARD PRODUCTION PROCESS

1. Physical Card Manufacturing

2. Data Preparation

3. Personalization and Issuance

4. Post-Issuance Management

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Symmetric vs. Asymmetric Encryption in EMV Cards

Symmetric Encryption:

- Single key for encryption and decryption
- Fast and efficient
- Used in EMV for:
  - Data preparation before card personalization (e.g., encrypting keys and application data)
  - Protecting transaction data integrity

Asymmetric Encryption:

- Uses a public and private key pair
- Ensures card and issuer identity verification
- Certificates are used to verify authenticity of the card and issuer
- Prevents the use of fraudulent cards

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DATA PREPARATION AND P3: THE PERSONALISATION PREPARATION

Data preparation for wide variety of card types and secure elements:

- Single-purpose and multi-application cards.
- Secure Elements (SE's) for smartphones.
- Remote SE's for cloud-based virtual card systems.

The P3 System: P3 software and Hardware Security Modules (HSMs):

P3® Advance

P3® Server

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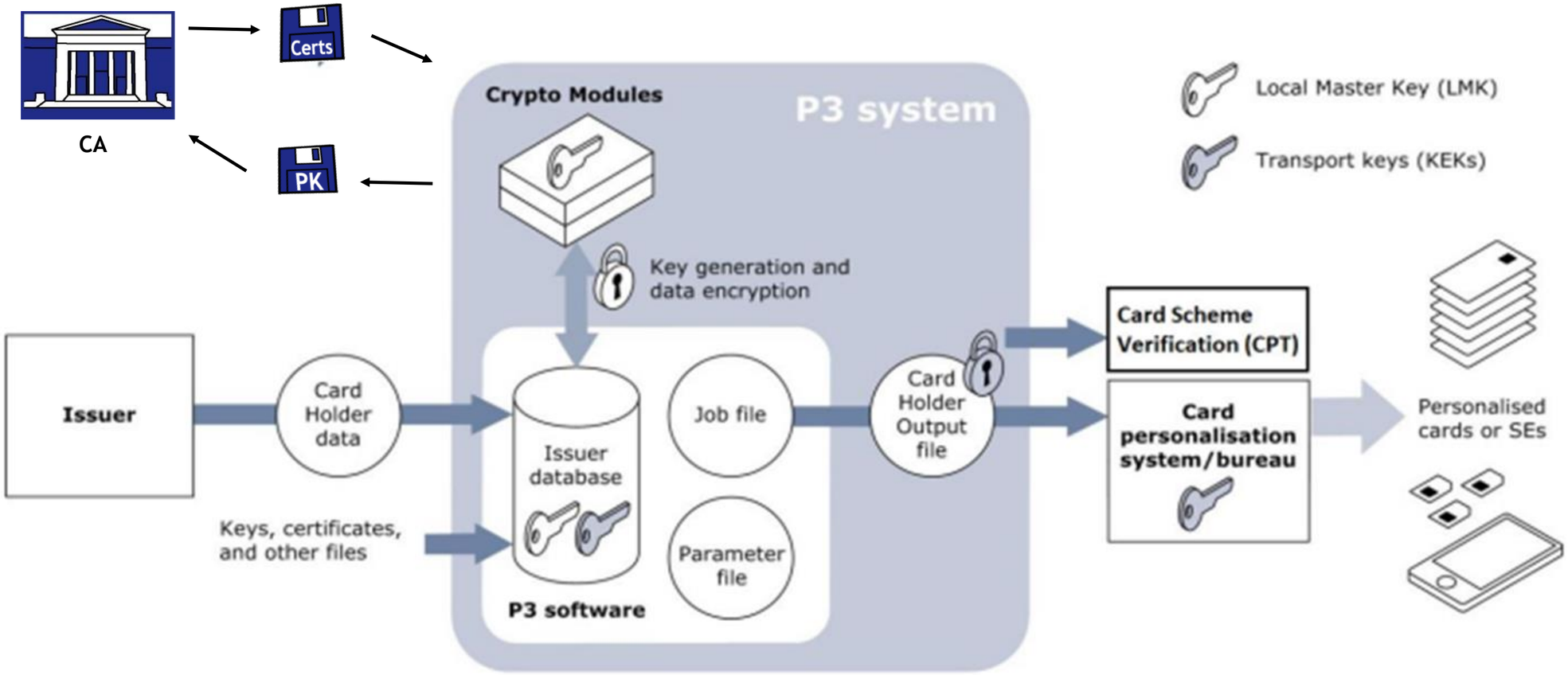
DATA PREPARATION AND P3: THE PERSONALISATION PREPARATION PROCESS



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THE FUTURE OF PAYMENTS: DIGITAL, SECURE, AND DATA-DRIVEN

Significant Shift Toward Electronic Payments:

- Increasing consumer adoption of digital wallets, mobile payments, and virtual cards.
- Convenience and security of contactless payments and tokenization technologies are driving this shift.
- These technologies are built on the same EMV principles used in physical card transactions.

Projected Growth:

- By 2027, electronic transactions are expected to make up over 70% of all global transactions, reducing reliance on physical cards. [Global Payments Report by FIS(Worldpay), 2022].
- Contactless payments are expected to account for over 80% of all card payments by 2030.
- Mobile payments and virtual cards are projected to reach $12 trillion by 2028.

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WHY DATA PREPARATION REMAINS ESSENTIAL IN A DIGITAL PAYMENTS WORLD

1. **Virtual and Tokenized Payments**
   - Tokenization replaces sensitive card data with unique tokens per transaction.
   - Relies on cryptographic keys and secure data preparation—exactly what P3 provides.
   - Keys are generated and encrypted similarly to traditional EMV cards, regardless of device used (smartphone, wearable).

