Asymmetric Encryption

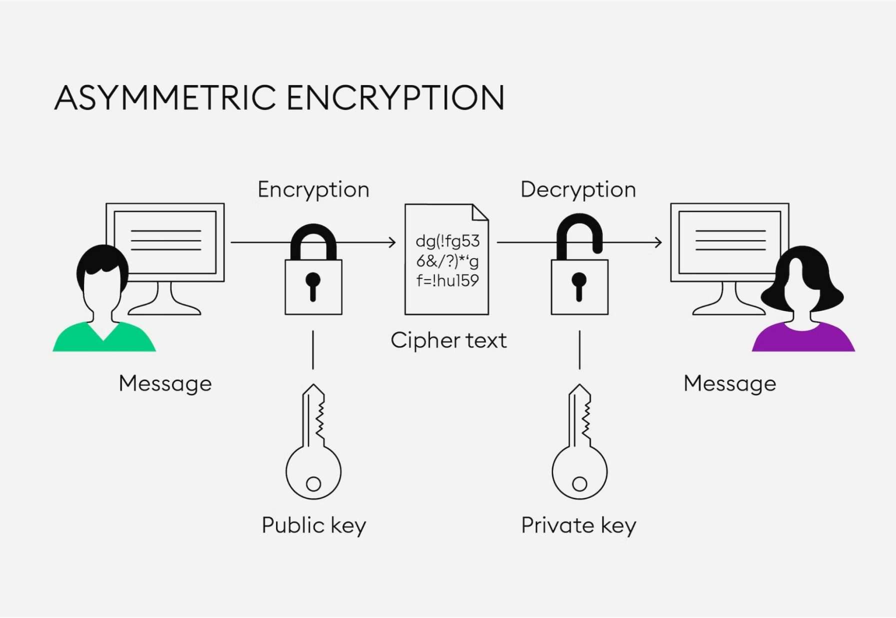
Gianna Bauzil

What is encryption and why do we need it?

- Uses mathematical algorithms to transform messages into an unreadable format (ciphertext) using keys
- Increases security of a message using keys
- Prevents attackers from understanding messages being sent between hosts
- One form of this is asymmetric encryption!

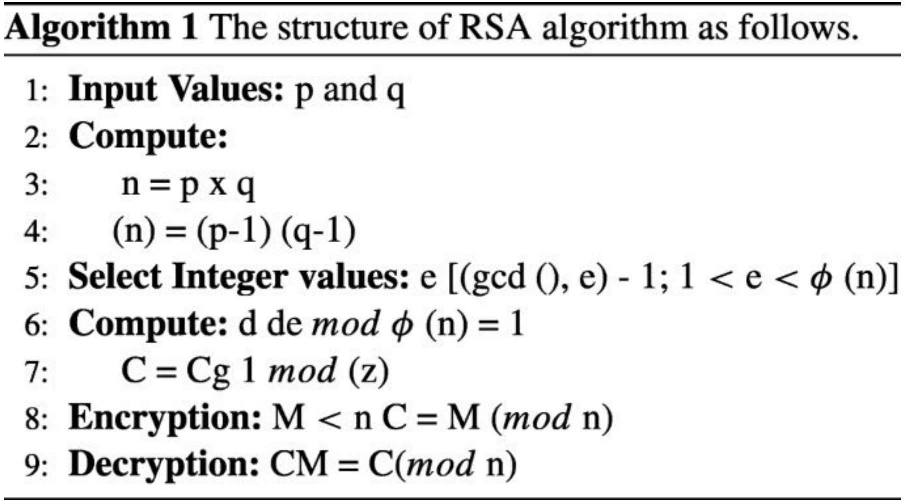
How it works

- Each user has a public and private key
- Before a message can be sent, it is encrypted using the receiver's private key
- The receiver uses their private key to decrypt the message



Rivest Shamir Adleman (RSA) Algorithm

- Invented in 1978 by Ron Rivest, Adi Shamir, and Leonard Adleman
- Algorithm ensures that the public and private keys are secure
- Keys are generated starting off with two large prime numbers and a series of mathematical equations



Algorithm 1 The structure of RSA algorithm as follows.

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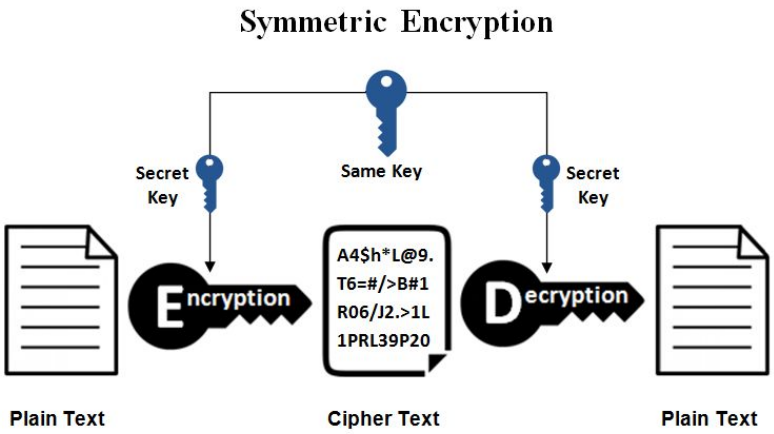
Input Values: p and q
Compute:
    $n = p x q$
    $(n) = (p-1) (q-1)$
Select Integer values: e $[(gcd (), e) - 1; 1 < e < \phi (n)]$
Compute: d de $mod\ \phi\ (n) = 1$
    $C = Cg\ 1\ mod\ (z)$
Encryption: $M < n\ C = M\ (mod\ n)$
Decryption: $CM = C(mod\ n)$
```

Advantages

- Most secure encryption process
- No need to exchange keys
- No need for computers to “handshake” before sending a message
- Provides message integrity
- Provides non-repudiation - decrypt digital signatures using private keys



How can one secret key be shared between 2 users safely? Asymmetric encryption provides a better solution!

Disadvantages

- Slower than symmetric encryption
- If a user loses their private key, then they cannot decrypt their messages
- Public keys are not authenticated
- If attacker discovers the private key, then a user’s messages can be read

Daily Uses

- Email security
- Web security when browsing
- Cryptocurrencies
- SSH

Sources

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