

Kryptologie LAB - 4.1

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Rivest-Shamir-Adleman (RSA)

- Public-key cryptosystem
- Different keys for encryption and decryption
- Keys are interpreted as (unsigned) integers
- Texts are interpreted as sequences of (unsigned) integers

Task 4 - part 1

- Implement an RSA key generation routine.
 - choose two **distinct** primes p and q
 - set $n = pq$, note $\phi(n) = (p - 1)(q - 1)$
 - public key: find an integer e with $1 \leq e \leq \phi(n)$ and $\gcd(e, \phi(n)) = 1$
 - private key: $d := e^{-1} \pmod{\phi(n)}$, i.e. $d \cdot e \equiv 1 \pmod{\phi(n)}$
- $\phi(n)$ should be expressible as a 64-bit unsigned integer, and larger than all 32-bit unsigned integers:

$$4,294,967,295 < \phi(n) \leq 18,446,744,073,709,551,615$$

Getting the keys

- public key (easy), use $e = 3$.
- private key (harder): use Extended Euclidean Algorithm (EEA)
 - we know that $\gcd(e, \phi(n)) = 1$
 - algorithm returns integers λ and μ such that

$$\lambda \cdot e + \mu \cdot \phi(n) = 1$$

- hence $\lambda = e^{-1}$
 - the private key is $d := \lambda$
- details for EEA can be found in the lecture slides