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Secure implementation of post-quantum cryptography

SPS Project Number: 984520

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Practical Implementation of McEliece Cryptosystem on Android

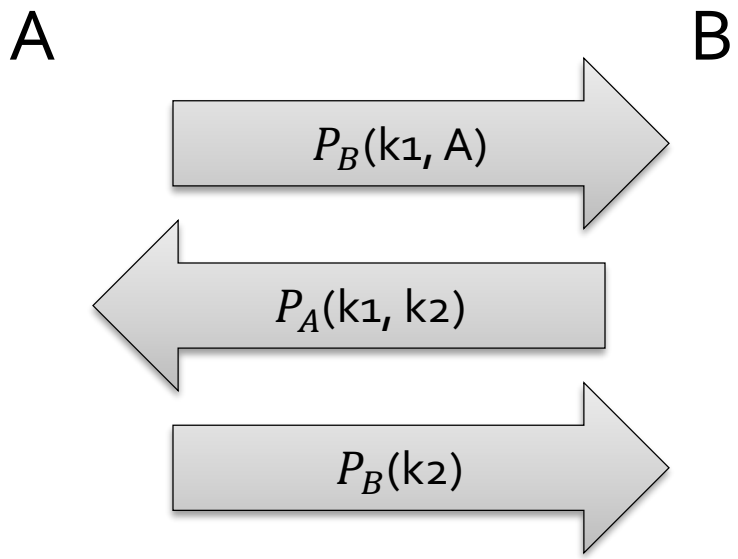
Central European Conference on Cryptography '16
Piestany, Slovakia
24.6. 2016

Introduction

- Post-quantum cryptography
- McEliece algorithm
  - Based on decoding problem (NP-complete)
- CCA2 extension
  - Pointcheval
  - Fujisaki
  - Kobara-Imai – the most suitable for mobile devices

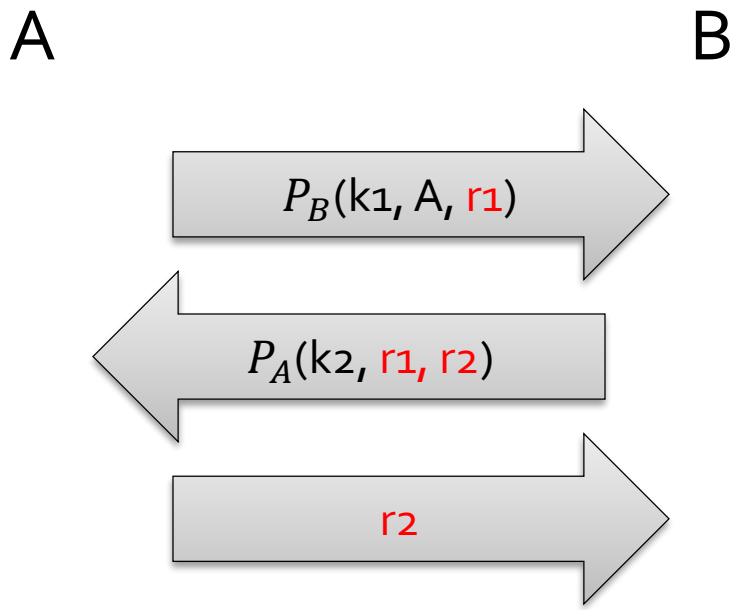
Securing communication (protocols)

- Needham-Schroeder



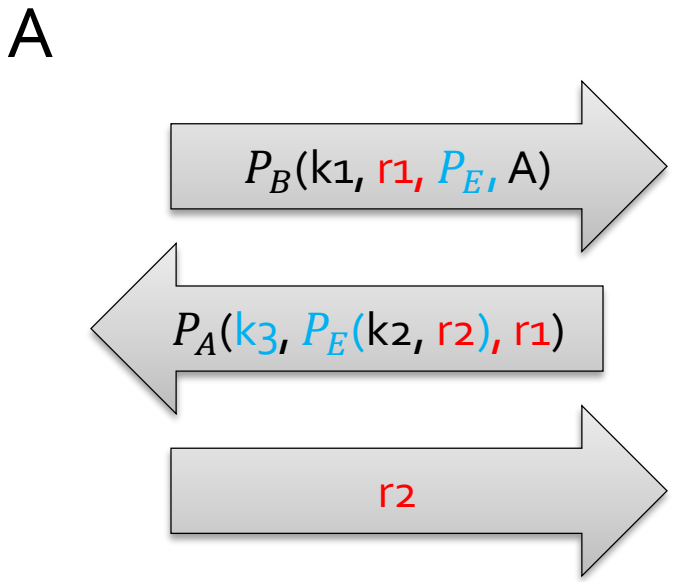
Securing communication (protocols)

