The ‘KSBA’ Reference Manual
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1 Introduction

KSBA is a library to make the task of working with X.509 certificates, CMS data and related data more easy.

1.1 Getting Started

This manual documents the ‘KSBA’ library programming interface. All functions and data types provided by the library are explained.

The reader is assumed to possess basic knowledge about the implemented protocols.

This manual can be used in several ways. If read from the beginning to the end, it gives a good introduction into the library and how it can be used in an application. Forward references are included where necessary. Later on, the manual can be used as a reference manual to get just the information needed about any particular interface of the library. Experienced programmers might want to start looking at the examples at the end of the manual, and then only read up those parts of the interface which are unclear.

1.2 Features

‘KSBA’ has a couple of advantages over other libraries doing a similar job, and over open coding the protocols in your application directly.

It’s Free Software

Anybody can use, modify, and redistribute it under the terms of the GNU General Public License (see [Copying], page 20).

It hides the low level stuff

‘KSBA’ a high level interface to the implemented protocols and presents the data in a consistent way. There is no more need to worry about all the nasty details of the protocols. The API gives the C programmer a more usual way of interacting with the data.

It copes with the version details

X.509 protocols tend to have many different versions and dialects. Applications must usually cope with all of this and it has to be coded over and over again. ‘KSBA’ hides this by providing just one API which does the Right Thing. Support for new versions and features of the protocols will be added over time.

1.3 Overview

The ‘KSBA’ library is thread-safe as long as objects described by one context are only used by one thread at a time. No initialization is required.
2 Preparation

To use ‘KSBA’, you have to perform some changes to your sources and the build system. The necessary changes are small and explained in the following sections. At the end of this chapter, it is described how the library is initialized, and how the requirements of the library are verified.

2.1 Header

All interfaces (data types and functions) of the library are defined in the header file ‘ksba.h’. You must include this in all programs using the library, either directly or through some other header file, like this:

```
#include <ksba.h>
```

The name space of ‘KSBA’ is `ksba_*` for function names, `ksba*` for data types and `KSBA_*` for other symbols. In addition the same name prefixes with one prepended underscore are reserved for internal use and should never be used by an application.

2.2 Version Check

It is often desirable to check that the version of ‘KSBA’ used is indeed one which fits all requirements. Even with binary compatibility, new features may have been introduced but through peculiarities of the runtime linker an old version gets actually used. So you better check that the version is as expected right after program startup.

```
const char * ksba_check_version (const char * req_version) [Function]
```

Check that the 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. It is a pretty good idea to run this function as soon as possible, because it may also initializes some subsystems. In a multi-threaded environment if should be called before any more threads are created.

2.3 Building the source

If you want to compile a source file including the ‘ksba.h’ header file, you must make sure that the compiler can find it in the directory hierarchy. This is accomplished by adding the path to the directory in which the header file is located to the compiler’s include file search path (via the ‘-I’ option).

However, the path to the include file is determined at the time the source is configured. To solve this problem, ‘KSBA’ ships with a small helper program `ksba-config` that knows about the path to the include file and other configuration options. The options that need to be added to the compiler invocation at compile time are output by the ‘--cflags’ option of `ksba-config`. The following example shows how it can be used at the command line:

```
gcc -c foo.c `ksba-config --cflags`
```

Adding the output of `ksba-config --cflags` to the compiler’s command line will ensure that the compiler can find the ‘ksba.h’ header file.

A similar problem occurs when linking the program with the library. Again, the compiler has to find the library files. For this to work, the path to the library files has to be added to
the library search path (via the ‘-L’ option). For this, the option ‘--libs’ of \texttt{ksba-config} can be used. For convenience, this option also outputs all other options that are required to link the program with the ‘KSBA’ libraries (in particular, the ‘-lksba’ option). The example shows how to link ‘foo.o’ with the ‘KSBA’ libraries to a program \texttt{foo}.

\begin{verbatim}
gcc -o foo foo.o 'ksba-config --libs'
\end{verbatim}

Of course you can also combine both examples to a single command by specifying both options to \texttt{ksba-config}:

\begin{verbatim}
gcc -o foo foo.c 'ksba-config --cflags --libs'
\end{verbatim}
Chapter 3: How to work with X.509 certificates.

