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MasterCard Worldwide

The practical application of cryptography to international card payments

EMV heuristics and standards

Colloquial expression of requirements

Consumer

- No unauthorised debits to their account
  - No modifications to an authorised transaction
  - No omissions of authorised transactions
  - Privacy
  - Audit and enquiry trail
  - Consumer protection checks and balances

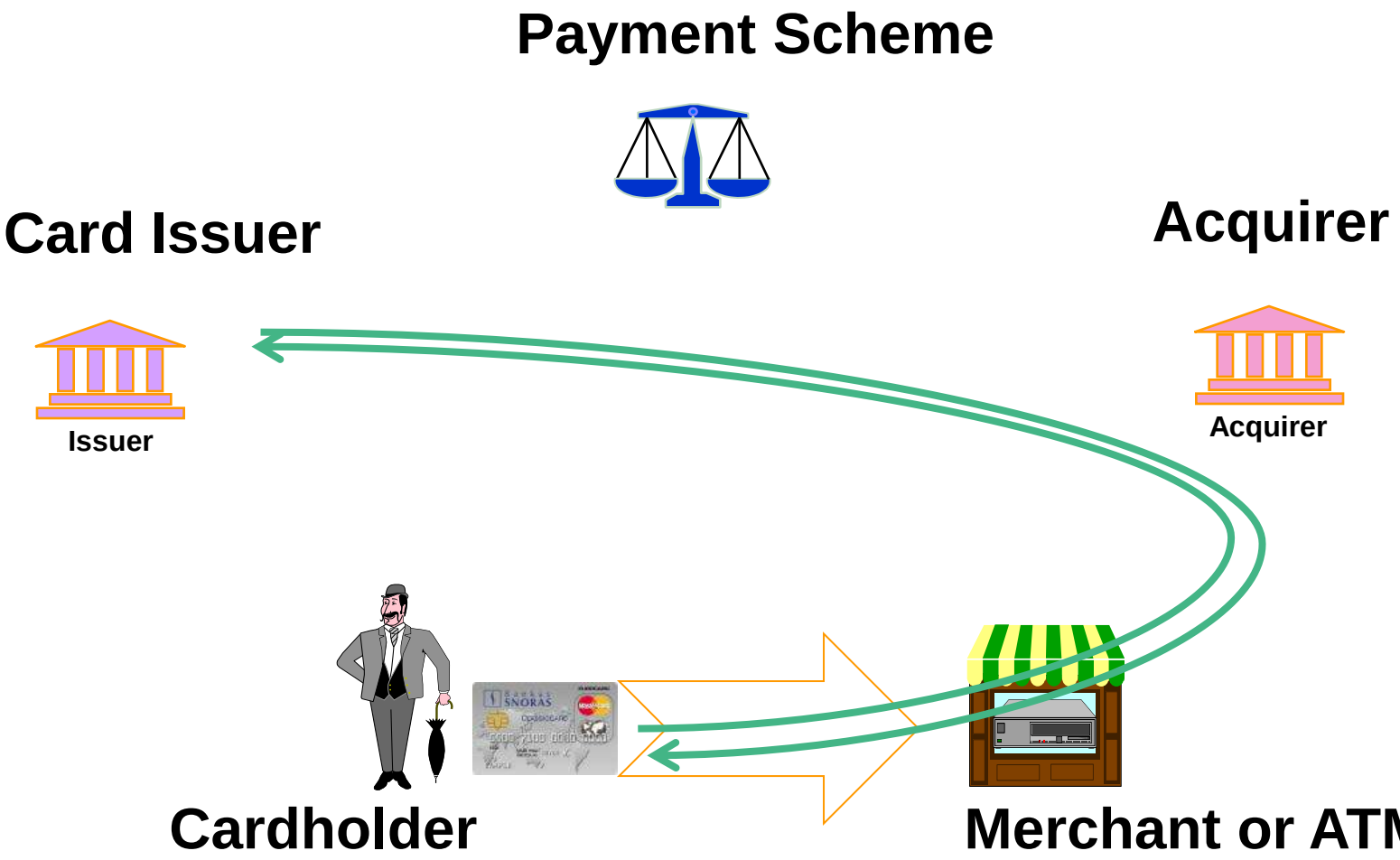
Merchant

- Funds received for release of goods/services
  - Integrity of an authorised transaction
  - Source authentication of authorisation
  - Non repudiation of a properly constructed authorisation
  - Audit and enquiry trail

Financial institution

- Source authentication of the merchant/cardholder
- Non-repudiation by acceptor /cardholder
- Data integrity for both originated and received
- Identification and rejection of counterfeit cards

