

# Libtasn1

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Abstract Syntax Notation One (ASN.1) library for the GNU system  
for version 4.19.0, 18 August 2022

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This manual is for GNU Libtasn1 (version 4.19.0, 18 August 2022), which is a library for Abstract Syntax Notation One (ASN.1) and Distinguished Encoding Rules (DER) manipulation.

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# 1 Introduction

This document describes the Libtasn1 library that provides Abstract Syntax Notation One (ASN.1, as specified by the X.680 ITU-T recommendation) parsing and structures management, and Distinguished Encoding Rules (DER, as per X.690) encoding and decoding functions.

The main features of this library are:

- On-line ASN.1 structure management that doesn't require any C code file generation.
- Off-line ASN.1 structure management with C code file generation containing an array.
- Distinguished Encoding Rules (DER) encoding support.
- No limits for INTEGER and ENUMERATED values.
- It's Free Software. Anybody can use, modify, and redistribute the library under the terms of the GNU Lesser General Public License version 2.1 or later. The command line tools, self-tests and build infrastructure are licensed under the GNU General Public License version 3.0 or later.
- Thread-safety. No global variables are used and multiple library handles and session handles may be used in parallel.
- Portability. The code should work on all Unix like operating systems, and Windows. The library itself should be portable to any C89 system, not even POSIX is required.

## 2 ASN.1 structure handling

### 2.1 ASN.1 syntax

The parser is case sensitive. The comments begin with `--` and end either with another `--`, or at the end of the respective line, whichever comes first. The C-style `/*, */` comments are not supported.

For an example of the syntax, check the `pkix.asn` file distributed with the library.

ASN.1 definitions must follow the syntax below:

```
definitions_name {<object definition>}

DEFINITIONS <EXPLICIT or IMPLICIT> TAGS ::=

BEGIN

<type and constants definitions>

END
```

The `::=` token must be separate from other elements, so the following declaration is invalid:

```
-- INCORRECT
Version ::=INTEGER
```

The correct form is:

```
Version ::= INTEGER
```

Here is the list of types that the parser can manage:

- INTEGER;
- ENUMERATED;
- BOOLEAN;
- OBJECT IDENTIFIER;
- NULL;
- BIT STRING;
- OCTET STRING;
- UTCTime;
- GeneralizedTime;
- GeneralString;
- NumericString;
- IA5String;
- TeletexString;
- PrintableString;
- UniversalString;
- BMPString;

- UTF8String;
- VisibleString;
- SEQUENCE;
- SEQUENCE OF;
- SET;
- SET OF;
- CHOICE;
- ANY;
- ANY DEFINED BY.

This version doesn't handle the `REAL` type. It doesn't support the `AUTOMATIC TAGS` option, and the `EXPORT` and `IMPORT` sections, either.

The `SIZE` constraints are allowed, but no check is done on them.

## 2.2 Naming

Consider this definition:

```
Example { 1 2 3 4 }

DEFINITIONS EXPLICIT TAGS ::=

BEGIN

Group ::= SEQUENCE {
    id    OBJECT IDENTIFIER,
    value Value
}

Value ::= SEQUENCE {
    value1 INTEGER,
    value2 BOOLEAN
}

END
```

The notation to access the `'Group'` type of the `'Example'` definition above is `'Example.Group'` (as a NUL-terminated string.) Such strings are used in the functions described below.

Others examples:

- field `'id'` of the `'Group'` type: `'Example.Group.id'`;
- field `'value1'` of the `'value'` field of the `'Group'` type: `'Example.Group.value.value1'`.

Elements of structured types unnamed by the respective definition receive the names `?1`, `?2`, and so on.

The `?LAST` name indicates the last element of a `SET OF` or `SEQUENCE OF`.

## 2.3 Simple parsing

For simple types like OCTET STRING the simple parsing functions listed below may be used instead.

- [asn1\_decode\_simple\_der], page 22,
- [asn1\_encode\_simple\_der], page 16,

## 2.4 Library Notes

The header file of this library is `libtasn1.h`.

The main type used in it is `asn1_node`, and it's used to store the ASN.1 definitions and structures (instances).

The NULL constant can be used for the variable initialization. For example:

```
asn1_node definitions = NULL;
```

Some functions require an `errorDescription` argument of type `char *`, pointing to a pre-allocated buffer of at least `ASN1_MAX_ERROR_DESCRIPTION_SIZE` bytes size (e.g., as in `'char description[ASN1_MAX_ERROR_DESCRIPTION_SIZE];'`).

`ASN1_MAX_NAME_SIZE` is the maximum number of characters allowed for an ASN.1 identifier.

## 2.5 Future developments

- Add functions for a C code file generation containing equivalent data structures (not a single array like now).
- The REAL type.

## 3 Utilities

### 3.1 Invoking asn1Parser

asn1Parser reads a single file with ASN.1 definitions and generates a file with an array to use with libtasn1 functions.

Usage: `asn1Parser [OPTION] FILE`

Read `FILE` with ASN.1 definitions and generate a C array that is used with libtasn1 functions.

Mandatory arguments to long options are mandatory for short options too.

<code>-c, --check</code>	checks the syntax only
<code>-o, --output=FILE</code>	output file
<code>-n, --name=NAME</code>	array name
<code>-h, --help</code>	display this help and exit
<code>-v, --version</code>	output version information and exit

Report bugs to: `help-libtasn1@gnu.org`

GNU Libtasn1 home page: `<https://www.gnu.org/software/libtasn1/>`

General help using GNU software: `<https://www.gnu.org/gethelp/>`

### 3.2 Invoking asn1Coding

asn1Coding generates a DER encoding from a file with ASN.1 definitions and another one with assignments.