One of the most complex data formats are the X.509 certificates. KSBA provides an easy to use interface to handle them.

ksba_cert_t
The ksba_cert_t type is a handle for an X.509 certificate.

ksba_sexp_t
The ksba_sexp_t type describes a canonically encoded S-expression stored in a memory buffer. It is alias for unsigned char *. Note that a length argument is not required because the length of such an S-expression is intrinsically available.

3.1 How to create a certificate object
This section explains how to create a certificate object, initialize it, copy it and eventually destroy it.

ksba_cert_t ksba_cert_new (void)
The function ksba_cert_new creates a new certificate object and returns a handle for it. The certificate object has initially one reference.

The only reason why this function may fail is an out-of-memory condition in which case NULL is returned. You might then get the actual error code using ‘gpg_error_from_errno (errno)’.

void ksba_cert_ref (ksba_cert_t cert)
The function ksba_cert_ref bumps the reference counter of the certificate object up by one. Thus an extra ksba_cert_release is required to actually release the memory used for the object.

void ksba_cert_release (ksba_cert_t cert)
The function ksba_cert_release reduces the number of references to the certificate object with the handle cert. If this was the last reference, it will also destroy the object and releases all associated resources. It is okay to pass NULL to the function in which case nothing happens.

gpg_error_t ksba_cert_read_der (ksba_cert_t cert, ksba_reader_t reader)
Read the next certificate from the reader object and store it in the certificate object cert for future access. The certificate is parsed and rejected if it has any syntactical or semantical error (i.e. does not match the ASN.1 description).

The function returns 0 if the operation was successfully performed. An error code is returned on failure.

gpg_error_t ksba_cert_init_from_mem (ksba_cert_t cert, const void *buffer, size_t length)
Parse the buffer which should contain a DER encoded certificate of length and initialize the certificate object cert with it. This function is intended as a convenience function to be used when a certificate is already available in a internal memory buffer.
This avoids the extra code needed to setup the reader object. Note that cert must be a valid certificate object.

The function returns 0 if the operation was successfully performed. An error code is returned on failure.

### 3.2 How to get the attributes of a certificate

The functions in this section allow accessing the attributes of a certificate in a well defined manner. An error will be returned if the certificate object has not yet been initialized by means of ksba_cert_read_der or ksba_cert_init_from_mem.

```c
const unsigned char * ksba_cert_get_image (ksba_cert_t cert, size_t *r_length)
```

This function returns a pointer to the DER encoded buffer with the raw certificate. The length of that buffer gets stored at r_length. This function is useful to export or store the raw certificate.

The function returns NULL on error or a pointer to a buffer with the raw certificate data. That pointer is only valid as long as the certificate object cert is valid and has not been reinitialized.

```c
gpg_error_t ksba_cert_hash (ksba_cert_t cert, int what, void (*hasher)(void *, const void *, size_t length), void *hasher_arg)
```

This function feeds the data which is expected to be hashed into the supplied function hasher, where the first argument passed is hasher_arg, the second the pointer to the data to be hashed and the third the length of this data.

The function returns 0 on success or an error code when something goes wrong. The hasher function is not expected to return an error; instead the caller should setup that function in a way to convey encountered errors by means of the hasher_arg. Note that a hash function is in general not expected to yield errors anyway.

```c
const char * ksba_cert_get_digest_algo (ksba_cert_t cert)  
```

Figure out the the digest algorithm used for the signature and return its OID in dotted decimal format. This function is most likely used to setup the hash context before calling ksba_cert_hash.

