

# Verificatum Mix-Net

Technical fact sheet  
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<https://www.verificatum.org>



## SECURE AND FLEXIBLE

- **Implementation of provably secure mix-net.**  
Completely faithful to cryptographic theory.  
Implemented by world-leading expert.
- **Unprecedented and unique blackbox functionality:**  
Distributed threshold key generation.  
Jointly decrypts ciphertexts.  
Shuffles ciphertexts using any public key.  
Mixes ciphertexts (shuffles + decrypts).
- **Everything is parameterized.**  
Any width of keys and ciphertexts.  
Security parameters, groups, communication model,...

## USAGE

- **Easy to use.**  
Basic use: simple commands with conservative defaults  
Complex use: Powerful optional parameters.
- **Mature and complete documentation.**  
High quality manual with examples.  
Detailed usage information for all commands.  
Commented generated configuration files.
- **Easy to demo both locally and remotely.**  
Bundled configurable demo script.  
Allows real-world remote demo.

## EFFICIENT

- **Runs in constant memory and scales linearly with:**  
servers, ciphertexts, width of ciphertexts
- **Example:**  
3 servers on 700 euro computers  
remotely located over plain Internet  
2/3 threshold for decryption  
P-256 elliptic curve (30 year security)  
1,000,000 ciphertexts  
Shuffles and decrypts in less than 30 minutes.  
Includes mutual verification of all ZK proofs.

## DEPLOYMENT

- **Free and open source.**  
MIT License
- **Easy to build and install.**  
Standard GNU build and install from source.  
Binary packages for major Linux distributions.
- **Portable.**  
POSIX and only one dependency.  
Runs on wide array of Unix/Linux systems.

## INTEGRATION

- **Philosophy.**

*This is the Unix philosophy: Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface.* – McIlroy

- **Dataformats.**

**Simplistic binary format for data with inspection tool.**

**XML configuration files.**

- **Interfaces.**

**Command line interface for most cases.**

**Software interface for custom applications.**

## UNIVERSALLY VERIFIABLE PROOFS

**Each execution generates a universally verifiable proof.**

**Mature, repeatedly revised, document describes proof. Level of detail is equivalent to NIST standard documents.**

**Undergrads at Tel Aviv University and KTH Royal Institute of Technology have implemented verifiers using the document with almost no advice.**

**Built-in verifier can print any subset of test vectors to help debug independently implemented verifiers.**

## CODE QUALITY

- **Excellent code quality:**

**Project started 2007. Slow careful development.**

**Everything is commented and documented.**

**Static analyzers – CheckStyle, FindBugs, PMD**

**Independent code analysis – Crisp AB, Joe Kiniry, and Demtech, Copenhagen Technical University (CTU)**

- **Only two sources of external code:**

**GNU Multiple Precision Arithmetic Library (depeny)**

**Three OpenSSL curves (bundled, not using the library!)**

*"...superior in quality, both in the big-picture design and the implementation details than any other crypto library I have ever audited."* –Joe Kiniry

*"It runs like a Swiss watch."* –Sven Heiberg

## OPTIMIZED

**Pre-computes when possible.**

**Fast arithmetic using all known relevant techniques.**

**Exploits multiple cores.**

**Exploits parallelism of mix-servers where possible.**

**Abstraction framework prevents code cluttering.**

**Advice from developers of GMP and JRockit JVM!**

## USED IN REAL ELECTIONS

- **Used by Wombat in Israel.**

**Student union elections of Tel Aviv University (twice).**

**Election of Meretz party leader**

- **Used by Agora Voting in Spain.**

**Several primary elections, municipal elections, etc, adding to at least 2.5M cast votes.**

- **Used by Scytl in Norway**

**2013 Norwegian electronic election**

**approximately 72K voters out of 250K eligible**

- **Used by Estonian Election Authority**

**2017, 2019 Estonian electronic elections**

## CONTACT INFORMATION

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