The file with assignments must have this syntax:

`InstanceName Asn1Definition`

`nameString value`

`nameString value`

...

To specify the field of a CHOICE to be used, specify its name as a value to the CHOICE element itself. Use `''` to denote the root element itself. (as in the example below.)

The output file is a binary file with the DER encoding.

Usage: `asn1Coding [OPTION] DEFINITIONS ASSIGNMENTS`

Generates a DER encoding of ASN.1 DEFINITIONS file and ASSIGNMENTS file with value assignments.

Mandatory arguments to long options are mandatory for short options too.

<code>-c, --check</code>	checks the syntax only
<code>-o, --output=FILE</code>	output file
<code>-h, --help</code>	display this help and exit
<code>-v, --version</code>	output version information and exit



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 General help using GNU software: [<https://www.gnu.org/gethelp/>](https://www.gnu.org/gethelp/)

For example, consider an ASN.1 definitions file as follows:

```

MYPKIX1 { }

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

OtherStruct := SEQUENCE {
    x      INTEGER,
    y      CHOICE {
        y1 INTEGER,
        y2 OCTET STRING },
}

Dss-Sig-Value ::= SEQUENCE {
    r      INTEGER,
    s      INTEGER,
    other  OtherStruct
    z      INTEGER OPTIONAL,
}

END

```

And a assignments file as follows:

```

dp MYPKIX1.Dss-Sig-Value

r 42
s 47
other.x 66
other.y y1
other.y.y1 15
z (NULL)

```

Running the command below will generate a `assign.out` file, containing the DER encoding of `PKIX1.Dss-Sig-Value`.

```
$ asn1Coding pkix.asn assign.asn1
```

If the root element is of the CHOICE type, the assignment file may be like (using the types defined in `pkix.asn`):

```

elt PKIX1Implicit88.GeneralName

''      dNSName
dNSName example.org

```

### 3.3 Invoking asn1Decoding

`asn1Decoding` generates an ASN.1 structure from a file with ASN.1 definitions and a binary file with a DER encoding.

Usage: `asn1Decoding` [OPTION] DEFINITIONS ENCODED ASN1TYPE  
Decodes DER data in ENCODED file, for the ASN1TYPE element  
described in ASN.1 DEFINITIONS file, and print decoded structures.

<code>-b, --benchmark</code>	perform a benchmark on decoding
<code>-s, --strict</code>	use strict DER decoding
<code>-t, --no-time-strict</code>	use strict DER decoding but not in time fields
<code>-h, --help</code>	display this help and exit
<code>-v, --version</code>	output version information and exit

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For example, after generating the `assign.out` file from the example section of the `asn1Coding` command above, the following invocation will decode the DER data.

```
$ asn1Decoding pkix.asn assign.out PKIX1.Dss-Sig-Value
```

## 4 Function reference

### 4.1 ASN.1 schema functions

#### asn1\_parser2tree

`int asn1_parser2tree (const char * file, asn1_node * definitions, char * error_desc)` [Function]

*file*: specify the path and the name of file that contains ASN.1 declarations.

*definitions*: return the pointer to the structure created from "file" ASN.1 declarations.

*error\_desc*: return the error description or an empty string if success.

Function used to start the parse algorithm. Creates the structures needed to manage the definitions included in *file* file.

**Returns:** ASN1\_SUCCESS if the file has a correct syntax and every identifier is known, ASN1\_ELEMENT\_NOT\_EMPTY if *definitions* not NULL , ASN1\_FILE\_NOT\_FOUND if an error occurred while opening *file* , ASN1\_SYNTAX\_ERROR if the syntax is not correct, ASN1\_IDENTIFIER\_NOT\_FOUND if in the file there is an identifier that is not defined, ASN1\_NAME\_TOO\_LONG if in the file there is an identifier with more than ASN1\_MAX\_NAME\_SIZE characters.

#### asn1\_parser2array

`int asn1_parser2array (const char * inputFileName, const char * outputFileName, const char * vectorName, char * error_desc)` [Function]

*inputFileName*: specify the path and the name of file that contains ASN.1 declarations.

*outputFileName*: specify the path and the name of file that will contain the C vector definition.

*vectorName*: specify the name of the C vector.

*error\_desc*: return the error description or an empty string if success.

Function that generates a C structure from an ASN1 file. Creates a file containing a C vector to use to manage the definitions included in *inputFileName* file. If *inputFileName* is "/aa/bb/xx.yy" and *outputFileName* is NULL , the file created is "/aa/bb/xx.asn1\_tab.c". If *vectorName* is NULL the vector name will be "xx.asn1\_tab".

**Returns:** ASN1\_SUCCESS if the file has a correct syntax and every identifier is known, ASN1\_FILE\_NOT\_FOUND if an error occurred while opening *inputFileName* , ASN1\_SYNTAX\_ERROR if the syntax is not correct, ASN1\_IDENTIFIER\_NOT\_FOUND if in the file there is an identifier that is not defined, ASN1\_NAME\_TOO\_LONG if in the file there is an identifier with more than ASN1\_MAX\_NAME\_SIZE characters.

### 4.2 ASN.1 field functions

**asn1\_array2tree**

**int** **asn1\_array2tree** (*const* *asn1\_static\_node* \* **array**, *asn1\_node* \* **definitions**, *char* \* **errorDescription**) [Function]

**array**: specify the array that contains ASN.1 declarations

**definitions**: return the pointer to the structure created by \*ARRAY ASN.1 declarations

**errorDescription**: return the error description.

Creates the structures needed to manage the ASN.1 definitions. **array** is a vector created by **asn1\_parser2array()** .