The function returns NULL for an error; on success a constant string with the OID is returned. This string is valid as long the certificate object is valid.

```c
ksba_sexp_t ksba_cert_get_serial (ksba_cert_t cert)
```

The function returns the serial number of the certificate cert. The serial number is an integer returned as a canonical encoded S-expression with just one element. The caller must free the returned value. The value NULL is returned in case of error.

```c
char * ksba_cert_get_issuer (ksba_cert_t cert, int idx)
```

With idx given as 0, this function returns the Distinguished Name (DN) of the certificate issuer; this usually is the name of a certification authority (CA). The format of the returned string is in accordance with RFC-2253. NULL is returned if the DN is not available; This is a severe error and actually should have been caught by the certificate reading function.
With $idx$ greater than zero, the function may be used to enumerate alternate issuer names. The function returns NULL when there are no more alternate names. Only alternate names recognized by libksba are returned, others are simply skipped. The format of the returned name is either a RFC-2253 formated string which can be detected by checking whether the first character is a letter or digit. RFC-822 conformant email addresses are returned enclosed in angle brackets; the opening angle bracket should be used to detect this. Other formats are returned as an S-Expression in canonical format, so a opening parenthesis should be used to detect this encoding. The name may include binary null characters, thus strlen may return a length shorter than actually used. The real length is implicitly given by the structure of the S-expression, an extra null is appended for safety reasons.

The caller must free the returned string using ksba_free or whatever function has been registered as a replacement.

char * ksba_cert_get_subject (ksba_cert_t cert, int idx)  

With $idx$ given as 0, this function returns the Distinguished Name (DN) of the certificate's subject. The format of the returned string is in accordance with RFC-2253. NULL is returned if the DN is not available.

With $idx$ greater than zero, the function may be used to enumerate alternate subject names. The function returns NULL when there are no more alternate names. Only alternate names recognized by libksba are returned, others are simply skipped. The format of the returned name is either a RFC-2253 formated string which can be detected by checking whether the first character is a letter or digit. RFC-2822 conform email addresses are returned enclosed in angle brackets; the opening angle bracket should be used to detect this. Other formats are returned as an S-Expression in canonical format, so a opening parenthesis should be used to detect this encoding, the name may include binary null characters, thus strlen may return a length shorter than actually used. The real length is implicitly given by the structure of the S-expression, an extra null is appended for safety reasons.

The caller must free the returned string using ksba_free or whatever function has been registered as a replacement.

ksba_isotime_t  

Due to problems with the C data type time_t, which will overflow on most 32 bit machines in the year 2038, it was not advisable to use this type for referencing times stored in certificates. Instead, you should use the ksba_isotime_t type, which can represent any time since the year 0.

It is implemented as a buffer of 16 bytes and may be handled like a standard string. It should be initialized to zero (i.e. the first byte needs to be 0x00) if it does not hold a valid date. Date values themselves are stored in ISO format and assumed to be referenced from UTC. The string with the date value is always guaranteed to be of length 15 and having a format like: ‘"19610711T172059"’. Note that the ‘T’ is required by ISO rules.

A simple assignment of these data types is not a good idea. You may use strcpy or better a specialized function like:
copy_time (ksba_isotime_t d, const ksba_isotime_t s)
{
    if (!*s)
        memset (d, 0, 16);
    else
        strcpy (d, s);
}

For reasons of documentation a special function should also be used to compare such
times:

int
    cmp_time (const ksba_isotime_t a, const ksba_isotime_t b)
{
    return strcmp (a, b);
}

gpg_error_t ksba_cert_get_validity
    (ksba_cert_t cert, int what, ksba_isotime_t timebuf)

Return the validity dates from the certificate. If no value is available an empty date
object (i.e. a strlen will be stored at timebuf, otherwise it will receive the date. On
failure an error code is returned.
To return the ‘notBefore’ date, the value 0 must be supplied for what; 1 yields the
‘notAfter’ value.

ksba_sexp_t ksba_cert_get_public_key (ksba_cert_t cert)
    [This needs to get written - for now please see libksba/src/cert.c]

ksba_sexp_t ksba_cert_get_sig_val (ksba_cert_t cert)
    [This needs to get written - for now please see libksba/src/cert.c]

gpg_error_t ksba_cert_get_extension
    (ksba_cert_t cert, int idx, char const **r_oid, int *r_crit, size_t *r_deroff, size_t *r_derlen)
    [This needs to get written - for now please see libksba/src/cert.c]

gpg_error_t ksba_cert_is_ca
    (ksba_cert_t cert, int *r_ca, int *r_pathlen)