Card Payments - The Players



Symmetric Cryptography

Cryptograms from card

- ARQC, TC, AAC
- 8 byte MACs on critical transaction data

Response from Issuer

- Issuer authentication by card (4-8 byte cryptograms)
- Secure Messaging: Card block/unblock, PIN Change

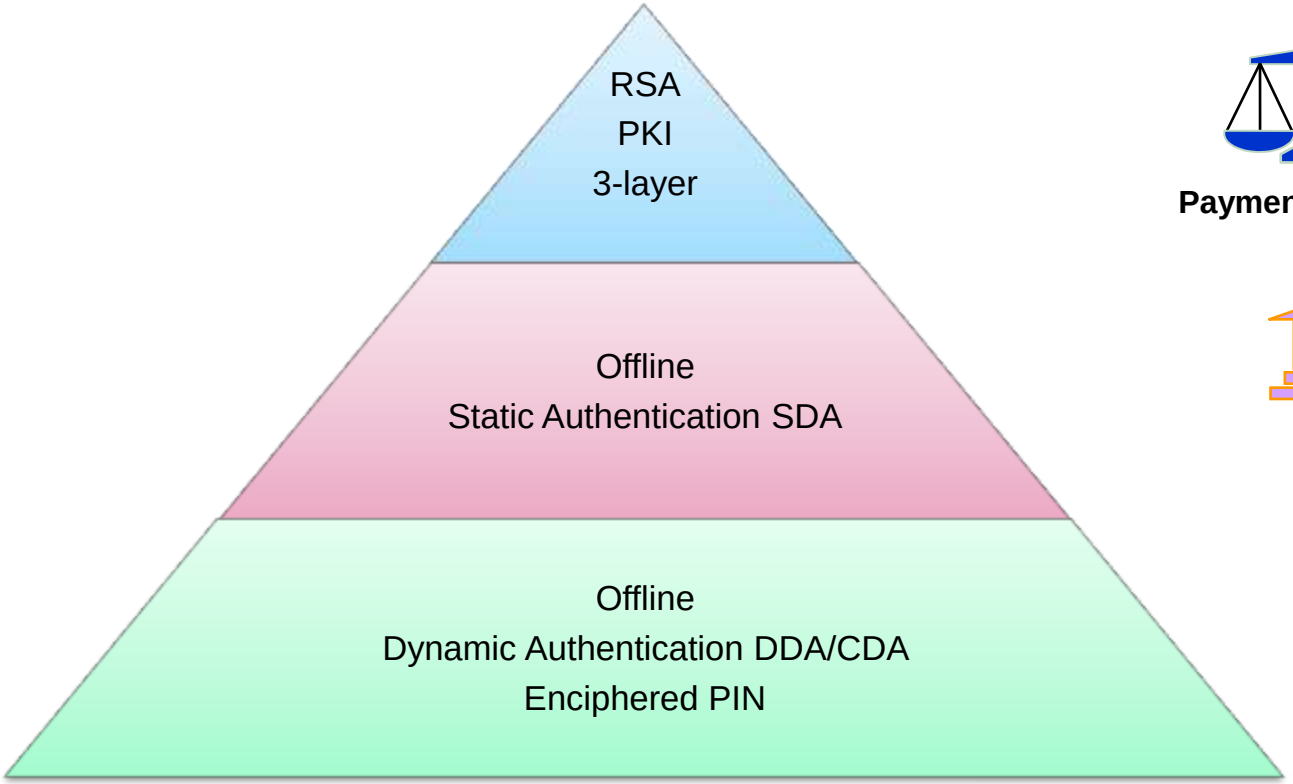
EMV recommended key derivation

- Card keys derived from Issuer keys using Card Number
- Session keys derived using Transaction Ctr and/or UN

MACs: EMV recommends ISO/IEC 9797-1

- Algorithm 3 (ANSI Retail MAC with 2-key TDES)
- Algorithm 5 (CMAC with AES-128/192/256)

Asymmetric Cryptography



Payment Scheme

Key Pair

Issuer

Key Pair

Card

Key Pair

- ISO/IEC 9796-2: Digital Signature Scheme giving message recovery – Part 2: Integer Factorization based methods (method 1) with SHA-1
- Signature formats and PIN encipherment are EMV proprietary

Experience and Research I

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Requirements
Recommendations
Best Practice

Session Key Derivation
Secure Messaging

Issuer Auths
Crypto Failures

Random Numbers
MACs

2-key Triple DES

References

Experience and Research II

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Payment System RSA key lengths