**Returns:** ASN1\_SUCCESS if structure was created correctly, ASN1\_ELEMENT\_NOT\_EMPTY if \* **definitions** not NULL, ASN1\_IDENTIFIER\_NOT\_FOUND if in the file there is an identifier that is not defined (see **errorDescription** for more information), ASN1\_ARRAY\_ERROR if the array pointed by **array** is wrong.

**asn1\_delete\_structure**

**int** **asn1\_delete\_structure** (*asn1\_node* \* **structure**) [Function]

**structure**: pointer to the structure that you want to delete.

Deletes the structure \* **structure** . At the end, \* **structure** is set to NULL.

**Returns:** ASN1\_SUCCESS if successful, ASN1\_ELEMENT\_NOT\_FOUND if \* **structure** was NULL.

**asn1\_delete\_structure2**

**int** **asn1\_delete\_structure2** (*asn1\_node* \* **structure**, *unsigned int* **flags**) [Function]

**structure**: pointer to the structure that you want to delete.

**flags**: additional flags (see ASN1\_DELETE\_FLAG\_ZEROIZE )

Deletes the structure \* **structure** . At the end, \* **structure** is set to NULL.

**Returns:** ASN1\_SUCCESS if successful, ASN1\_ELEMENT\_NOT\_FOUND if \* **structure** was NULL.

**asn1\_delete\_element**

**int** **asn1\_delete\_element** (*asn1\_node* **structure**, *const char* \* **element\_name**) [Function]

**structure**: pointer to the structure that contains the element you want to delete.

**element\_name**: element's name you want to delete.

Deletes the element named \* **element\_name** inside \* **structure** .

**Returns:** ASN1\_SUCCESS if successful, ASN1\_ELEMENT\_NOT\_FOUND if the **element\_name** was not found.

### asn1\_create\_element

**int** `asn1_create_element` (*asn1\_node\_const definitions*, *const char \* source\_name*, *asn1\_node \* element*) [Function]

*definitions*: pointer to the structure returned by "parser\_asn1" function

*source\_name*: the name of the type of the new structure (must be inside p\_structure).

*element*: pointer to the structure created.

Creates a structure of type `source_name` . Example using "pkix.asn":

```
rc = asn1_create_element(cert_def, "PKIX1.Certificate", certptr);
```

**Returns:** ASN1\_SUCCESS if creation OK, ASN1\_ELEMENT\_NOT\_FOUND if `source_name` is not known.

### asn1\_print\_structure

**void** `asn1_print_structure` (*FILE \* out*, *asn1\_node\_const structure*, *const char \* name*, *int mode*) [Function]

*out*: pointer to the output file (e.g. stdout).

*structure*: pointer to the structure that you want to visit.

*name*: an element of the structure

*mode*: specify how much of the structure to print, can be ASN1\_PRINT\_NAME , ASN1\_PRINT\_NAME\_TYPE , ASN1\_PRINT\_NAME\_TYPE\_VALUE , or ASN1\_PRINT\_ALL .

Prints on the `out` file descriptor the structure's tree starting from the `name` element inside the structure `structure` .

### asn1\_number\_of\_elements

**int** `asn1_number_of_elements` (*asn1\_node\_const element*, *const char \* name*, *int \* num*) [Function]

*element*: pointer to the root of an ASN1 structure.

*name*: the name of a sub-structure of ROOT.

*num*: pointer to an integer where the result will be stored

Counts the number of elements of a sub-structure called NAME with names equal to "?1", "?2", ...

**Returns:** ASN1\_SUCCESS if successful, ASN1\_ELEMENT\_NOT\_FOUND if `name` is not known, ASN1\_GENERIC\_ERROR if pointer `num` is NULL .

### asn1\_find\_structure\_from\_oid

**const char \*** `asn1_find_structure_from_oid` (*asn1\_node\_const definitions*, *const char \* oidValue*) [Function]

*definitions*: ASN1 definitions

*oidValue*: value of the OID to search (e.g. "1.2.3.4").

Search the structure that is defined just after an OID definition.

**Returns:** NULL when `oidValue` not found, otherwise the pointer to a constant string that contains the element name defined just after the OID.

**asn1\_copy\_node**

```
int asn1_copy_node (asn1_node dst, const char * dst_name,          [Function]
                   asn1_node_const src, const char * src_name)
```

*dst*: Destination asn1 node.

*dst\_name*: Field name in destination node.

*src*: Source asn1 node.

*src\_name*: Field name in source node.

Create a deep copy of a `asn1_node` variable. That function requires `dst` to be expanded using `asn1_create_element()`.

**Returns:** Return `ASN1_SUCCESS` on success.

**asn1\_dup\_node**

```
asn1_node asn1_dup_node (asn1_node_const src, const char *      [Function]
                        src_name)
```

*src*: Source asn1 node.

*src\_name*: Field name in source node.

Create a deep copy of a `asn1_node` variable. This function will return an exact copy of the provided structure.

**Returns:** Return `NULL` on failure.

**asn1\_write\_value**

```
int asn1_write_value (asn1_node node_root, const char * name,    [Function]
                     const void * ivalue, int len)
```

*node\_root*: pointer to a structure

*name*: the name of the element inside the structure that you want to set.

*ivalue*: vector used to specify the value to set. If `len` is `>0`, `VALUE` must be a two's complement form integer. if `len=0` `*VALUE` must be a null terminated string with an integer value.

*len*: number of bytes of `*value` to use to set the value: `value[0]..value[len-1]` or 0 if value is a null terminated string

Set the value of one element inside a structure.

