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# Liboath API Reference Manual

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## Chapter 1

# Liboath API Reference Manual

Liboath is a shared and static C library for handling OATH related technology such as HOTP.

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### 1.1 oath

oath —

#### Synopsis

```
#define OATHAPI
#define OATH_VERSION
#define OATH_VERSION_NUMBER
enum oath_rc;
int oath_init (void);
int oath_done (void);
const char * oath_check_version (const char *req_version);
const char * oath_strerror (int err);
const char * oath_strerror_name (int err);
int oath_hex2bin (const char *hexstr,
                  char *binstr,
                  size_t *binlen);
void oath_bin2hex (const char *binstr,
                  size_t binlen,
                  char *hexstr);
int oath_base32_decode (const char *in,
                       size_t inlen,
                       char **out,
                       size_t *outlen);
int oath_base32_encode (const char *in,
                       size_t inlen,
                       char **out,
                       size_t *outlen);
#define OATH_HOTP_LENGTH
#define OATH_HOTP_DYNAMIC_TRUNCATION
int oath_hotp_generate (const char *secret,
```

---

```

size_t secret_length,
uint64_t moving_factor,
unsigned digits,
bool add_checksum,
size_t truncation_offset,
char *output_otp);
int      oath_hotp_validate
(const char *secret,
size_t secret_length,
uint64_t start_moving_factor,
size_t window,
const char *otp);
int      (*oath_validate_strcmp_function)
(void *handle,
const char *test_otp);
#define   oath_hotp_validate_strcmp_function
int      oath_hotp_validate_callback
(const char *secret,
size_t secret_length,
uint64_t start_moving_factor,
size_t window,
unsigned digits,
oath_validate_strcmp_function str
void *strcmp_handle);

#define   OATH_TOTP_DEFAULT_TIME_STEP_SIZE
#define   OATH_TOTP_DEFAULT_START_TIME
int      oath_totp_generate
(const char *secret,
size_t secret_length,
time_t now,
unsigned time_step_size,
time_t start_offset,
unsigned digits,
char *output_otp);
int      oath_totp_validate
(const char *secret,
size_t secret_length,
time_t now,
unsigned time_step_size,
time_t start_offset,
size_t window,
const char *otp);
int      oath_totp_validate_callback
(const char *secret,
size_t secret_length,
time_t now,
unsigned time_step_size,
time_t start_offset,
unsigned digits,
size_t window,
oath_validate_strcmp_function str
void *strcmp_handle);
int      oath_totp_validate2
(const char *secret,
size_t secret_length,
time_t now,
unsigned time_step_size,
time_t start_offset,
size_t window,
int *otp_pos,
const char *otp);
int      oath_totp_validate2_callback
(const char *secret,
size_t secret_length,
time_t now,

```

---

```
int                                oath_authenticate_usersfile

                                unsigned time_step_size,
                                time_t start_offset,
                                unsigned digits,
                                size_t window,
                                int *otp_pos,
                                oath_validate_strerror_function str
                                void *stricmp_handle);
                                (const char *usersfile,
                                const char *username,
                                const char *otp,
                                size_t window,
                                const char *passwd,
                                time_t *last_otp);
```

## Description

## Details

### OATHAPI

```
#define OATHAPI
```

### OATH\_VERSION

```
#define OATH_VERSION "1.12.1"
```

Pre-processor symbol with a string that describe the header file version number. Used together with [oath\\_check\\_version\(\)](#) to verify header file and run-time library consistency.

### OATH\_VERSION\_NUMBER

```
#define OATH_VERSION_NUMBER 0x010c0100
```

Pre-processor symbol with a hexadecimal value describing the header file version number. For example, when the header version is 1.2.3 this symbol will have the value 0x01020300. The last two digits are only used between public releases, and will otherwise be 00.