- Needham-Schroeder
- Modified Needham-Schroeder



Securing communication (protocols)

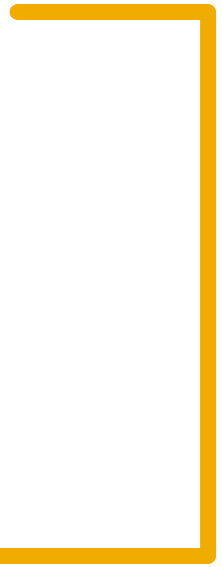
- Needham-Schroeder
- Modified Needham-Schroeder
- Perfect Forward Secrecy extension



Android and McEliece

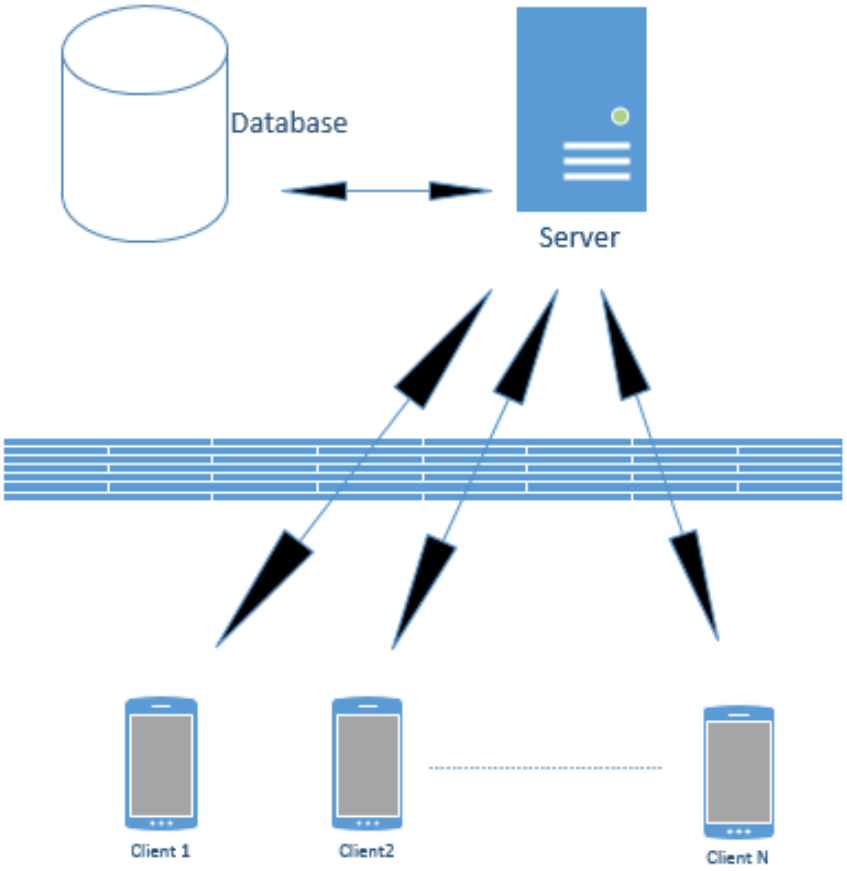
- BitPunch
- Bouncy Castle
  - Pointcheval
  - Kobara Imai
  - Fujisaki
- Bouncy Castle Beta
  - Kobara Imai (11, 50)

