MINX: Micropayments with Secure Network Exchange

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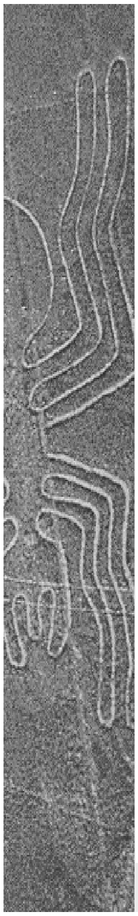

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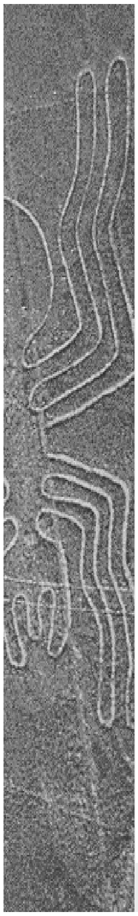
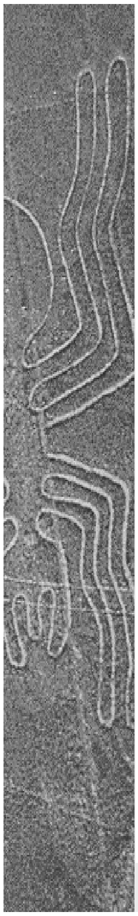


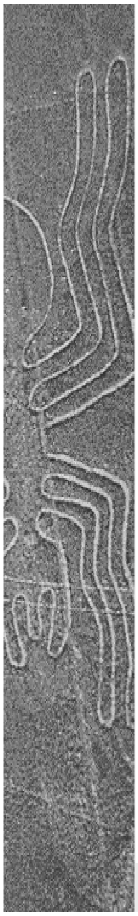
Micro- & Macro- Payments

- Macropayments
  - User makes few but large transactions
  - Widely use in e-commerce systems (shops, etc)
- Micropayments
  - User makes many small transactions
  - Buying web content, streaming services, etc.
- Micro vs Macro
  - Frequency of macropayments is quite low
    - computation connected with using strong cryptography (public key cryptosystems) and need of on-line communication between broker (bank), vendor and client is not a problem
  - In micropayments frequency of transactions is quite high
    - use of PKI is impossible – too many computation per one transactions
    - Need for an on-line communication between broker, vendor and client is problematic



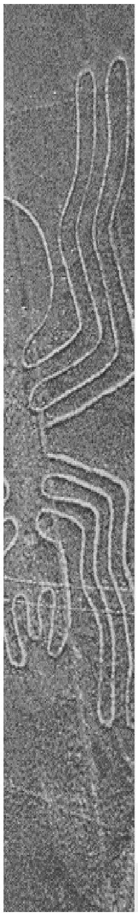
Known Micropayments Schemes

- Payword & Micromint
  R. Rivest, A. Shamir (1996)
- CAFE system (ESPIRIT project)
  T. Pedersen (1994)
- NetPay
  X. Dai, J. Grundy (2002)
- Micropyments based on Probabilistic Polling
  S. Jarecki, A. Odlyzko (1998)
- Electronic Lottery Tickets
  R. Rivest (1998)
- Internet Keyed Payment System (*i*KP)
  R. Hauser, M. Steiener, M. Waidner, IBM (1996)



Electronic Prepaid Card

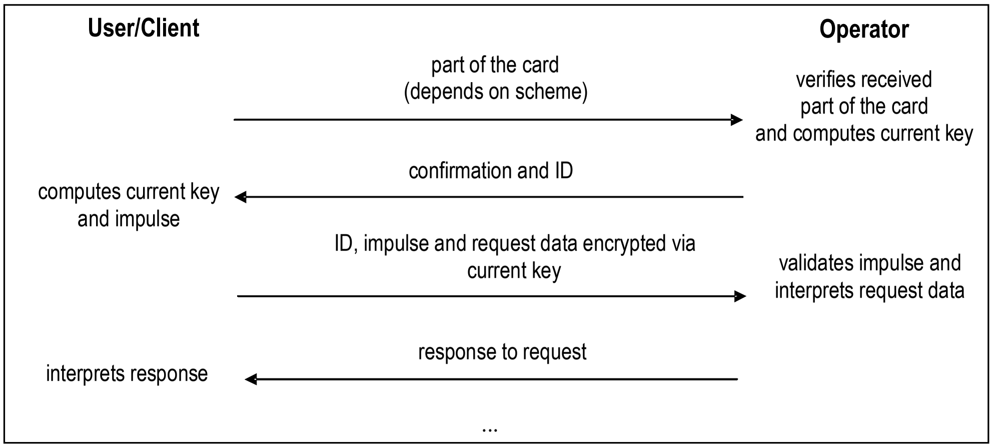
- Prepaid card is kind of micropayments scheme
- Idea based on real-life prepaid cards
- Main properties
  - User buy a prepaid card from operator
  - User trust operator that card is valid and will be able to use it
  - Card can be used only partially
  - User can utilize card in any moment
  - User is not required to provide operator with any data apart of data concerning the card
  - No TTP (Trusted Third Party) required