### enum oath\_rc

```
typedef enum
{
    OATH_OK = 0,
    OATH_CRYPTO_ERROR = -1,
    OATH_INVALID_DIGITS = -2,
    OATH_PRINTF_ERROR = -3,
    OATH_INVALID_HEX = -4,
    OATH_TOO_SMALL_BUFFER = -5,
    OATH_INVALID_OTP = -6,
    OATH_REPLAYED_OTP = -7,
    OATH_BAD_PASSWORD = -8,
    OATH_INVALID_COUNTER = -9,
    OATH_INVALID_TIMESTAMP = -10,
    OATH_NO_SUCH_FILE = -11,
    OATH_UNKNOWN_USER = -12,
```

```
OATH_FILE_SEEK_ERROR = -13,  
OATH_FILE_CREATE_ERROR = -14,  
OATH_FILE_LOCK_ERROR = -15,  
OATH_FILE_RENAME_ERROR = -16,  
OATH_FILE_UNLINK_ERROR = -17,  
OATH_TIME_ERROR = -18,  
OATH_STRCMP_ERROR = -19,  
OATH_INVALID_BASE32 = -20,  
OATH_BASE32_OVERFLOW = -21,  
OATH_MALLOC_ERROR = -22  
} oath_rc;
```

Return codes for OATH functions. All return codes are negative except for the successful code `OATH_OK` which are guaranteed to be 0. Positive values are reserved for non-error return codes.

Note that the `oath_rc` enumeration may be extended at a later date to include new return codes.

**OATH\_OK** Successful return

**OATH\_CRYPTO\_ERROR** Internal error in crypto functions

**OATH\_INVALID\_DIGITS** Unsupported number of OTP digits

**OATH\_PRINTF\_ERROR** Error from system printf call

**OATH\_INVALID\_HEX** Hex string is invalid

**OATH\_TOO\_SMALL\_BUFFER** The output buffer is too small

**OATH\_INVALID\_OTP** The OTP is not valid

**OATH\_REPLAYED\_OTP** The OTP has been replayed

**OATH\_BAD\_PASSWORD** The password does not match

**OATH\_INVALID\_COUNTER** The counter value is corrupt

**OATH\_INVALID\_TIMESTAMP** The timestamp is corrupt

**OATH\_NO\_SUCH\_FILE** The supplied filename does not exist

**OATH\_UNKNOWN\_USER** Cannot find information about user

**OATH\_FILE\_SEEK\_ERROR** System error when seeking in file

**OATH\_FILE\_CREATE\_ERROR** System error when creating file

**OATH\_FILE\_LOCK\_ERROR** System error when locking file

**OATH\_FILE\_RENAME\_ERROR** System error when renaming file

**OATH\_FILE\_UNLINK\_ERROR** System error when removing file

**OATH\_TIME\_ERROR** System error for time manipulation

**OATH\_STRCMP\_ERROR** A strcmp callback returned an error

**OATH\_INVALID\_BASE32** Base32 string is invalid

**OATH\_BASE32\_OVERFLOW** Base32 encoding would overflow

**OATH\_MALLOC\_ERROR** Memory allocation failed

**oath\_init ()**

```
int                oath_init                (void);
```

This function initializes the OATH library. Every user of this library needs to call this function before using other functions. You should call **oath\_done()** when use of the OATH library is no longer needed.

Note that this function may also initialize Libgcrypt, if the OATH library is built with libgcrypt support and libgcrypt has not been initialized before. Thus if you want to manually initialize libgcrypt you must do it before calling this function. This is useful in cases you want to disable libgcrypt's internal lockings etc.

**Returns :** On success, **OATH\_OK** (zero) is returned, otherwise an error code is returned.

**oath\_done ()**

```
int                oath_done                (void);
```

This function deinitializes the OATH library, which were initialized using **oath\_init()**. After calling this function, no other OATH library function may be called except for to re-initialize the library using **oath\_init()**.

**Returns :** On success, **OATH\_OK** (zero) is returned, otherwise an error code is returned.

**oath\_check\_version ()**

```
const char *      oath_check_version      (const char *req_version);
```

Check OATH library version.