If an element is `OPTIONAL` and you want to delete it, you must use the `value=NULL` and `len=0`. Using "pkix.asn":

```
result=asn1_write_value(cert, "tbsCertificate.issuerUniqueID", NULL, 0);
```

Description for each type:

**INTEGER:** `VALUE` must contain a two's complement form integer.

`value[0]=0xFF` , `len=1` -> `integer=-1`. `value[0]=0xFF` `value[1]=0xFF` , `len=2` -> `integer=-1`. `value[0]=0x01` , `len=1` -> `integer= 1`. `value[0]=0x00` `value[1]=0x01` , `len=2` -> `integer= 1`. `value="123"` , `len=0` -> `integer= 123`.

**ENUMERATED:** As `INTEGER` (but only with not negative numbers).

**BOOLEAN:** VALUE must be the null terminated string "TRUE" or "FALSE" and LEN != 0.

value="TRUE" , len=1 -> boolean=TRUE. value="FALSE" , len=1 -> boolean=FALSE.

**OBJECT IDENTIFIER:** VALUE must be a null terminated string with each number separated by a dot (e.g. "1.2.3.543.1"). LEN != 0.

value="1 2 840 10040 4 3" , len=1 -> OID=dsa-with-sha.

**UTCTime:** VALUE must be a null terminated string in one of these formats: "YYMMDDhhmmssZ", "YYMMDDhhmmssZ", "YYMMDDhhmmss+hh'mm'", "YYMMDDhhmmss-hh'mm'", "YYMMDDhhmm+hh'mm'", or "YYMMDDhhmm-hh'mm'". LEN != 0.

value="9801011200Z" , len=1 -> time=January 1st, 1998 at 12h 00m Greenwich Mean Time

**GeneralizedTime:** VALUE must be in one of this format: "YYYYMMDDhhmmss.sZ", "YYYYMMDDhhmmss.sZ", "YYYYMMDDhhmmss.s+hh'mm'", "YYYYMMDDhhmmss.s-hh'mm'", "YYYYMMDDhhmm+hh'mm'", or "YYYYMMDDhhmm-hh'mm'" where ss.s indicates the seconds with any precision like "10.1" or "01.02". LEN != 0

value="2001010112001.12-0700" , len=1 -> time=January 1st, 2001 at 12h 00m 01.12s Pacific Daylight Time

**OCTET STRING:** VALUE contains the octet string and LEN is the number of octets.  
value="\backslash\$x01\backslashbackslash\$x02\backslashbackslash\$x03" , len=3 -> three bytes octet string

**GeneralString:** VALUE contains the generalstring and LEN is the number of octets.  
value="\backslash\$x01\backslashbackslash\$x02\backslashbackslash\$x03" , len=3 -> three bytes generalstring

**BIT STRING:** VALUE contains the bit string organized by bytes and LEN is the number of bits.

value="\backslash\$xCF" , len=6 -> bit string="110011" (six bits)

**CHOICE:** if NAME indicates a choice type, VALUE must specify one of the alternatives with a null terminated string. LEN != 0. Using "pkix.asn":

```
result=asn1_write_value(cert, "certificate1.tbsCertificate.subject", "rdnSequence", 1);
```

**ANY:** VALUE indicates the der encoding of a structure. LEN != 0.

**SEQUENCE OF:** VALUE must be the null terminated string "NEW" and LEN != 0. With this instruction another element is appended in the sequence. The name of this element will be "?1" if it's the first one, "?2" for the second and so on.

Using "pkix.asn":

```
result=asn1_write_value(cert, "certificate1.tbsCertificate.subject.rdnSequence", "NEW", 1);
```

**SET OF:** the same as SEQUENCE OF. Using "pkix.asn":

```
result=asn1_write_value(cert, "tbsCertificate.subject.rdnSequence.?LAST", "NEW", 1);
```

**Returns:** ASN1\_SUCCESS if the value was set, ASN1\_ELEMENT\_NOT\_FOUND if *name* is not a valid element, and ASN1\_VALUE\_NOT\_VALID if *ivalue* has a wrong format.

## asn1\_read\_value

```
int asn1_read_value (asn1_node_const root, const char * name,      [Function]
                    void * ivalue, int * len)
```

*root*: pointer to a structure.

*name*: the name of the element inside a structure that you want to read.

*ivalue*: vector that will contain the element's content, must be a pointer to memory cells already allocated (may be NULL ).

*len*: number of bytes of \*value: value[0]..value[len-1]. Initially holds the sizeof value.

Returns the value of one element inside a structure. If an element is OPTIONAL and this returns ASN1\_ELEMENT\_NOT\_FOUND , it means that this element wasn't present in the der encoding that created the structure. The first element of a SEQUENCE\_OF or SET\_OF is named "?1". The second one "?2" and so on. If the *root* provided is a node to specific sequence element, then the keyword "?CURRENT" is also acceptable and indicates the current sequence element of this node.

Note that there can be valid values with length zero. In these case this function will succeed and *len* will be zero.

**INTEGER:** VALUE will contain a two's complement form integer.

integer=-1 -> value[0]=0xFF , len=1. integer=1 -> value[0]=0x01 , len=1.

**ENUMERATED:** As INTEGER (but only with not negative numbers).

**BOOLEAN:** VALUE will be the null terminated string "TRUE" or "FALSE" and LEN=5 or LEN=6.

**OBJECT IDENTIFIER:** VALUE will be a null terminated string with each number separated by a dot (i.e. "1.2.3.543.1").

LEN = strlen(VALUE)+1

**UTCTime:** VALUE will be a null terminated string in one of these formats: "YYMMDDhhmmss+hh'mm'" or "YYMMDDhhmmss-hh'mm'". LEN=strlen(VALUE)+1.