Return information on the basicConstraint (2.5.19.19) of CERT. R_CA receives true
if this is a CA and only in that case R_PATHLEN is set to the maximum certification
path length or -1 if there is no such limitation

gpg_error_t ksba_cert_get_key_usage
    (ksba_cert_t cert, unsigned int *r_flags)

Get the key usage flags. The function returns GPG_ERR_NO_DATA if no key usage is
specified. The usage flags are as shown in RFC3280, section 4.2.1.3. The key usage
flags are represented by a bitmask, and you can test each bit using symbolic constants,
which tells you if that usage is set on the certificate. The constants are

KSBA_KEYUSAGE_DIGITAL_SIGNATURE
    Usable for digitalSignature.
KSBA_KEYUSAGE_NON_REPUDIATION
Usable for nonRepudiation.

KSBA_KEYUSAGE_KEY_ENCIPHERMENT
Usable for keyEncipherment.

KSBA_KEYUSAGE_DATA_ENCIPHERMENT
Usable for dataEncipherment.

KSBA_KEYUSAGE_KEY_AGREEMENT
Usable for keyAgreement.

KSBA_KEYUSAGE_KEY_CERT_SIGN
Usable for keyCertSign.

KSBA_KEYUSAGE_CRL_SIGN
Usable for cRLSign.

KSBA_KEYUSAGE_ENCIPHER_ONLY
Usable for encipherOnly.

KSBA_KEYUSAGE_DECIPHER_ONLY
Usable for decipherOnly.

These are the basic constraints on usage of a certificate. If you need to get additional
constraints, see ksba_cert_get_ext_key_usages.

```
gpg_error_t ksba_cert_get_ext_key_usages
    (ksba_cert_t cert, char **result)
Return a string containing the extended usages for the certificate, delimited by line-
feeds.
```

```
gpg_error_t ksba_cert_get_cert_policies
    (ksba_cert_t cert, char **r_policies)
Return a string with the certificatePolicies delimited by linefeeds. The return values
may be extended to carry more information per line, so the caller should only use the
first white-space delimited token per line. The function returns GPG_ERR_NO_DATA
when this extension is not used. Caller must free the returned value.
```

```
gpg_error_t ksba_cert_get_crl_dist_point
    (ksba_cert_t cert, int idx, ksba_name_t *r_distpoint, ksba_name_t *r_issuer, unsigned int *)
Return the CRLDistPoints given in the certificate extension of certificate cert. idx
should be iterated starting from 0 until the function returns GPG_ERR_EOF. r_distpoint
returns a ksba_name_t object with the distribution point name(s); the return value
may be NULL to indicate that this name is not available. r_issuer returns the CRL
issuer; if the returned value is NULL the caller should assume that the CRL issuer is
the same as the certificate issuer. r_reason returns the reason for the CRL. This is a
bit encoded value with no bit set if no reason has been specified in the certificate.
The caller may pass NULL to any of the pointer arguments if he is not interested in
this value. The return values for r_distpoint and r_issuer must be released by the
caller using ksba_name_release.
```
Chapter 3: How to work with X.509 certificates.

3.3 How to set certificate attributes

[This needs to be written. For example code see newpg/sm/sign.c]

3.4 How to associate other data with a certificate.

Certificate objects play a central role in many applications and often it is desirable to associate other data with the certificate to avoid wrapping the certificate object into an own object. ‘KSBA’ provides a mechanism for this by means of two functions:

**gpg_error_t ksba_cert_set_user_data**

*(ksba_cert_t cert, const char *key, const void *data, size_t datalen)*

Stores arbitrary data along with a certificate. The data is expected in the buffer `data` of length `datalen`. It will be stored under the string `key`. If data is already stored...
under this key it will be replaced by the new data. Using NULL for data will effectively delete the data.

On error (i.e. out of memory) an already existing data object stored under key may get deleted.