See **OATH\_VERSION** for a suitable *req\_version* string.

This function is one of few in the library that can be used without a successful call to **oath\_init()**.

**req\_version :** version string to compare with, or NULL.

**Returns :** Check that the version of the library is at minimum the one given as a string in *req\_version* and return the actual version string of the library; return NULL if the condition is not met. If NULL is passed to this function no check is done and only the version string is returned.

**oath\_strerror ()**

```
const char *      oath_strerror           (int err);
```

Convert return code to human readable string explanation of the reason for the particular error code.

This string can be used to output a diagnostic message to the user.

This function is one of few in the library that can be used without a successful call to **oath\_init()**.

**err :** liboath error code

**Returns :** Returns a pointer to a statically allocated string containing an explanation of the error code *err*.

Since 1.8.0



**oath\_strerror\_name ()**

```
const char *      oath_strerror_name      (int err);
```

Convert return code to human readable string representing the error code symbol itself. For example, `oath_strerror_name(OATH_OK)` returns the string "OATH\_OK".

This string can be used to output a diagnostic message to the user.

This function is one of few in the library that can be used without a successful call to `oath_init()`.

**err** : liboath error code

**Returns** : Returns a pointer to a statically allocated string containing a string version of the error code *err*, or **NULL** if the error code is not known.

Since 1.8.0

**oath\_hex2bin ()**

```
int              oath_hex2bin              (const char *hexstr,  
                                           char *binstr,  
                                           size_t *binlen);
```

Convert string with hex data to binary data.

Non-hexadecimal data are not ignored but instead will lead to an **OATH\_INVALID\_HEX** error.

If *binstr* is **NULL**, then *binlen* will be populated with the necessary length. If the *binstr* buffer is too small, **OATH\_TOO\_SMALL** is returned and *binlen* will contain the necessary length.

**hexstr** : input string with hex data

**binstr** : output string that holds binary data, or **NULL**

**binlen** : output variable holding needed length of *binstr*

**Returns** : On success, **OATH\_OK** (zero) is returned, otherwise an error code is returned.

**oath\_bin2hex ()**

```
void              oath_bin2hex              (const char *binstr,  
                                           size_t binlen,  
                                           char *hexstr);
```

Convert binary data to NUL-terminated string with hex data. The output *hexstr* is allocated by the caller and must have room for at least  $2*binlen+1$ , to make room for the encoded data and the terminating NUL byte.

**binstr** : input binary data

**binlen** : length of input binary data *binstr*

**hexstr** : output string with hex data, must have room for  $2*binlen+1$ .

Since 1.12.0

**oath\_base32\_decode ()**

```
int                oath_base32_decode                (const char *in,
                                                    size_t inlen,
                                                    char **out,
                                                    size_t *outlen);
```

Decode a base32 encoded string into binary data.

Non-base32 data are not ignored but instead will lead to an **OATH\_INVALID\_BASE32** error.

The *in* parameter should contain *inlen* bytes of base32 encoded data. The function allocates a new string in *\*out* to hold the decoded data, and sets *\*outlen* to the length of the data.

If *out* is NULL, then *\*outlen* will be set to what would have been the length of *\*out* on successful encoding.

If the caller is not interested in knowing the length of the output data *out*, then *outlen* may be set to NULL.

It is permitted but useless to have both *out* and *outlen* NULL.

**in** : input string with base32 encoded data of length *inlen*

**inlen** : length of input base32 string *in*

**out** : pointer to output variable for binary data of length *outlen*, or NULL

**outlen** : pointer to output variable holding length of *out*, or NULL

**Returns** : On success **OATH\_OK** (zero) is returned, **OATH\_INVALID\_BASE32** is returned if the input contains non-base32 characters, and **OATH\_MALLOC\_ERROR** is returned on memory allocation errors.