768, 896, 1024,1152, 1408,1984

Low-exponent

~~e=2 Rabin~~

e = 3 or 65537

References

References

RSA Signatures ISO/IEC 9796

$\sigma = (6A||m_1||h(m)||BC)^d \bmod n$

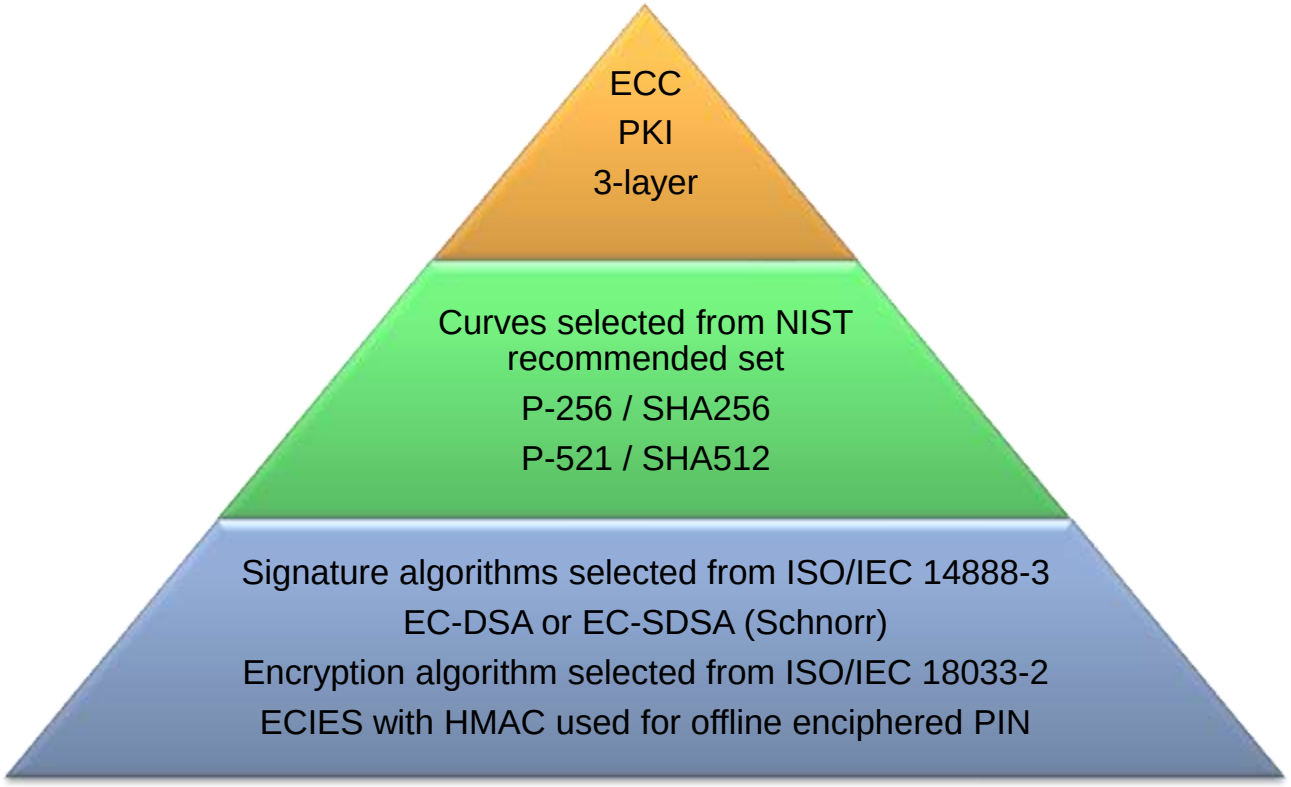
CRT RSA Key Gen

RSA Encryption Key Separation

$Enc(pin) = (7F||pin||UNcard||RANDterminal)^e \bmod n$

References

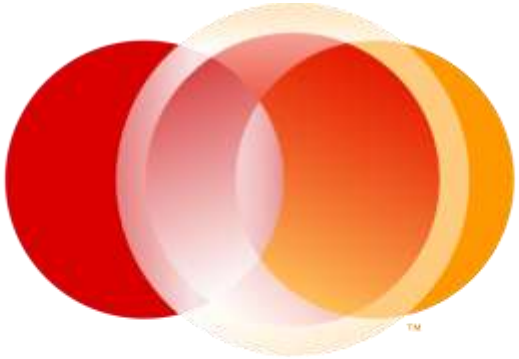
Future Asymmetric Cryptography (work in progress)



Hash algorithm selected from ISO/IEC 10118

- Defaults are SHA256 (for P-256) and SHA512 (for P-521)
- Considering also SHA3 (due 2012) or AES-based hash

References



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Brøk

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