SpongyCastle



Architecture

- Unsecured web-service (RESTful)
- Secured channel (sockets) by protocol

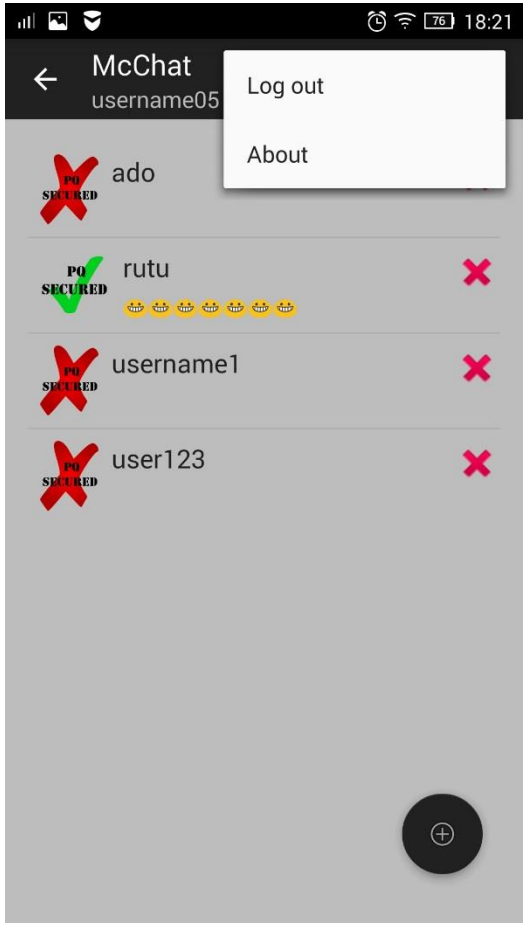


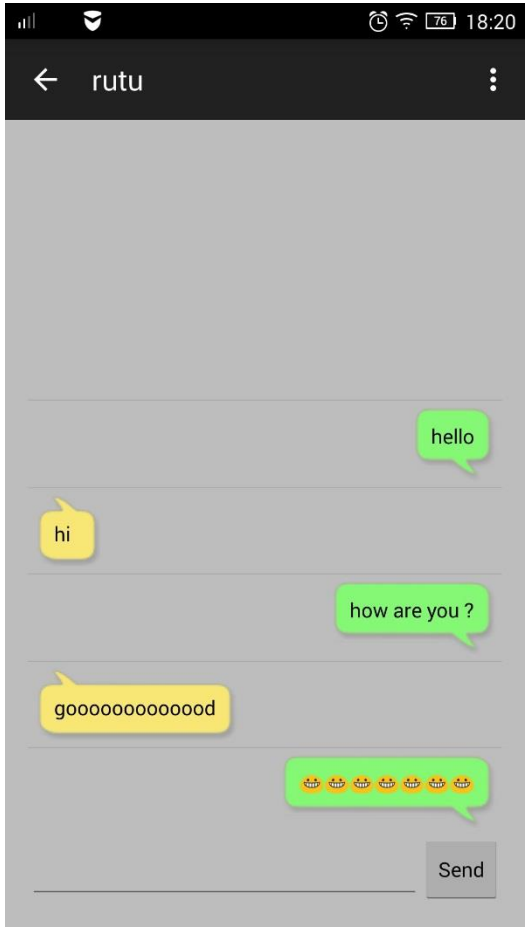
Users
Login : VARCHAR (10) NOT NULL PUBLICK : BLOB NOT NULL SECRETK : VARCHAR (16) NULL

Communication

- Log-in by protocol (client-server connection)
  - Mutual autentication, password not required
  - Hello server, key expiration…
- Client-client connection
  - JSON objects
    - {"WHAT":"GET_PUBLIC","TO":"SERVER","PROT":"P0A","OF":"user_name"}
    - {"TO":"user_name","PROT":"P1B","MESSAGE":"DDXSXCRgmrsTilpSoWSpi4…"}
    - {"TO":"user_name","PROT":"NO","MESSAGE":"KeSJfzP3f3rpgitMAWTOoA=="}