**GeneralizedTime:** VALUE will be a null terminated string in the same format used to set the value.

**OCTET STRING:** VALUE will contain the octet string and LEN will be the number of octets.

**GeneralString:** VALUE will contain the generalstring and LEN will be the number of octets.

**BIT STRING:** VALUE will contain the bit string organized by bytes and LEN will be the number of bits.

**CHOICE:** If NAME indicates a choice type, VALUE will specify the alternative selected.

**ANY:** If NAME indicates an any type, VALUE will indicate the DER encoding of the structure actually used.



**Returns:** ASN1\_SUCCESS if value is returned, ASN1\_ELEMENT\_NOT\_FOUND if *name* is not a valid element, ASN1\_VALUE\_NOT\_FOUND if there isn't any value for the element selected, and ASN1\_MEM\_ERROR if The value vector isn't big enough to store the result, and in this case *len* will contain the number of bytes needed. On the occasion that the stored data are of zero-length this function may return ASN1\_SUCCESS even if the provided *len* is zero.

## asn1\_read\_value\_type

```
int asn1_read_value_type (asn1_node_const root, const char *      [Function]
                          name, void * ivalue, int * len, unsigned int * etype)
```

*root*: pointer to a structure.

*name*: the name of the element inside a structure that you want to read.

*ivalue*: vector that will contain the element's content, must be a pointer to memory cells already allocated (may be NULL ).

*len*: number of bytes of \*value: value[0]..value[len-1]. Initially holds the sizeof value.

*etype*: The type of the value read (ASN1\_ETYPE)

Returns the type and value of one element inside a structure. If an element is OPTIONAL and this returns ASN1\_ELEMENT\_NOT\_FOUND , it means that this element wasn't present in the der encoding that created the structure. The first element of a SEQUENCE\_OF or SET\_OF is named "?1". The second one "?2" and so on. If the *root* provided is a node to specific sequence element, then the keyword "?CURRENT" is also acceptable and indicates the current sequence element of this node.

Note that there can be valid values with length zero. In these case this function will succeed and *len* will be zero.

**INTEGER:** VALUE will contain a two's complement form integer.

integer=-1 -> value[0]=0xFF , len=1. integer=1 -> value[0]=0x01 , len=1.

**ENUMERATED:** As INTEGER (but only with not negative numbers).

**BOOLEAN:** VALUE will be the null terminated string "TRUE" or "FALSE" and LEN=5 or LEN=6.

**OBJECT IDENTIFIER:** VALUE will be a null terminated string with each number separated by a dot (i.e. "1.2.3.543.1").

LEN = strlen(VALUE)+1

**UTCTime:** VALUE will be a null terminated string in one of these formats: "YYMMDDhhmmss+hh'mm'" or "YYMMDDhhmmss-hh'mm'". LEN=strlen(VALUE)+1.

**GeneralizedTime:** VALUE will be a null terminated string in the same format used to set the value.

**OCTET STRING:** VALUE will contain the octet string and LEN will be the number of octets.

**GeneralString:** VALUE will contain the generalstring and LEN will be the number of octets.

**BIT STRING:** VALUE will contain the bit string organized by bytes and LEN will be the number of bits.

**CHOICE:** If NAME indicates a choice type, VALUE will specify the alternative selected.

**ANY:** If NAME indicates an any type, VALUE will indicate the DER encoding of the structure actually used.

**Returns:** ASN1\_SUCCESS if value is returned, ASN1\_ELEMENT\_NOT\_FOUND if name is not a valid element, ASN1\_VALUE\_NOT\_FOUND if there isn't any value for the element selected, and ASN1\_MEM\_ERROR if The value vector isn't big enough to store the result, and in this case len will contain the number of bytes needed. On the occasion that the stored data are of zero-length this function may return ASN1\_SUCCESS even if the provided len is zero.

### asn1\_read\_tag

```
int asn1_read_tag (asn1_node_const root, const char * name, int * tagValue, int * classValue) [Function]
```

root: pointer to a structure

name: the name of the element inside a structure.

tagValue: variable that will contain the TAG value.

classValue: variable that will specify the TAG type.

Returns the TAG and the CLASS of one element inside a structure. CLASS can have one of these constants: ASN1\_CLASS\_APPLICATION , ASN1\_CLASS\_UNIVERSAL , ASN1\_CLASS\_PRIVATE or ASN1\_CLASS\_CONTEXT\_SPECIFIC .

**Returns:** ASN1\_SUCCESS if successful, ASN1\_ELEMENT\_NOT\_FOUND if name is not a valid element.

### asn1\_read\_node\_value

```
int asn1_read_node_value (asn1_node_const node, asn1_data_node_st * data) [Function]
```

node: pointer to a node.

data: a point to a asn1\_data\_node\_st

Returns the value a data node inside a asn1\_node structure. The data returned should be handled as constant values.

**Returns:** ASN1\_SUCCESS if the node exists.

## 4.3 DER functions

### asn1\_length\_der

```
void asn1_length_der (unsigned long int len, unsigned char * der, int * der_len) [Function]
```

len: value to convert.

der: buffer to hold the returned encoding (may be NULL ).

der\_len: number of meaningful bytes of ANS (der[0]..der[der\_len-1]).

Creates the DER encoding of the provided length value. The `der` buffer must have enough room for the output. The maximum length this function will encode is `ASN1_MAX_LENGTH_SIZE`.

To know the size of the DER encoding use a `NULL` value for `der`.

### **asn1\_octet\_der**

```
void asn1_octet_der (const unsigned char * str, int str_len,          [Function]
                    unsigned char * der, int * der_len)
```

`str`: the input data.

`str_len`: STR length (`str[0]..str[*str_len-1]`).