2. **Mobile Payments and Secure Elements (SEs)**
   - Secure Elements (embedded or cloud-based) act as virtual cards with personalized, encrypted data.
   - P3 securely prepares and transmits data to SEs.
   - Ensures mobile payments are as secure as traditional card transactions.

Pay | G Pay | SAMSUNG pay

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WHY DATA PREPARATION REMAINS ESSENTIAL IN A DIGITAL PAYMENTS WORLD

3. Cloud-Based Virtual Cards

- Virtual cards depend on secure cloud infrastructures.
- Cryptographic keys and data must be securely prepared before cloud storage.
- P3 ensures virtual cards are as secure as physical cards through seamless data preparation.

4. Continued Security and Compliance

- Compliance with standards like EMVCo, PCI DSS, and ISO/IEC remains essential.
- P3 encrypts all sensitive data and maintains compliance in both physical and virtual transactions.
- Protects both issuers and consumers in the evolving payment landscape.

EMVCo®

PCI DSS COMPLIANT

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WHY DATA PREPARATION REMAINS ESSENTIAL IN A DIGITAL PAYMENTS WORLD

- Innovation in the payment market is happening in the acquirer side of things.
- The fundamental structure of the card scheme (Cardholder, Merchant, Issuing Bank, Acquiring Bank) remains unchanged.
- Payment methods like magnetic strip, chip, etc. are managed in the same way as new innovations on the market.

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CHALLENGES IN THE FUTURE OF SECURE PAYMENTS: CRYPTOGRAPHY & QUANTUM COMPUTING

Quantum Computing & Cryptographic Threats

- Quantum computing, while still developing, poses a serious risk to current cryptographic methods.
- Algorithms like RSA and ECC can be broken by quantum computers, potentially in hours, using Shor's Algorithm.
- By 2030, quantum computers are expected to be capable of challenging today's encryption.

Immediate Action Required

- Though quantum computing is not mainstream yet, preparing for its impact on cryptography is crucial now.

Google Quantum AI

IBM Quantum

D-Wave The Quantum Computing Company™

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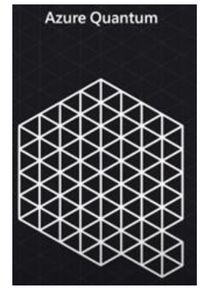
CHALLENGES IN THE FUTURE OF SECURE PAYMENTS: CRYPTOGRAPHY & QUANTUM COMPUTING

Asymmetric Encryption (RSA, ECC):

- Vulnerable to quantum algorithms like Shor's Algorithm.
- RSA and ECC used for key exchanges and digital signatures in payments can be broken by quantum computers.
- Quantum computers can intercept communication and break cryptographic systems, exposing sensitive payment data.

Example Threats:

- Compromise of public-key encryption used in card issuance and mobile payments.
- Risk to digital wallets and tokenization if asymmetric encryption is broken.



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WHERE WE ARE SAFE FROM QUANTUM COMPUTING (FOR NOW…)

Symmetric Encryption (AES):

- AES-256 remains strong even with quantum attacks (due to Grover's Algorithm, which halves security).
- Widely used in EMV cards and HSMs, providing strong protection for card data and cryptographic keys.

EMV Cards:

- EMV cards use dynamic data authentication (DDA), ensuring each transaction generates unique cryptograms.
- Symmetric encryption in EMV cards and HSM-based key management remains safe from quantum threats. (for now…)

Google Quantum AI

IBM Quantum

D:Wave The Quantum Computing Company™

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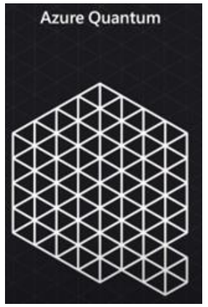
POST-QUANTUM CRYPTOGRAPHY

Quantum-Resistant Algorithms:

- Cryptography experts are developing quantum-resistant methods such as:
- Lattice-based cryptography
- Hash-based cryptography
- Multivariate-quadratic-equations
- These algorithms are designed to withstand quantum computing attacks.

Transitioning to Quantum-Resistant Standards:

- Fintech companies must begin experimenting with and adopting these algorithms.
- Transitioning infrastructure gradually is essential to secure future payments.



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ADVANCEMENTS IN CURRENT CRYPTOGRAPHY

What is Key Block Encryption

- Encrypted packaging of cryptographic keys with usage metadata.

Why is it used?

- Enhances security by preventing key misuse.
- Controls key usage through embedded metadata.
- Aligns with industry standards (e.g., ANSI TR-31).

P3’s Advantage

- One of the first data preparation solutions to support Key Block Encryption.
- Provides secure key management within data preparation.
- Ensures compliance and future-ready security practices.

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PREPARING FINTECH'S FOR THE FUTURE OF PAYMENTS

Stay Ahead of Cryptographic Standards:

- Adopt quantum-resistant encryption early.
- Implement Key Block formats and track emerging cryptographic trends.
- Engage with standard bodies like EMVCo, PCI DSS, and NIST to stay compliant.
- Use solutions like P3 that is always implementing the latest cryptographic standards.

Invest in Cryptography Expertise:

- Cryptography talent is scarce in the fintech industry.
- Companies must hire and train experts in cryptography and encryption.
- Encourage ongoing education, certifications, and participations in industry conferences.

Engage with the Cryptographic Community:

- Fintechs should actively participate in industry working groups, academic collaborations, and open-source projects.
- This ensures a proactive approach to future cryptographic challenge and helps shape the future of secure payments.

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THANK YOU!

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