

**NAME**

**snmp\_value\_free**, **snmp\_value\_parse**, **snmp\_value\_copy**, **snmp\_pdu\_free**, **snmp\_pdu\_decode**, **snmp\_pdu\_encode**, **snmp\_pdu\_decode\_header**, **snmp\_pdu\_decode\_scoped**, **snmp\_pdu\_decode\_secmode**, **snmp\_pdu\_init\_secparams**, **snmp\_pdu\_dump**, **snmp\_passwd\_to\_keys**, **snmp\_get\_local\_keys**, **snmp\_calc\_keychange**, **TRUTH\_MK**, **TRUTH\_GET**, **TRUTH\_OK** - SNMP decoding and encoding library

**LIBRARY**

Begemot SNMP library (libbsnmp, -lbsnmp)

**SYNOPSIS**

```
#include <bsnmp/asn1.h>
```

```
#include <bsnmp/snmp.h>
```

*void*

```
snmp_value_free(struct snmp_value *value);
```

*int*

```
snmp_value_parse(const char *buf, enum snmp_syntax, union snmp_values *value);
```

*int*

```
snmp_value_copy(struct snmp_value *to, const struct snmp_value *from);
```

*void*

```
snmp_pdu_free(struct snmp_pdu *value);
```

*enum snmp\_code*

```
snmp_pdu_decode(struct asn_buf *buf, struct snmp_pdu *pdu, int32_t *ip);
```

*enum snmp\_code*

```
snmp_pdu_encode(struct snmp_pdu *pdu, struct asn_buf *buf);
```

*enum snmp\_code*

```
snmp_pdu_decode_header(struct snmp_pdu *pdu, struct asn_buf *buf);
```

*enum snmp\_code*

```
snmp_pdu_decode_scoped(struct asn_buf *buf, struct snmp_pdu *pdu, int32_t *ip);
```

*enum snmp\_code*

```
snmp_pdu_decode_secmode(struct asn_buf *buf, struct snmp_pdu *pdu);
```

*void*

**snmp\_pdu\_init\_secparams**(*struct snmp\_pdu \*pdu*);

*void*

**snmp\_pdu\_dump**(*const struct snmp\_pdu \*pdu*);

*enum snmp\_code*

**snmp\_passwd\_to\_keys**(*struct snmp\_user \*user, char \*passwd*);

*enum snmp\_code*

**snmp\_get\_local\_keys**(*struct snmp\_user \*user, uint8\_t \*eid, uint32\_t elen*);

*enum snmp\_code*

**snmp\_calc\_keychange**(*struct snmp\_user \*user, uint8\_t \*keychange*);

*int*

**TRUTH\_MK**(*F*);

*int*

**TRUTH\_GET**(*T*);

*int*

**TRUTH\_OK**(*T*);

## DESCRIPTION

The SNMP library contains routines to handle SNMP version 1, 2 and 3 PDUs. There are several basic structures used throughout the library:

```

struct snmp_value {
    struct asn_oid          var;
    enum snmp_syntax syntax;
    union snmp_values {
        int32_t            integer; /* also integer32 */
        struct {
            u_int          len;
            u_char         *octets;
        }                  octetstring;
        struct asn_oid     oid;
        u_char             ipaddress[4];
        uint32_t           uint32; /* also gauge32, counter32,

```

```

                                unsigned32, timeticks */
        uint64_t      counter64;
    }                v;
};

```

This structure represents one variable binding from an SNMP PDU. The field *var* is the ASN.1 of the variable that is bound. *syntax* contains either the syntax code of the value or an exception code for SNMPv2 and may be one of:

```

enum snmp_syntax {
    SNMP_SYNTAX_NULL      = 0,
    SNMP_SYNTAX_INTEGER,  /* == INTEGER32 */
    SNMP_SYNTAX_OCTETSTRING,
    SNMP_SYNTAX_OID,
    SNMP_SYNTAX_IPADDRESS,
    SNMP_SYNTAX_COUNTER,
    SNMP_SYNTAX_GAUGE, /* == UNSIGNED32 */
    SNMP_SYNTAX_TIMETICKS,

    /* v2 additions */
    SNMP_SYNTAX_COUNTER64,
    /* exceptions */
    SNMP_SYNTAX_NOSUCHOBJECT,
    SNMP_SYNTAX_NOSUCHINSTANCE,
    SNMP_SYNTAX_ENDOFMIBVIEW,
};

```

The field *v* holds the actual value depending on *syntax*. Note, that if *syntax* is `SNMP_SYNTAX_OCTETSTRING` and *v.octetstring.len* is not zero, *v.octetstring.octets* points to a string allocated by `malloc(3)`.

```

#define  SNMP_ENGINE_ID_SIZ      32

struct snmp_engine {
    uint8_t      engine_id[SNMP_ENGINE_ID_SIZ];
    uint32_t     engine_len;
    int32_t      engine_boots;
    int32_t      engine_time;
    int32_t      max_msg_size;
};