`der`: encoded string returned.

`der_len`: number of meaningful bytes of DER (`der[0]..der[der_len-1]`).

Creates a length-value DER encoding for the input data. The DER encoding of the input data will be placed in the `der` variable.

Note that the OCTET STRING tag is not included in the output.

This function does not return any value because it is expected that `der_len` will contain enough bytes to store the string plus the DER encoding. The DER encoding size can be obtained using `asn1_length_der()`.

### **asn1\_encode\_simple\_der**

```
int asn1_encode_simple_der (unsigned int etype, const unsigned      [Function]
                           char * str, unsigned int str_len, unsigned char * t1, unsigned int *
                           t1_len)
```

`etype`: The type of the string to be encoded (`ASN1_ETYPE_`)

`str`: the string data.

`str_len`: the string length

`t1`: the encoded tag and length

`t1_len`: the bytes of the `t1` field

Creates the DER encoding for various simple ASN.1 types like strings etc. It stores the tag and length in `t1`, which should have space for at least `ASN1_MAX_TL_SIZE` bytes. Initially `t1_len` should contain the size of `t1`.

The complete DER encoding should consist of the value in `t1` appended with the provided `str`.

**Returns:** `ASN1_SUCCESS` if successful or an error value.

### **asn1\_object\_id\_der**

```
int asn1_object_id_der (const char * str, unsigned char * der,      [Function]
                       int * der_len, unsigned flags)
```

`str`: An object identifier in numeric, dot format.

`der`: buffer to hold the returned encoding (may be `NULL`).

`der_len`: initially the size of `der`; will hold the final size.

*flags*: must be zero

Creates the DER encoding of the provided object identifier.

**Returns:** ASN1\_SUCCESS if DER encoding was OK, ASN1\_VALUE\_NOT\_VALID if *str* is not a valid OID, ASN1\_MEM\_ERROR if the *der* vector isn't big enough and in this case *der\_len* will contain the length needed.

## asn1\_bit\_der

```
void asn1_bit_der (const unsigned char * str, int bit_len,           [Function]
                  unsigned char * der, int * der_len)
```

*str*: BIT string.

*bit\_len*: number of meaningful bits in STR.

*der*: string returned.

*der\_len*: number of meaningful bytes of DER (*der*[0]..*der*[*ans\_len*-1]).

Creates a length-value DER encoding for the input data as it would have been for a BIT STRING. The DER encoded data will be copied in *der* .

Note that the BIT STRING tag is not included in the output.

This function does not return any value because it is expected that *der\_len* will contain enough bytes to store the string plus the DER encoding. The DER encoding size can be obtained using *asn1\_length\_der*() .

## asn1\_der\_coding

```
int asn1_der_coding (asn1_node_const element, const char * name,   [Function]
                    void * ider, int * len, char * ErrorDescription)
```

*element*: pointer to an ASN1 element

*name*: the name of the structure you want to encode (it must be inside \*POINTER).

*ider*: vector that will contain the DER encoding. DER must be a pointer to memory cells already allocated.

*len*: number of bytes of \* *ider* : *ider* [0]..*ider* [*len*-1], Initially holds the sizeof of der vector.

*ErrorDescription*: return the error description or an empty string if success.

Creates the DER encoding for the NAME structure (inside \*POINTER structure).

**Returns:** ASN1\_SUCCESS if DER encoding OK, ASN1\_ELEMENT\_NOT\_FOUND if *name* is not a valid element, ASN1\_VALUE\_NOT\_FOUND if there is an element without a value, ASN1\_MEM\_ERROR if the *ider* vector isn't big enough and in this case *len* will contain the length needed.

## asn1\_get\_length\_der

```
long asn1_get_length_der (const unsigned char * der, int           [Function]
                          der_len, int * len)
```

*der*: DER data to decode.

*der\_len*: Length of DER data to decode.

*len*: Output variable containing the length of the DER length field.

Extract a length field from DER data.

**Returns:** Return the decoded length value, or -1 on indefinite length, or -2 when the value was too big to fit in a int, or -4 when the decoded length value plus `len` would exceed `der_len`.

### **asn1\_get\_tag\_der**

`int` **asn1\_get\_tag\_der** (*const unsigned char \* der, int der\_len, unsigned char \* cls, int \* len, unsigned long \* tag*) [Function]

*der*: DER data to decode.

*der\_len*: Length of DER data to decode.

*cls*: Output variable containing decoded class.

*len*: Output variable containing the length of the DER TAG data.

*tag*: Output variable containing the decoded tag (may be NULL).

Decode the class and TAG from DER code.

**Returns:** Returns ASN1\_SUCCESS on success, or an error.

### **asn1\_get\_length\_ber**

`long` **asn1\_get\_length\_ber** (*const unsigned char \* ber, int ber\_len, int \* len*) [Function]

*ber*: BER data to decode.

*ber\_len*: Length of BER data to decode.

*len*: Output variable containing the length of the BER length field.

Extract a length field from BER data. The difference to **asn1\_get\_length\_der()** is that this function will return a length even if the value has indefinite encoding.

**Returns:** Return the decoded length value, or negative value when the value was too big.

**Since:** 2.0

### **asn1\_get\_octet\_der**

`int` **asn1\_get\_octet\_der** (*const unsigned char \* der, int der\_len, int \* ret\_len, unsigned char \* str, int str\_size, int \* str\_len*) [Function]

*der*: DER data to decode containing the OCTET SEQUENCE.

*der\_len*: The length of the *der* data to decode.

*ret\_len*: Output variable containing the encoded length of the DER data.

*str*: Pre-allocated output buffer to put decoded OCTET SEQUENCE in.

