PV204 Security technologies

Team projects

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CROCS
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Project idea

Improve existing cryptographic libraries

1. Select existing open-source cryptographic library
2. Generate large number of RSA and ECC keys
3. Analyze cryptographic operations for side-channel leakage
4. Implement support for hardware tokens
5. (Try to push changes to upstream repository)

Teams

- 3 people per team
  - Formed today (within group), available in IS
- Teams must use GitHub for cooperation
  - Distribute work load evenly between all members
  - Contribution from all team members must be visible in git (git commits from each member)
  - Your evaluation will be partially based on your participation
- Teams may use existing code, but must make clear attribution to the original author(s)

Basic hints on successful team work

- Form team from people with similar expectations
  - intended effort, final mark, interactions…
- Plan your work (GitHub milestones + issues)
- Don’t overcommit and fulfil your promises
- Agree on 4 personal session to work on project (at least 1 hour each) and block time in your calendar
  - Mail me the dates
- Every seminar 10 minutes reserved for team sync
  - Update your GitHub project milestones…

Projects – timeline (details on next slides)

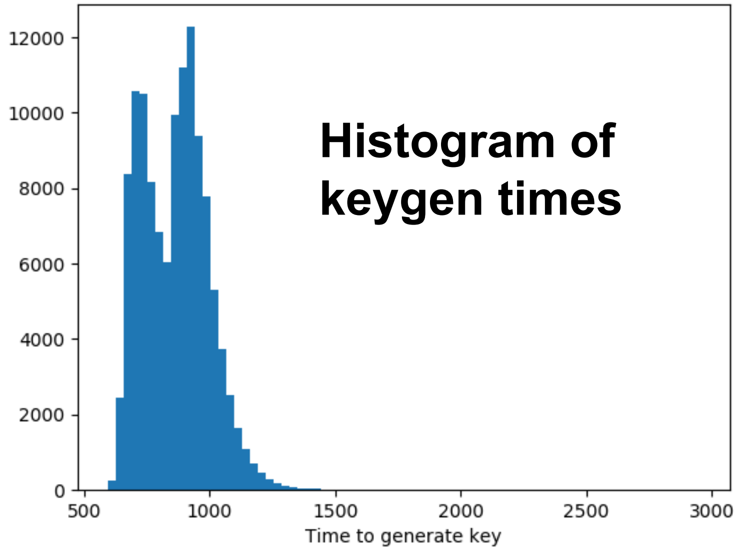
1. Select target library, fork/create repository (4.3.2019)
   - No duplicate libraries allowed, predefined list, FIFO, mail me!
2. Collect 1 million RSA and 1 million ECC keys: 5 points (14.3.2019)
   - Store resulting keys (public and private, primes…) + measured timing + graphs
   - Plot graphs: histogram of MSB and LSB, histogram timing
   - Keygen code, keys, report (max. 2 pages A4) + presentation (your seminar)
3. Analyze crypto operations for side-channel leakage: 7 points (4.4.2019)
   - Time side-channel (random inputs, mostly zeroes, mostly binary ones…)
   - Bonuses: cache-based side-channel; pull requests with fix
   - Report (max. 4 pages A4) + presentation (your seminar group)
4. Implement support for hardware tokens: 8 points (19.4.2019)
   - Key generation in hardware token (PKCS#11, JavaCard…)
   - Sign & encrypt operation using key stored inside token