Application

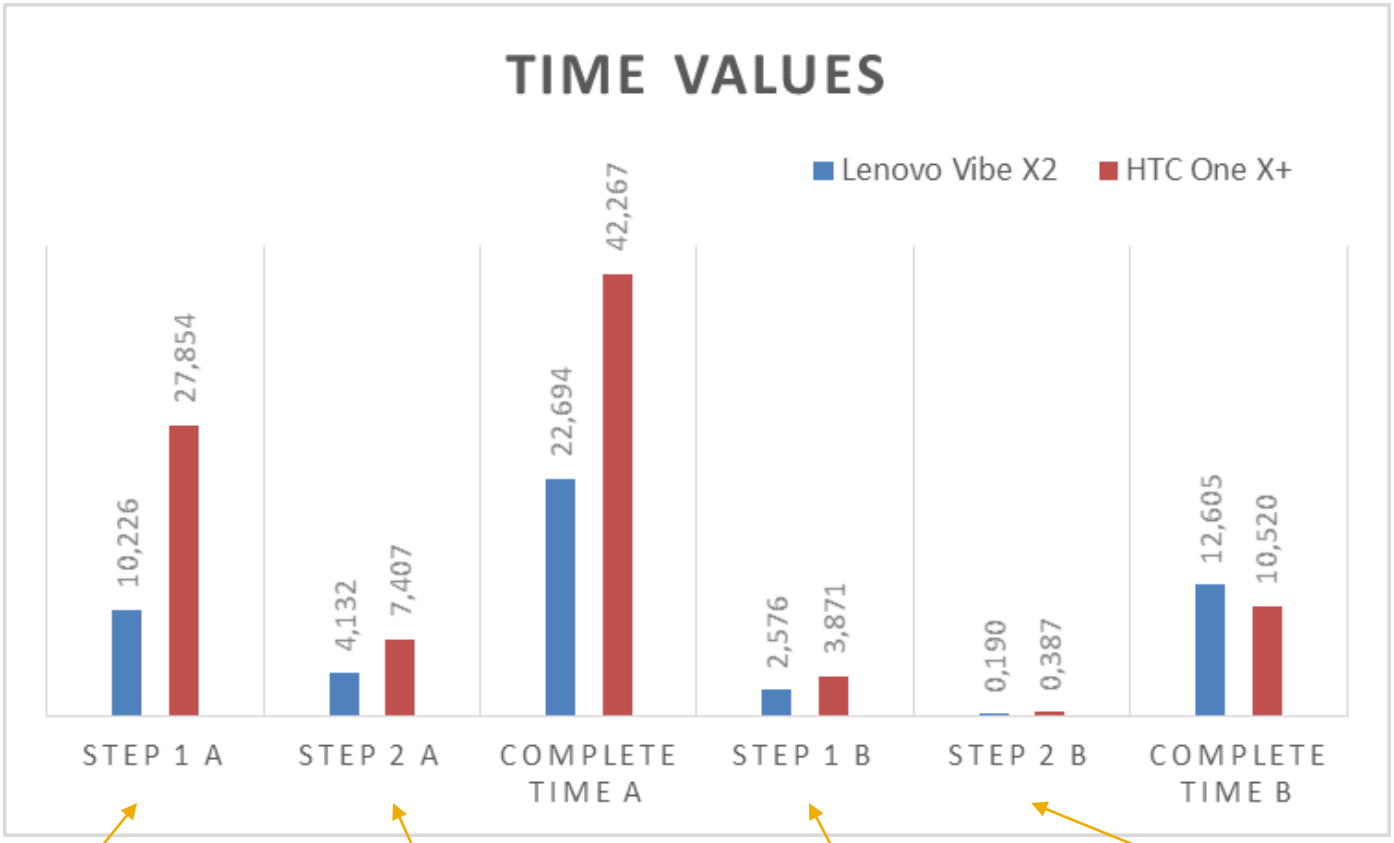




Tests

- HTC One X+
  - App memory: 64 MB
  - After enlargement: 256 MB
- Lenovo Vibe X2
  - App memory: 195 MB
  - After enlargement: 512 MB