*str\_size*: Length of pre-allocated output buffer.

*str\_len*: Output variable containing the length of the contents of the OCTET SEQUENCE.

Extract an OCTET SEQUENCE from DER data. Note that this function expects the DER data past the tag field, i.e., the length and content octets.

**Returns:** Returns ASN1\_SUCCESS on success, or an error.

**asn1\_get\_object\_id\_der**

**int** `asn1_get_object_id_der` (*const unsigned char \* der, int der\_len, int \* ret\_len, char \* str, int str\_size*) [Function]

*der*: DER data to decode containing the OBJECT IDENTIFIER

*der\_len*: Length of DER data to decode.

*ret\_len*: Output variable containing the length of the DER data.

*str*: Pre-allocated output buffer to put the textual object id in.

*str\_size*: Length of pre-allocated output buffer.

Converts a DER encoded object identifier to its textual form. This function expects the DER object identifier without the tag.

**Returns:** ASN1\_SUCCESS on success, or an error.

**asn1\_get\_bit\_der**

**int** `asn1_get_bit_der` (*const unsigned char \* der, int der\_len, int \* ret\_len, unsigned char \* str, int str\_size, int \* bit\_len*) [Function]

*der*: DER data to decode containing the BIT SEQUENCE.

*der\_len*: Length of DER data to decode.

*ret\_len*: Output variable containing the length of the DER data.

*str*: Pre-allocated output buffer to put decoded BIT SEQUENCE in.

*str\_size*: Length of pre-allocated output buffer.

*bit\_len*: Output variable containing the size of the BIT SEQUENCE.

Extract a BIT SEQUENCE from DER data.

**Returns:** ASN1\_SUCCESS on success, or an error.

**asn1\_der\_decoding2**

**int** `asn1_der_decoding2` (*asn1\_node \* element, const void \* ider, int \* max\_ider\_len, unsigned int flags, char \* errorDescription*) [Function]

*element*: pointer to an ASN1 structure.

*ider*: vector that contains the DER encoding.

*max\_ider\_len*: pointer to an integer giving the information about the maximal number of bytes occupied by \* *ider* . The real size of the DER encoding is returned through this pointer.

*flags*: flags controlling the behaviour of the function.

*errorDescription*: null-terminated string contains details when an error occurred.

Fill the structure \* *element* with values of a DER encoding string. The structure must just be created with function `asn1_create_element()` .

If ASN1\_DECODE\_FLAG\_ALLOW\_PADDING flag is set then the function will ignore padding after the decoded DER data. Upon a successful return the value of \* *max\_ider\_len* will be set to the number of bytes decoded.

If ASN1\_DECODE\_FLAG\_STRICT\_DER flag is set then the function will not decode any BER-encoded elements.

**Returns:** ASN1\_SUCCESS if DER encoding OK, ASN1\_ELEMENT\_NOT\_FOUND if ELEMENT is NULL , and ASN1\_TAG\_ERROR or ASN1\_DER\_ERROR if the der encoding doesn't match the structure name (\* ELEMENT deleted).

### asn1\_der\_decoding

```
int asn1_der_decoding (asn1_node * element, const void * ider,      [Function]
                      int ider_len, char * errorDescription)
```

*element*: pointer to an ASN1 structure.

*ider*: vector that contains the DER encoding.

*ider\_len*: number of bytes of \* ider : ider [0].. ider [len-1].

*errorDescription*: null-terminated string contains details when an error occurred.

Fill the structure \* *element* with values of a DER encoding string. The structure must just be created with function `asn1_create_element()` .

Note that the \* *element* variable is provided as a pointer for historical reasons.

**Returns:** ASN1\_SUCCESS if DER encoding OK, ASN1\_ELEMENT\_NOT\_FOUND if ELEMENT is NULL , and ASN1\_TAG\_ERROR or ASN1\_DER\_ERROR if the der encoding doesn't match the structure name (\* ELEMENT deleted).

### asn1\_der\_decoding\_element

```
int asn1_der_decoding_element (asn1_node * structure, const      [Function]
                              char * elementName, const void * ider, int len, char *
                              errorDescription)
```

*structure*: pointer to an ASN1 structure

*elementName*: name of the element to fill

*ider*: vector that contains the DER encoding of the whole structure.

*len*: number of bytes of \*der: der[0]..der[len-1]

*errorDescription*: null-terminated string contains details when an error occurred.

Fill the element named ELEMENTNAME with values of a DER encoding string. The structure must just be created with function `asn1_create_element()` . The DER vector must contain the encoding string of the whole STRUCTURE . If an error occurs during the decoding procedure, the \* STRUCTURE is deleted and set equal to NULL .

This function is deprecated and may just be an alias to `asn1_der_decoding()` in future versions. Use `asn1_der_decoding()` instead.

**Returns:** ASN1\_SUCCESS if DER encoding OK, ASN1\_ELEMENT\_NOT\_FOUND if ELEMENT is NULL or *elementName* == NULL, and ASN1\_TAG\_ERROR or ASN1\_DER\_ERROR if the der encoding doesn't match the structure *structure* (\*ELEMENT deleted).

### asn1\_der\_decoding\_startEnd

```
int asn1_der_decoding_startEnd (asn1_node element, const void      [Function]
                               * ider, int ider_len, const char * name_element, int * start, int * end)
```

*element*: pointer to an ASN1 element

*ider*: vector that contains the DER encoding.

*ider\_len*: number of bytes of \* *ider* : *ider* [0].. *ider* [len-1]

*name\_element*: an element of NAME structure.