MINX – General Overview (1)

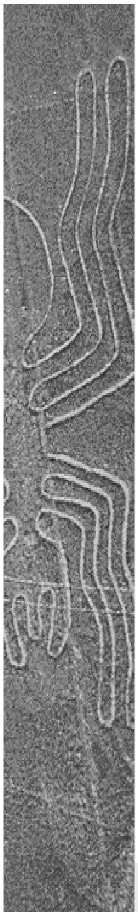
- Main advantages
  - Functionality of electronic prepaid card
  - Ability to perform cryptographic key distribution with micropayment process
- Cryptographic primitives
  - One-way has function
  - Pseudorandom bit generator
- Basic definitions
  - Key
  - Impulse
  - ID
- Card is built of the following:
  - secret seed – x
  - card’s value
  - number of impulses – z
  - function for generating impulses or secret parameters of CSPRBG

MINX – General Overview (2)



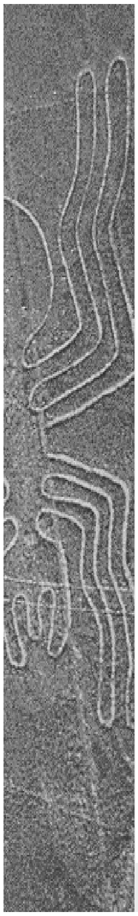
MINX – Hash Function Version

- Secret key and impulse are generated using one-way hash function from seed x: h(x)
- The advantages of this scheme include:
  - confidentiality of communication between a user and an operator
  - possibility of using services with different values/prices with one card
  - no need for TTP to compute impulses prior to card usage. A user does not have to request an authorization of a card
- The disadvantages include:
  - computation of impulses and keys, their validation is slower then in classical micropayments schemes
  - an operator has to be trusted same as in the real world



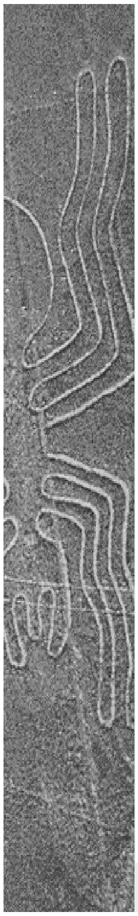
MINX – CSPRBG Version

- Instead of the hash function, a client uses cryptographically secure pseudorandom number generator (CSPRBG)
  - generation and a verification of a key and an impulse take almost the same amount of time
- The advantages include:
  - the same number of operations to generate key/impulse every time and to verify them
  - the same as in the previous scheme
- The disadvantages are:
  - generating proper parameters of CSPRBG is quite complex
  - computation CSPRBG values is not very fast, and poses almost the same problems as public-key cryptosystems



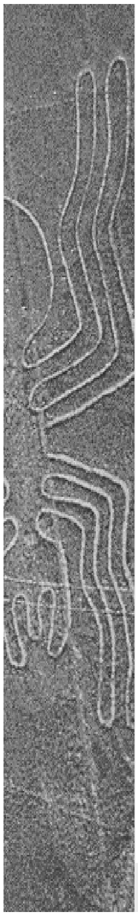
MINX - Application

- Independent cryptosystem
  - Application layer (where micropayments are provided)
  - Keys placed on pre-paid cards are utilized to provide confidentiality for clients' requests or operators' responses including security of the content during the paying process
- Use with other security protocol
  - Possible security protocols: SSL/TLS (Secure Sockets Layer/Transport Layer Security)
  - In this case (i.e. SSL/TLS), the adequate session key (SSL/TLS MasterKey) is extracted from a pre-paid card and is utilized to provide transaction security according to admitted context (for example duration or data volume)



Conclusions

- Both original schemes presented in this article (the first one based on one-way hash functions, the second one based on cryptographically secure pseudorandom bit generators) are integrated with cryptographic key distribution
- Payment for access to resources without compromising users' privacy
- The usage of keys placed in pre-paid cards
  - reduces costs of key management system implementation
  - simplifies clients' software/hardware
- Other main advantages of the proposed schemes:
  - a possibility of using services with different values/prices with one card
  - the absence of TTP



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