Tests



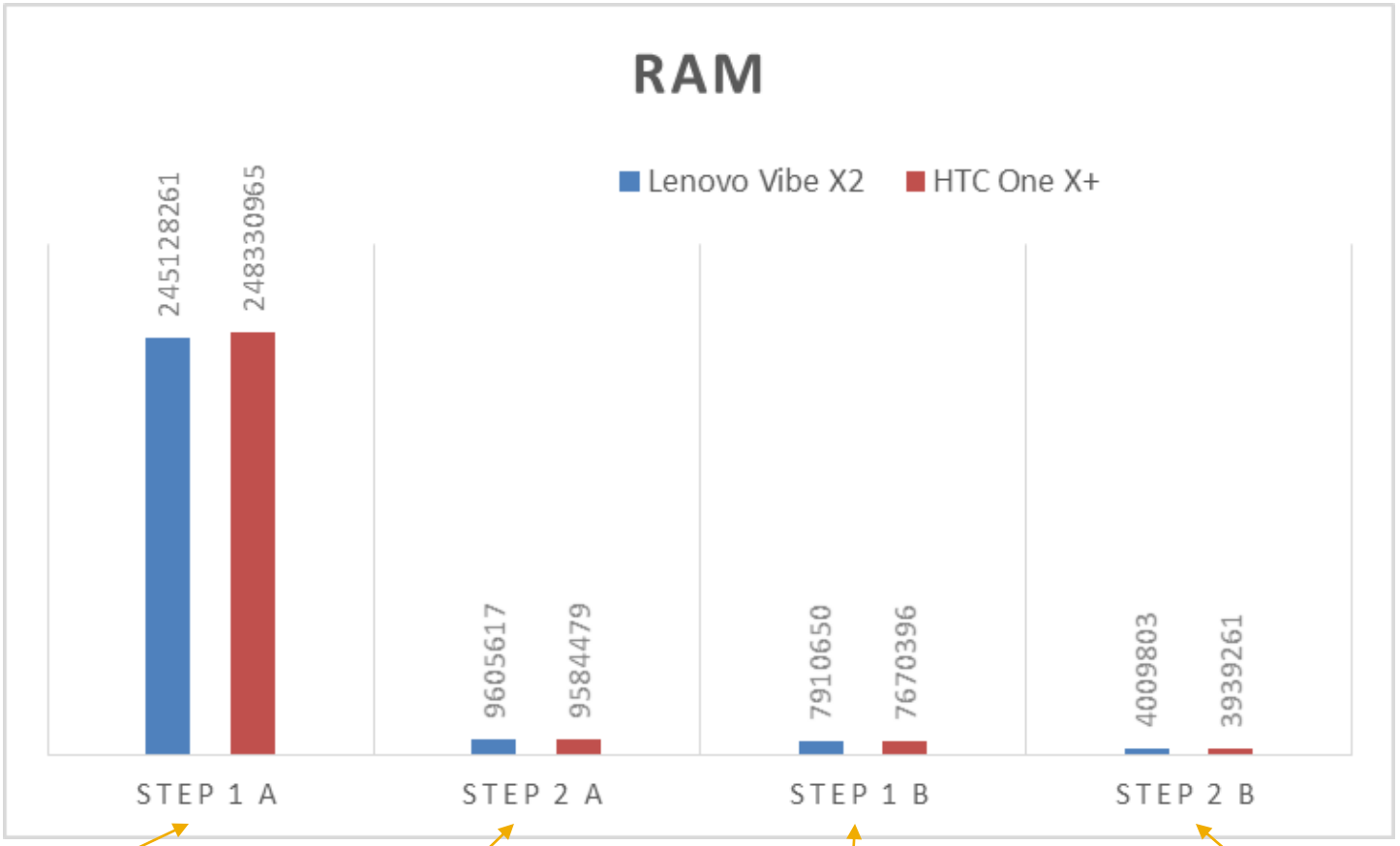
generating keys
1x encryption

2x decryption

1x decryption

2x encryption

Tests



generating keys
1x encryption

2x decryption

1x decryption

2x encryption

Conclusion

- First known McEliece implementation on OS Android (Real-time messenger app)
- Performance depends on device
- Some parts need further optimization
- Source codes will be published on git-hub

Questions?

Thank you for your attention