Since 1.12.0

**oath\_base32\_encode ()**

```
int                oath_base32_encode                (const char *in,
                                                    size_t inlen,
                                                    char **out,
                                                    size_t *outlen);
```

Encode binary data into a string with base32 data.

The *in* parameter should contain *inlen* bytes of data to encode. The function allocates a new string in *\*out* to hold the encoded data, and sets *\*outlen* to the length of the data. The output string *\*out* is zero-terminated (ASCII NUL), but the NUL is not counted in *\*outlen*.

If *out* is NULL, then *\*outlen* will be set to what would have been the length of *\*out* on successful encoding.

If the caller is not interested in knowing the length of the output data *out*, then *outlen* may be set to NULL.

It is permitted but useless to have both *out* and *outlen* NULL.

**in** : input string with binary data of length *inlen*

**inlen** : length of input data *in*

**out** : pointer to newly allocated output string of length *outlen*, or NULL

**outlen** : pointer to output variable holding length of *out*, or NULL

**Returns** : On success **OATH\_OK** (zero) is returned, **OATH\_BASE32\_OVERFLOW** is returned if the output would be too large to store, and **OATH\_MALLOC\_ERROR** is returned on memory allocation errors.

Since 1.12.0



Validate an OTP according to OATH HOTP algorithm per RFC 4226.

Currently only OTP lengths of 6, 7 or 8 digits are supported. This restrictions may be lifted in future versions, although some limitations are inherent in the protocol.

**secret** : the shared secret string

**secret\_length** : length of *secret*

**start\_moving\_factor** : start counter in OTP stream

**window** : how many OTPs after start counter to test

**otp** : the OTP to validate.

**Returns** : Returns position in OTP window (zero is first position), or **OATH\_INVALID\_OTP** if no OTP was found in OTP window, or an error code.

### oath\_validate\_strcmp\_function ()

```
int (*oath_validate_strcmp_function) (void *handle,
                                     const char *test_otp);
```

Prototype of strcmp-like function that will be called by **oath\_hotp\_validate\_callback()** or **oath\_totp\_validate\_callback()** to validate OTPs.

The function should be similar to strcmp in that it return 0 only on matches. It differs by permitting use of negative return codes as indication of internal failures in the callback. Positive values indicate OTP mismatch.

This callback interface is useful when you cannot compare OTPs directly using normal strcmp, but instead for example only have a hashed OTP. You would then typically pass in the hashed OTP in the *strcmp\_handle* and let your implementation of *oath\_strcmp* hash the test\_otp OTP using the same hash, and then compare the results.

**handle** : caller handle as passed to **oath\_hotp\_validate\_callback()**

**test\_otp** : OTP to match against.

**Returns** : 0 if and only if *test\_otp* is identical to the OTP to be validated. Negative value if an internal failure occurs. Positive value if the test\_otp simply doesn't match.

Since 1.6.0

### oath\_hotp\_validate\_strcmp\_function

```
#define oath_hotp_validate_strcmp_function oath_validate_strcmp_function
```

### oath\_hotp\_validate\_callback ()

```
int oath_hotp_validate_callback (const char *secret,
                                size_t secret_length,
                                uint64_t start_moving_factor,
                                size_t window,
                                unsigned digits,
                                oath_validate_strcmp_function ↔
                                strcmp_otp,
                                void *strcmp_handle);
```

Validate an OTP according to OATH HOTP algorithm per RFC 4226.

Validation is implemented by generating a number of potential OTPs and performing a call to the `strcmp_otp` function, to compare the potential OTP against the given `otp`. It has the following prototype:

```
int (*oath_validate_strcmp_function)(void *handle, const char *test_otp);
```

The function should be similar to `strcmp` in that it return 0 only on matches. It differs by permitting use of negative return codes as indication of internal failures in the callback. Positive values indicate OTP mismatch.