*start*: the position of the first byte of NAME\_ELEMENT decoding ( *ider* [\*start])

*end*: the position of the last byte of NAME\_ELEMENT decoding ( *ider* [\*end])

Find the start and end point of an element in a DER encoding string. I mean that if you have a der encoding and you have already used the function `asn1_der_decoding()` to fill a structure, it may happen that you want to find the piece of string concerning an element of the structure.

One example is the sequence "tbsCertificate" inside an X509 certificate.

Note that since libtasn1 3.7 the *ider* and *ider\_len* parameters can be omitted, if the element is already decoded using `asn1_der_decoding()` .

**Returns:** ASN1\_SUCCESS if DER encoding OK, ASN1\_ELEMENT\_NOT\_FOUND if ELEMENT is `asn1_node EMPTY` or *name\_element* is not a valid element, ASN1\_TAG\_ERROR or ASN1\_DER\_ERROR if the der encoding doesn't match the structure ELEMENT.

## asn1\_expand\_any\_defined\_by

```
int asn1_expand_any_defined_by (asn1_node_const definitions,      [Function]
                               asn1_node * element)
```

*definitions*: ASN1 definitions

*element*: pointer to an ASN1 structure

Expands every "ANY DEFINED BY" element of a structure created from a DER decoding process (`asn1_der_decoding` function). The element ANY must be defined by an OBJECT IDENTIFIER. The type used to expand the element ANY is the first one following the definition of the actual value of the OBJECT IDENTIFIER.

**Returns:** ASN1\_SUCCESS if Substitution OK, ASN1\_ERROR\_TYPE\_ANY if some "ANY DEFINED BY" element couldn't be expanded due to a problem in OBJECT\_ID -> TYPE association, or other error codes depending on DER decoding.

## asn1\_expand\_octet\_string

```
int asn1_expand_octet_string (asn1_node_const definitions,      [Function]
                              asn1_node * element, const char * octetName, const char * objectName)
```

*definitions*: ASN1 definitions

*element*: pointer to an ASN1 structure

*octetName*: name of the OCTET STRING field to expand.

*objectName*: name of the OBJECT IDENTIFIER field to use to define the type for expansion.

Expands an "OCTET STRING" element of a structure created from a DER decoding process (the `asn1_der_decoding()` function). The type used for expansion is the first one following the definition of the actual value of the OBJECT IDENTIFIER indicated by OBJECTNAME.

**Returns:** ASN1\_SUCCESS if substitution OK, ASN1\_ELEMENT\_NOT\_FOUND if *objectName* or *octetName* are not correct, ASN1\_VALUE\_NOT\_VALID if it wasn't possible to find the type to use for expansion, or other errors depending on DER decoding.



**asn1\_decode\_simple\_der**

```
int asn1_decode_simple_der (unsigned int etype, const unsigned [Function]
                           char * der, unsigned int _der_len, const unsigned char ** str, unsigned
                           int * str_len)
```

*etype*: The type of the string to be encoded (ASN1\_ETYPE\_)

*der*: the encoded string

*\_der\_len*: the bytes of the encoded string

*str*: a pointer to the data

*str\_len*: the length of the data

Decodes a simple DER encoded type (e.g. a string, which is not constructed). The output is a pointer inside the *der* .

**Returns:** ASN1\_SUCCESS if successful or an error value.

**asn1\_decode\_simple\_ber**

```
int asn1_decode_simple_ber (unsigned int etype, const unsigned [Function]
                           char * der, unsigned int _der_len, unsigned char ** str, unsigned int *
                           str_len, unsigned int * ber_len)
```

*etype*: The type of the string to be encoded (ASN1\_ETYPE\_)

*der*: the encoded string

*\_der\_len*: the bytes of the encoded string

*str*: a pointer to the data

*str\_len*: the length of the data

*ber\_len*: the total length occupied by BER (may be NULL )

Decodes a BER encoded type. The output is an allocated value of the data. This decodes BER STRINGS only. Other types are decoded as DER.

**Returns:** ASN1\_SUCCESS if successful or an error value.

**4.4 Error handling functions****asn1\_perror**

```
void asn1_perror (int error) [Function]
```

*error*: is an error returned by a libtasn1 function.

Prints a string to stderr with a description of an error. This function is like **perror()** . The only difference is that it accepts an error returned by a libtasn1 function.

**Since:** 1.6

**asn1\_strerror**

```
const char * asn1_strerror (int error) [Function]
```

*error*: is an error returned by a libtasn1 function.

Returns a string with a description of an error. This function is similar to `strerror`. The only difference is that it accepts an error (number) returned by a libtasn1 function.

**Returns:** Pointer to static zero-terminated string describing error code.

**Since:** 1.6

## 4.5 Auxilliary functions

### `asn1_find_node`

`asn1_node` `asn1_find_node` (*asn1\_node\_const* `pointer`, *const char \** `name`) [Function]

*pointer*: `NODE_ASN` element pointer.

*name*: null terminated string with the element's name to find.

Searches for an element called `name` starting from `pointer`. The name is composed by different identifiers separated by dots. When `* pointer` has a name, the first identifier must be the name of `* pointer`, otherwise it must be the name of one child of `* pointer`.

**Returns:** the search result, or `NULL` if not found.

### `asn1_check_version`

*const char \** `asn1_check_version` (*const char \** `req_version`) [Function]

*req\_version*: Required version number, or `NULL`.

Check that the version of the library is at minimum the requested one and return the version string; return `NULL` if the condition is not satisfied. If a `NULL` is passed to this function, no check is done, but the version string is simply returned.

See `ASN1_VERSION` for a suitable `req_version` string.

**Returns:** Version string of run-time library, or `NULL` if the run-time library does not meet the required version number.

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Version 1.3, 3 November 2008

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