- At least **10 points** (total) from the project required

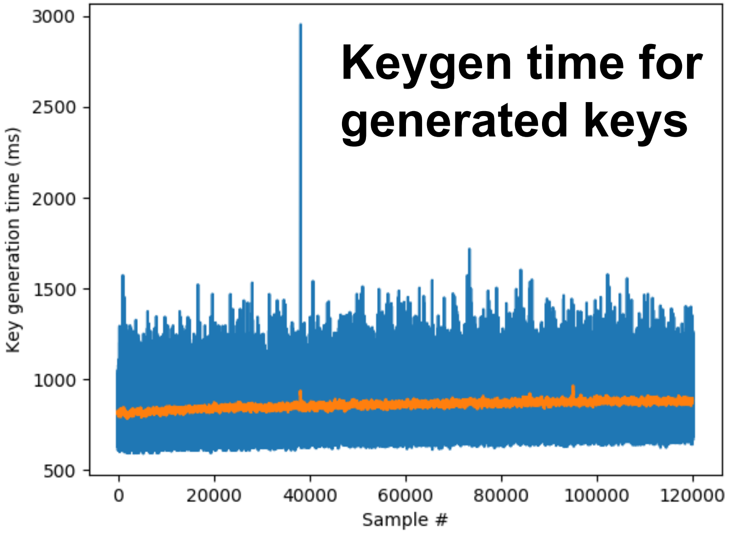
PROJECT: KEY COLLECTION

Collect 1 million RSA and ECC keys

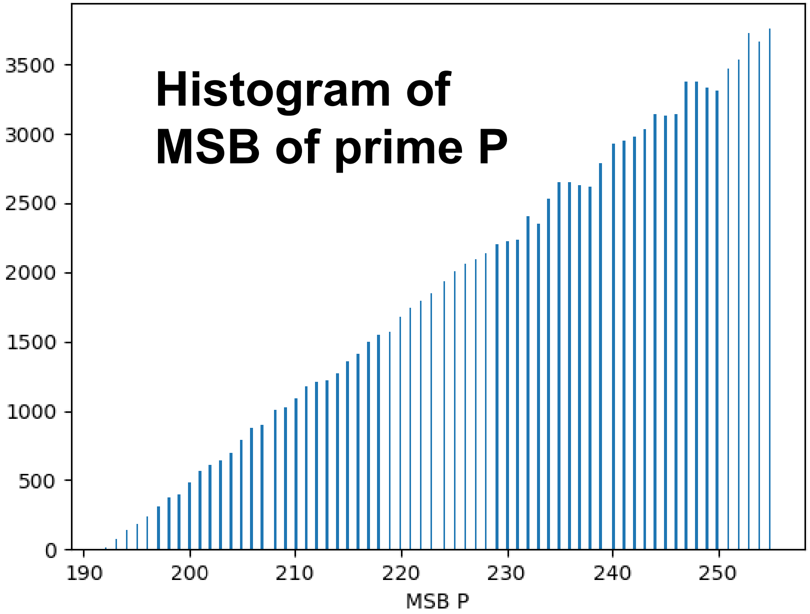
- Investigate library code, locate key generation methods
- Write small program collecting generated keypairs
  - 10^6 RSA-512b keys
  - 10^4 RSA-1024b, 10^4 RSA-2048b
  - 10^6 ECDSA (NIST P-256) keys
  - Store resulting keys (format on next slides)
- Plot graphs using generated keys
  - histogram of MSBs and LSB, timing histogram



Histogram of keygen times

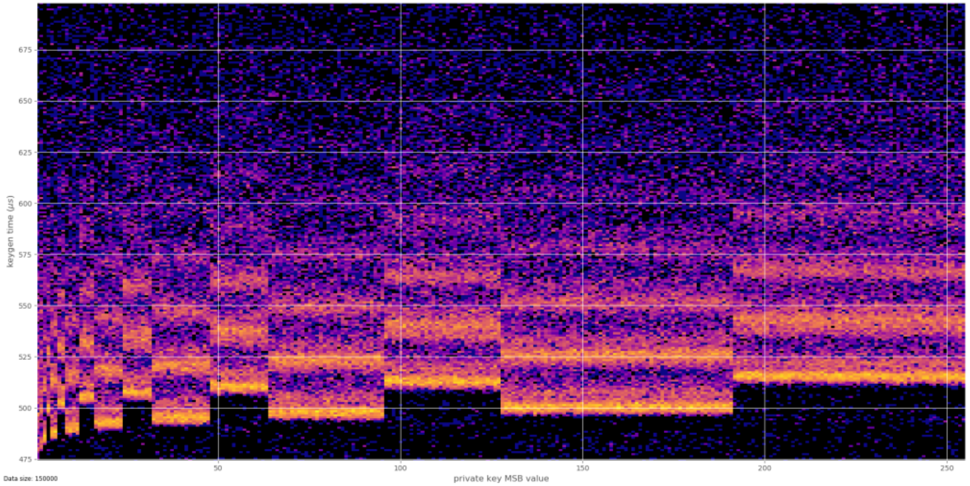


Keygen time for generated keys



Histogram of MSB of prime P

Heatmap of private keys MSB to keygen time



RSA key format

- CSV Format, hexadecimal coding
- **id;n;e;p;q;d;t1;**
- id – simple counter: 1, 2 ….
- n – modulus
- e – public exponent
- p – first prime
- q – second prime
- d – private exponent
- t1 – time to generate key (ns)

ECC key format

- CSV Format, hexadecimal coding
- **id;e;d;t1;**
- id – simple counter: 1, 2 ….
- e – public key
- d – private key
- t1 – time to generate key (ns)

LIBRARIES AVAILABLE FOR SELECTION

- BearSSL
  - https://bearssl.org/
  - Michal Čech, Šimon Doucha a Martin Bulák
- BoringSSL
  - http://www.boringssl.com/
  - Mária Micháliková, Darek Cidlinský, + one other
- Amazon s2n
  - https://github.com/awslabs/s2n
  - Jan Kvapil, Vladmír Sedláček, Ondřej Krčma
- Apple coretls
  - https://opensource.apple.com/tarballs/coreTLS/
  - ??
- Apple corecrypto
  - https://developer.apple.com/security/
  - Tomáš Šlancar, Xichu Zhang + one other

mbedTLS
Pedro Gomes

- GO language crypto
  - https://golang.org/
  - ??
- Mozilla NSS
  - https://hg.mozilla.org/projects/nss
  - ??
- GNU TLS
  - https://gnutls.org/
  - Martin Frian, Pedro Gomes, Peter Sekan
- WolfSSL
  - https://www.wolfssl.com/
  - Daniel Filakovsky, Antonin Dufka, Jakub Bartolomej
- LibreSSL
  - https://www.libressl.org/
  - Natália Gregušková (422562), Daniela Belajová (445323), Nikola Šedivcová (433396)
- Nettle
  - http://www.lysator.liu.se/~nisse/nettle/
  - Richard Kalinec, Ondřej Zoder a Filip Gontko