This callback interface is useful when you cannot compare OTPs directly using normal `strcmp`, but instead for example only have a hashed OTP. You would then typically pass in the hashed OTP in the `strcmp_handle` and let your implementation of `strcmp_otp` hash the test\_otp OTP using the same hash, and then compare the results.

Currently only OTP lengths of 6, 7 or 8 digits are supported. This restrictions may be lifted in future versions, although some limitations are inherent in the protocol.

**secret** : the shared secret string

**secret\_length** : length of `secret`

**start\_moving\_factor** : start counter in OTP stream

**window** : how many OTPs after start counter to test

**digits** : number of requested digits in the OTP

**strcmp\_otp** : function pointer to a strcmp-like function.

**strcmp\_handle** : caller handle to be passed on to `strcmp_otp`.

**Returns** : Returns position in OTP window (zero is first position), or **OATH\_INVALID\_OTP** if no OTP was found in OTP window, or an error code.

Since 1.4.0

## OATH\_TOTP\_DEFAULT\_TIME\_STEP\_SIZE

```
#define OATH_TOTP_DEFAULT_TIME_STEP_SIZE~30
```

## OATH\_TOTP\_DEFAULT\_START\_TIME

```
#define OATH_TOTP_DEFAULT_START_TIME ((time_t) 0)
```

## oath\_totp\_generate ()

```
int                oath_totp_generate                (const char *secret,
                                                    size_t secret_length,
                                                    time_t now,
                                                    unsigned time_step_size,
                                                    time_t start_offset,
                                                    unsigned digits,
                                                    char *output_otp);
```

Generate a one-time-password using the time-variant TOTP algorithm described in RFC 6238. The input parameters are taken as time values.

The system parameter `time_step_size` describes how long the time window for each OTP is. The recommended value is 30 seconds, and you can use the value 0 or the symbol **OATH\_TOTP\_DEFAULT\_TIME\_STEP\_SIZE** to indicate this.

The system parameter *start\_offset* denote the Unix time when time steps are started to be counted. The recommended value is 0, to fall back on the Unix epoch) and you can use the symbol **OATH\_TOTP\_DEFAULT\_START\_TIME** to indicate this.

The *output\_otp* buffer must have room for at least *digits* characters, plus one for the terminating NUL.

Currently only values 6, 7 and 8 for *digits* are supported. This restriction may be lifted in future versions.

**secret** : the shared secret string

**secret\_length** : length of *secret*

**now** : Unix time value to compute TOTP for

**time\_step\_size** : time step system parameter (typically 30)

**start\_offset** : Unix time of when to start counting time steps (typically 0)

**digits** : number of requested digits in the OTP, excluding checksum

**output\_otp** : output buffer, must have room for the output OTP plus zero

**Returns** : On success, **OATH\_OK** (zero) is returned, otherwise an error code is returned.

Since 1.4.0

#### **oath\_totp\_validate ()**

```
int                oath_totp_validate      (const char *secret,
                                           size_t secret_length,
                                           time_t now,
                                           unsigned time_step_size,
                                           time_t start_offset,
                                           size_t window,
                                           const char *otp);
```

Validate an OTP according to OATH TOTP algorithm per RFC 6238.

Currently only OTP lengths of 6, 7 or 8 digits are supported. This restrictions may be lifted in future versions, although some limitations are inherent in the protocol.

**secret** : the shared secret string

**secret\_length** : length of *secret*

**now** : Unix time value to validate TOTP for

**time\_step\_size** : time step system parameter (typically 30)

**start\_offset** : Unix time of when to start counting time steps (typically 0)

**window** : how many OTPs after/before start OTP to test

**otp** : the OTP to validate.

**Returns** : Returns absolute value of position in OTP window (zero is first position), or **OATH\_INVALID\_OTP** if no OTP was found in OTP window, or an error code.

Since 1.6.0



Validate an OTP according to OATH TOTP algorithm per RFC 6238.

Currently only OTP lengths of 6, 7 or 8 digits are supported. This restrictions may be lifted in future versions, although some limitations are inherent in the protocol.