**Caution:** This function is definitely not thread safe because we don’t employ any locking mechanisms.

```c
#include <gpg_error.h>

/* [Function] */
gpg_error_t ksba_cert_get_user_data (ksba_cert_t cert, const char *key, void *buffer, size_t bufferlen, size_t *datalen)

Return user data for certificate cert stored under the string key. The caller needs to provide a suitable large buffer and the usable length of this buffer in bufferlen. If datalen is not NULL, the length of the data stored in buffer will be stored there.

If buffer is given as NULL, bufferlen will be ignored and the required length of the buffer will be returned at datalen.

On success 0 is returned. If no data is stored under the given key, GPG_ERR_NOT_FOUND is returned. If the provided buffer is too short and buffer is not NULL, GPG_ERR_BUFFER_TOO_SHORT will be returned.
```
Chapter 4: Mastering the Cryptographic Message Syntax

4 Mastering the Cryptographic Message Syntax

The CMS is also known under the name PKCS#7. Is is a cryptographic framework for securing data transactions and storage, much like OpenPGP. It is heavily based on X.509 semantics and for example used with the email encryption protocol S/MIME.

4.1 CMS Basics

All operations with the CMS framework require the use of a so called CMS object which is internally used to keep track of the current state and to store some meta information.

ksba_cms_t

The ksba_cms_t type is used for this CMS object.

ksba_stop_reason_t

The ksba_stop_reason_t type is an enumeration used for communication between the phases of a parsing or building process.

ksba_cms_t ksba_cms_new (void)

This function creates a new CMS object. The only reason the function may fail is an out-of-memory condition in which case NULL is returned. It is safe for the caller to translate this to the standard error code GPG_ERR_ENOMEM. Any object created with this function should be released after use by using ksba_cms_release.

void ksba_cms_release (ksba_cms_t cms)

Release all resources associated with the CMS object. It is perfectly okay to pass NULL to this function in which case nothing happens.

gpg_error_t ksba_cms_set_reader_writer

(ksba_cms_t cms, ksba_reader_t r, ksba_writer_t w)

About all usages of the CMS framework require some input and output data (great surprise!). To accomplish this in the most abstract way, no direct output functions are used - instead special reader and writer objects are used instead. Depending on the desired operations either a reader, a writer or both must be given. Associate a reader object with cms by passing it as r and a writer object by passing it as w. Note that no reference counting is done, so make sure that those objects have a lifetime at least as long as CMS.

If you forget to set these objects, you will get an appropriate error later when data is actually to be read or written. The function returns zero on success or an error code when invalid objects are passed.

4.2 CMS Parser

KSBA includes a versatile CMS parser for encryption (enveloped data) and digital signing. The parser is capable of handling arbitrary amounts of data without requiring much memory. Well, certain objects are built in memory because it can be assumed that those objects are limited in size; e.g. it does not make sense to use a video clip as the DN despite the fact that the standard does not forbid it.
Chapter 4: Mastering the Cryptographic Message Syntax

Function

```c
gpg_error_t ksba_cms_parse
    (ksba_cms_t cms, ksba_stop_reason_t *r_stopreason)
```

This is the core function of the parser and commonly used in a loop. The parsing process is divided into several phases to allow the user to get information at the right time and prepare for further processing. The caller has to act on certain stop reasons which are returned by `r_stopreason` and set up things accordingly; KSBA may introduce new stop reasons to let the caller know other details; there is no need for the caller to act on every stop reason; it should only do so for reasons that the caller understands and which are mandatory. The function will return with an error if the caller did not setup things correctly for certain stop reasons.

The use of this function is best explained by an example, leaving out all error checking.

```c
do {
    ksba_cms_parse (cms, &stopreason);
    if (stopreason == KSBA_SR_BEGIN_DATA) {
        get_recipients ();
        decrypt_session_key ();
        setup_bulk_decryption ();
    } else if (stopreason == KSBA_SR_END_DATA) {
        remove_padding ();
    }
} while (stopreason != KSBA_SR_READY);
```

This function assumes that the parsed data is so called ‘enveloped data’.

