Crypto libraries intro – examples

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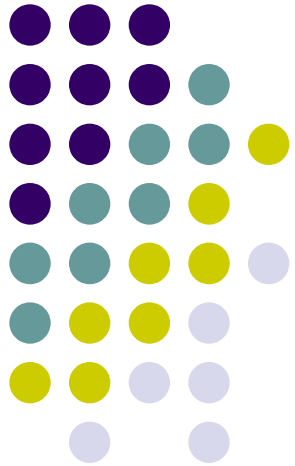
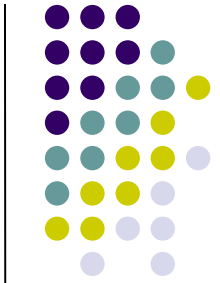


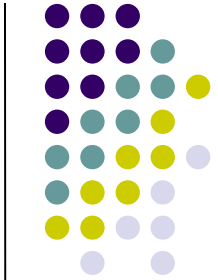
Today’s examples



- **Low-level crypto primitives**
  - RNG
  - Hash, HMAC
  - PBKDF
- Examples comparison in **libgcrypt**, **OpenSSL**, **and libsodium**
- **Comparison OpenSSL 1.1.x / 3.0.x**

- See git (examples 1, 2, 3)

Example 1: RNG in libraries



libgcrypt

see **1_rng_gcrypt** example

```
(void) gcry_randomize(buf, sizeof(buf), GCRY_STRONG_RANDOM)
```

OpenSSL

see **1_rng_openssl** example

```
(int) RAND_bytes(buf, sizeof(buf))
```

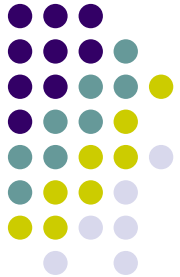
libsodium

see **1_rng_sodium** example

```
(void) randombytes_buf(buf, sizeof(buf))
```

Simple? Not in the real-world. RNG or pseudo RNG, optional parameters, initialization or another call for configuration, can/cannot fail, can/cannot block if not enough entropy, is it own implementation or wrapper to system RNG, can it be used in FIPS mode ...

Example 2: Hash functions



libgcrypt

See **2_hash_hmac_gcrypt** example

```
gcry_md_open(context, hash_id, flags)
gcry_md_write(context, data, data_len)
gcry_md_read(context, hash_id)
gcry_md_close(context)
```

OpenSSL (new 1.1.0 syntax)

EVP (envelope) interface, see **2_hash_hmac_openssl** example

```
EVP_MD_CTX_new();
EVP_DigestInit(context, hash_id)
EVP_DigestUpdate(context, data, data_len)
EVP_DigestFinal(context, out, &out_len)
EVP_MD_CTX_free(context);
```

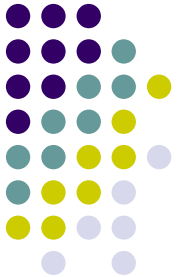
libsodium

See **2_hash_hmac_sodium** example

```
crypto_hash_sha256_init(context)
crypto_hash_sha256_update(context, data, data_len)
crypto_hash_sha256_final(context, out))
```

Example 2: HMAC

Keyed Hash Message Authentication Code



libgcrypt

See **2_hash_hmac_gcrypt** example

```
gcry_md_open(context, hash_id, GCRY_MD_FLAG_HMAC)
gcry_md_setkey(context, key, key_len)
gcry_md_write(context, data, data_len)
gcry_md_read(context, hash_id)
gcry_md_close(context)
```

OpenSSL (new 3.0.0 syntax)

EVP interface, see **2_hash_hmac_openssl3** example (+ older syntax example)

```
EVP_MAC_fetch(…);
EVP_MAC_CTX_new(EVP_mac);
EVP_MAC_init(context, key, key_len, PARAMS[])
EVP_MAC_Update(context, data, data_len)
EVP_MAC_Final(context, out, &out_len, sizeof(out))
EVP_MAC_CTX_free(context);
```

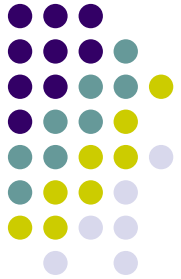
libsodium

NaCl compatible interface, see **2_hash_hmac_sodium** example

```
crypto_auth(out, data, data_len, key))
crypto_auth_verify(expected_out, data, data_len, key))
```

Example 3: PBKDF

Password-Based Key Derivation Functions



libgcrypt

See **3_pbkdf_gcrypt** example (and for bonus: **3_pbkdf_argon2_gcrypt**)

```
gcry_kdf_derive(password, password_len,
                GCRY_KDF_PBKDF2, GCRY_MD_SHA256,
                salt, salt_len, iterations, key_len, key)
```

OpenSSL 1.1.x / 3.0.0

See **3_pbkdf_openssl** example

```
PKCS5_PBKDF2_HMAC(password, password_len, salt, salt_len,
                  iterations, EVP_sha256, key_len, key)
```

See **3_pbkdf_openssl3** example

```
EVP_KDF_fetch(…);
EVP_KDF_CTX_new(EVP_kdf);
EVP_KDF_derive(context, key, key_size, PARAMS[]);
EVP_KDF_CTX_free(context);
```

libsodium

See **3_pbkdf_sodium** example

*(Note: default algorithm is memory-hard **Argon2id**, PBKDF2 not implemented)*

```
crypto_pwhash(key, key_len, password, password_len,
              salt, opslimit, memlimit, algorithm)
```