**secret** : the shared secret string

**secret\_length** : length of *secret*

**now** : Unix time value to validate TOTP for

**time\_step\_size** : time step system parameter (typically 30)

**start\_offset** : Unix time of when to start counting time steps (typically 0)

**window** : how many OTPs after/before start OTP to test

**otp\_pos** : output search position in search window (may be NULL).

**otp** : the OTP to validate.

**Returns** : Returns absolute value of position in OTP window (zero is first position), or **OATH\_INVALID\_OTP** if no OTP was found in OTP window, or an error code.

Since 1.10.0

#### **oath\_totp\_validate2\_callback ()**

```
int                oath_totp_validate2_callback      (const char *secret,
                                                    size_t secret_length,
                                                    time_t now,
                                                    unsigned time_step_size,
                                                    time_t start_offset,
                                                    unsigned digits,
                                                    size_t window,
                                                    int *otp_pos,
                                                    oath_validate_strcmp_function ↔
                                                    strcmp_otp,
                                                    void *strcmp_handle);
```

Validate an OTP according to OATH TOTP algorithm per RFC 6238.

Validation is implemented by generating a number of potential OTPs and performing a call to the *strcmp\_otp* function, to compare the potential OTP against the given *otp*. It has the following prototype:

```
int (*oath_validate_strcmp_function) (void *handle, const char *test_otp);
```

The function should be similar to *strcmp* in that it return 0 only on matches. It differs by permitting use of negative return codes as indication of internal failures in the callback. Positive values indicate OTP mismatch.

This callback interface is useful when you cannot compare OTPs directly using normal *strcmp*, but instead for example only have a hashed OTP. You would then typically pass in the hashed OTP in the *strcmp\_handle* and let your implementation of *strcmp\_otp* hash the test\_otp OTP using the same hash, and then compare the results.

Currently only OTP lengths of 6, 7 or 8 digits are supported. This restrictions may be lifted in future versions, although some limitations are inherent in the protocol.

**secret** : the shared secret string

**secret\_length** : length of *secret*

**now** : Unix time value to compute TOTP for



**time\_step\_size**: time step system parameter (typically 30)

**start\_offset**: Unix time of when to start counting time steps (typically 0)

**digits**: number of requested digits in the OTP

**window**: how many OTPs after start counter to test

**otp\_pos**: output search position in search window (may be NULL).

**strcmp\_otp**: function pointer to a strcmp-like function.

**strcmp\_handle**: caller handle to be passed on to `strcmp_otp`.

**Returns**: Returns absolute value of position in OTP window (zero is first position), or **OATH\_INVALID\_OTP** if no OTP was found in OTP window, or an error code.

Since 1.10.0

### **oath\_authenticate\_usersfile ()**

```
int                oath_authenticate_usersfile    (const char *usersfile,
                                                    const char *username,
                                                    const char *otp,
                                                    size_t window,
                                                    const char *passwd,
                                                    time_t *last_otp);
```

Authenticate user named *username* with the one-time password *otp* and (optional) password *passwd*. Credentials are read (and updated) from a text file named *usersfile*.

Note that for TOTP the usersfile will only record the last OTP and use that to make sure more recent OTPs have not been seen yet when validating a new OTP. That logics relies on using the same search window for the same user.

**usersfile**: string with user credential filename, in UsersFile format

**username**: string with name of user

**otp**: string with one-time password to authenticate

**window**: how many past/future OTPs to search

**passwd**: string with password, or NULL to disable password checking

**last\_otp**: output variable holding last successful authentication

**Returns**: On successful validation, **OATH\_OK** is returned. If the supplied *otp* is the same as the last successfully authenticated one-time password, **OATH\_REPLAYED\_OTP** is returned and the timestamp of the last authentication is returned in *last\_otp*. If the one-time password is not found in the indicated search window, **OATH\_INVALID\_OTP** is returned. Otherwise, an error code is returned.

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