As CMS provides a common framework for a variety of data formats, it is probably very useful to check the type of that data very early. This can be accomplished by hooking into the stop reason `KSBA_SR_GOT_CONTENT` and retrieving the content using the following function.

Function

```c
ksba_content_t ksba_cms_get_content_type
    (ksba_cms_t cms, int what)
```

By using a value of 0 for `what` this function returns the content type of the outer container; using 1 does return the content type of the enclosed object.

Data type

```c
ksba_content_t
```

The `ksba_content_t` type is an enumeration used to describe the content of a CMS message. Here is a list of possible values:

- `KSBA_CT_NONE`
  - No content type known (value 0)
- `KSBA_CT_DATA`
  - The content is plain data, not further interpreted.
KSBA_CT_SIGNED_DATA
The content is an signed CMS object. This also includes the case of a detached signature where no actual data is included in the message.

KSBA_CT_ENVELOPED_DATA
The content is encrypted using a session key.

KSBA_CT_DIGESTED_DATA
Not yet supported

KSBA_CT_ENCRYPTED_DATA
Not yet supported

KSBA_CT_AUTH_DATA
Not yet supported

const char * ksba_cms_get_content_oid
(const ksba_cms_t cms, int what)

Return the object ID of cms. This is a constant string valid as long as the context is valid and no new parse is started. This function is similar to ksba_cms_get_content_type but returns the OID actually used in the data. Depending on the value of what different values are returned: Using a value of 0 yields the OID of the outer container, a value of 1 yields the OID of the inner container if available and the value 2 returns the OID of the algorithm used to encrypt the inner container.
5 Certification Revocation Lists

KSBA also comes with an API to process certification revocation lists. The API is similar to the CMS one but returns the contents entry by entry.
6 Certification Requests

When using decentral generated keys, it is necessary to send out special formatted messages so that a CA can generate the certificate.
7 Utilities

A few utility function and objects are available. Some of them must be used to support some of the main functions.

7.1 General Names object

This is an object to handle some of the names used in X.509. We need this object approach because those names may come as a set and there is no other clean way to access them.

ksba_name_t

The ksba_name_t type is an object to represent names sets.

void ksba_name_release (ksba_name_t name)

This function releases the object name. Passing NULL is allowed.

const char * ksba_name_enum (ksba_name_t name, int idx)

By iterating idx up starting with 0, this function returns all General Names stored in name. The format of the returned name is either a RFC-2253 formatted one which can be detected by checking whether the first character is letter or a digit. RFC 2822 conformant email addresses are returned enclosed in angle brackets, the opening angle bracket should be used to detect this. Other formats are returned as an S-Expression in canonical format, so an opening parenthesis may be used to detect this encoding, in this case the name may include binary null characters, so strlen might return a length shorter than actually used, the real length is implicitly given by the structure of the S-Exp, an extra null is appended for safety reasons. One common format return is a Universal Resource Identifier which has the S-expression: ‘(uri <urivalue>)’.

The returned string has the same lifetime as name.

char * ksba_name_get_uri (ksba_name_t name, int idx)

Convenience function to return names representing an URI. Caller must free the returned value. Note that this function should not be used to enumerate the names.

Here is an example on how you can use this function to enumerate all URIs:

```c
void
print_names (ksba_name_t name)
{
    int idx;
    const char *s;
    for (idx=0; (s = ksba_name_enum (name, idx)); idx++)
    {
        char *p = ksba_name_get_uri (name, idx);
        if (p)
        {
            puts (p);
            ksba_free (p);
        }
    }
}
```
7.2 Object Identifier helpers
[This needs to get written - for now please see libksba/src/oids.c]

7.3 Distinguished Name helpers
These are helper functions for the so called distinguished names. They are used for example as the issuer and subject name.

```c
#define gpg_error_t
#define ksba
#define dn
#define teststr

[gpg_error_t]
[ksba_dn_teststr] (const char *string, int seq,
size_t *rerroff, size_t *rerrlen)

Assuming that string contains an RFC-2253 encoded string, test whether this string may be passed as a valid DN to libksba. On success the function returns 0. On error the function returns an error code and stores the offset of the erroneous part at rerroff. rerrlen will then receive the length of the erroneous part.

This function is mostly useful to test whether a certain component label is supported. seq should be passed as 0 for now. Any of rerroff and rerrlen may be passed as NULL if the caller is not interested at this value.

