# `Cry` (cryptographic framework)
# Project 1 (Project Plan): Report

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## 1 Motivation

- For end-users:
  - Problem: An end-user wants to send and receive secure messages with other end-users.
  - Solution: `Cry` lets end-users establish secure communication via built-in cryptosystems.
- For cryptographers:
  - Problem: New cryptosystems need to be developed.
    - Reason: Most existing cryptosystems are secure only if their assumptions are true.
    - Example: The RSA cryptosystem's security relies on the assumption that integer factorization is hard. It is currenly unknown whether a polynomial-time factorizing algorithm exists.

– Solution: `Cry` let cryptographers easily prototype and test their new cryptosystems.

# 2 Overview

## 2.1 Example Use Case

Situation:

- *Alice* (sender) wants to confidentially send a message to *Bob* (receiver).
- *Eve* (eavesdropper) wants to know that message.

Procedure:

1. Each person downloads the binary file `cry` of the `Cry` cryptographic framework.
2. *Bob* publishes his choice of cryptosystem: RSA (Rivest, Shamir, Adleman).
3. *Bob* generates his keys:

```
$ cry getkeys --cryptosystem=rsa
The public & private keys are 825 & 637 (took 1 second).
```

4. *Bob* publishes his public key (and hides his private key).
5. *Alice* obtains *Bob*'s published public key.
6. *Alice* encrypts her message (say, her phone number):

```
$ cry encrypt --cryptosystem=rsa \
> --public-key=825 \
> --plaintext=4692301804
The ciphertext is 1110003333 (took 1 second).
```

7. *Alice* publishes the encrypted message.
8. *Bob* obtains *Alice*'s published encrypted message.
9. *Bob* easily decrypts the message with his private key:

```
$ cry decrypt --cryptosystem=rsa \
> --private-key=637 \
> --ciphertext=1110003333
The plaintext is 4692301804 (took 1 second).
```

10. *Eve* struggles to eavesdrop the message without *Bob*'s private key:

```
$ cry eavesdrop --cryptosystem=rsa \
> --public-key=825 \
> --ciphertext=1110003333
The plaintext is 4692301804 (took 1 century).
```

### 2.2 Functionality

In the previous example:

- `Cry` is the cryptographic framework.
- RSA is a cryptosystem implemented in `Cry`.
- The key-generation, encryption, decryption, and eavesdropping algorithms are specific to RSA.

In general, with `Cry`:

- an end-user can use an implemented cryptosystem to confidentially send and receive messages with others.
- a cryptographer can:
  - prototype her own cryptosystems where the cryptographic algorithms are either newly defined or reused from different existing cryptosystems.
  - test her cryptosystems for security and performance.

## 3 Expectation

- Usability:
  - `Cry` enables end-users to establish secure communication via simple command-line options.
  - Being a modular object-oriented framework, `Cry` lets cryptographers easily define and benchmark new cryptosystems.