```c
gpg_error_t ksba_dn_str2der (const char *string, void **rder, size_t *rderlen);
gpg_error_t ksba_dn_der2str (const void *der, size_t derlen, char **r_string);
```
Chapter 8: Error Handling

8 Error Handling

Most functions in ‘KSBA’ will return an error if they fail. For this reason, the application should always catch the error condition and take appropriate measures, for example by releasing the resources and passing the error up to the caller, or by displaying a descriptive message to the user and canceling the operation.

Some error values do not indicate a system error or an error in the operation, but the reasonable result of an operation. For example, if you try to access optional attributes of a certificate that are not present, you get an appropriate error message. Some error values have specific meanings if returned by a specific function. Such cases are described in the documentation of those functions.

All error codes are defined by the library libgpg-error. See there for ways to check the error values and print descriptive strings. Please be aware that you can’t check directly against an error code but have to do it like this:

```c
err = ksba_foo ();
if (gpg_err_code (err) == GPG_ERR_EOF)
    okay = 1;
```

The only exception is that success (i.e. no error) is defined to be 0; thus you may directly test for success like:

```c
if (!ksba_foo ())
    okay = 1;
```
RFC-2253 defines the following table with string representations of name components:

<table>
<thead>
<tr>
<th>Label</th>
<th>Component</th>
<th>OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>countryName</td>
<td>2.5.4.6</td>
</tr>
<tr>
<td>CN</td>
<td>commonName</td>
<td>2.5.4.3</td>
</tr>
<tr>
<td>DC</td>
<td>domainComponent</td>
<td>0.9.2342.19200300.100.1.25</td>
</tr>
<tr>
<td>L</td>
<td>localityName</td>
<td>2.5.4.7</td>
</tr>
<tr>
<td>O</td>
<td>organizationName</td>
<td>2.5.4.10</td>
</tr>
<tr>
<td>OU</td>
<td>organizationalUnit</td>
<td>2.5.4.11</td>
</tr>
<tr>
<td>ST</td>
<td>stateOrProvince</td>
<td>2.5.4.8</td>
</tr>
<tr>
<td>STREET</td>
<td>streetAddress</td>
<td>2.5.4.9</td>
</tr>
<tr>
<td>UID</td>
<td>userid</td>
<td>0.9.2342.19200300.100.1.1</td>
</tr>
</tbody>
</table>

They are used internally for converting a DN into its string representation; components not listed in this table will be represented by their OID.

For the other direction, i.e. creating a DN from the string representation, KSBA recognizes the following extra labels:

<table>
<thead>
<tr>
<th>Label</th>
<th>Component</th>
<th>OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDR</td>
<td>postalAddress</td>
<td>2.5.4.16</td>
</tr>
<tr>
<td>BC</td>
<td>businessCategory</td>
<td>2.5.4.15</td>
</tr>
<tr>
<td>D</td>
<td>description</td>
<td>2.5.4.13</td>
</tr>
<tr>
<td>EMAIL</td>
<td>emailAddress</td>
<td>1.2.840.113549.1.9.1</td>
</tr>
<tr>
<td>GN</td>
<td>givenName</td>
<td>2.5.4.42</td>
</tr>
<tr>
<td>POSTALCODE</td>
<td>postalCode</td>
<td>2.5.4.17</td>
</tr>
<tr>
<td>PSEUDO</td>
<td>pseudonym</td>
<td>2.5.4.65</td>
</tr>
<tr>
<td>SERIALNUMBER</td>
<td>serialNumber</td>
<td>2.5.4.5</td>
</tr>
<tr>
<td>SN</td>
<td>surname</td>
<td>2.5.4.4</td>
</tr>
<tr>
<td>T</td>
<td>title</td>
<td>2.5.4.12</td>
</tr>
</tbody>
</table>
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Version 3, 29 June 2007


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