```

This structure represents an SNMP engine as specified by the SNMP Management Architecture described in RFC 3411.

```
#define  SNMP_ADM_STR32_SIZ      (32 + 1)
#define  SNMP_AUTH_KEY_SIZ      40
#define  SNMP_PRIV_KEY_SIZ      32

enum snmp_usm_level {
    SNMP_noAuthNoPriv = 1,
    SNMP_authNoPriv = 2,
    SNMP_authPriv = 3
};

struct snmp_user {
    char          sec_name[SNMP_ADM_STR32_SIZ];
    enum snmp_authentication  auth_proto;
    enum snmp_privacy         priv_proto;
    uint8_t      auth_key[SNMP_AUTH_KEY_SIZ];
    uint8_t      priv_key[SNMP_PRIV_KEY_SIZ];
};
```

This structure represents an SNMPv3 user as specified by the User-based Security Model (USM) described in RFC 3414. The field *sec\_name* is a human readable string containing the security user name. *auth\_proto* contains the id of the authentication protocol in use by the user and may be one of:

```
enum snmp_authentication {
    SNMP_AUTH_NOAUTH = 0,
    SNMP_AUTH_HMAC_MD5,
    SNMP_AUTH_HMAC_SHA
};
```

*priv\_proto* contains the id of the privacy protocol in use by the user and may be one of:

```
enum snmp_privacy {
    SNMP_PRIV_NOPRIV = 0,
    SNMP_PRIV_DES = 1,
    SNMP_PRIV_AES
};
```

*auth\_key* and *priv\_key* contain the authentication and privacy keys for the user.

```
#define  SNMP_COMMUNITY_MAXLEN      128
```

```

#define SNMP_MAX_BINDINGS          100
#define  SNMP_CONTEXT_NAME_SIZ      (32 + 1)
#define  SNMP_TIME_WINDOW          150

#define  SNMP_USM_AUTH_SIZE        12
#define  SNMP_USM_PRIV_SIZE        8

#define  SNMP_MSG_AUTH_FLAG        0x1
#define  SNMP_MSG_PRIV_FLAG        0x2
#define  SNMP_MSG_REPORT_FLAG      0x4

#define  SNMP_MPM_SNMP_V1          0
#define  SNMP_MPM_SNMP_V2c         1
#define  SNMP_MPM_SNMP_V3          3

struct snmp_pdu {
    char                community[SNMP_COMMUNITY_MAXLEN + 1];
    enum snmp_version   version;
    u_int               type;

    /* SNMPv3 PDU header fields */
    int32_t             identifier;
    uint8_t             flags;
    int32_t             security_model;
    struct snmp_engine engine;

    /* Associated USM user parameters */
    struct snmp_user    user;
    uint8_t             msg_digest[SNMP_USM_AUTH_SIZE];
    uint8_t             msg_salt[SNMP_USM_PRIV_SIZE];

    /* View-based Access Model */
    uint32_t            context_engine_len;
    uint8_t             context_engine[SNMP_ENGINE_ID_SIZ];
    char                context_name[SNMP_CONTEXT_NAME_SIZ];

    /* trap only */
    struct asn_oid      enterprise;
    u_char              agent_addr[4];
    int32_t             generic_trap;

```

```

int32_t          specific_trap;
uint32_t        time_stamp;

/* others */
int32_t          request_id;
int32_t          error_status;
int32_t          error_index;

/* fixes for encoding */
size_t          outer_len;
size_t          scoped_len;
u_char          *outer_ptr;
u_char          *digest_ptr;
u_char          *encrypted_ptr;
u_char          *scoped_ptr;
u_char          *pdu_ptr;
u_char          *vars_ptr;

struct snmp_value bindings[SNMP_MAX_BINDINGS];
u_int           nbindings;
};

```

This structure contains a decoded SNMP PDU. *version* is one of

```

enum snmp_version {
    SNMP_Verr = 0,
    SNMP_V1 = 1,
    SNMP_V2c,
    SNMP_V3
};

```

and *type* is the type of the PDU. *security\_model* is the security model used for SNMPv3 PDUs. The only supported value currently is 3 (User-based Security Model). Additional values for any, unknown, SNMPv1 and SNMPv2c security models are also enumerated

```

enum snmp_secmodel {
    SNMP_SECMODEL_ANY = 0,
    SNMP_SECMODEL_SNMPv1 = 1,
    SNMP_SECMODEL_SNMPv2c = 2,
    SNMP_SECMODEL_USM = 3,
    SNMP_SECMODEL_UNKNOWN
};

```

```
};
```

The function **snmp\_value\_free()** is used to free all the dynamic allocated contents of an SNMP value. It does not free the structure pointed to by *value* itself.

The function **snmp\_value\_parse()** parses the ASCII representation of an SNMP value into its binary form. This function is mainly used by the configuration file reader of `bsnmpd(1)`.

The function **snmp\_value\_copy()** makes a deep copy of the value pointed to by *from* to the structure pointed to by *to*. It assumes that *to* is uninitialized and will overwrite its previous contents. It does not itself allocate the structure pointed to by *to*.

The function **snmp\_pdu\_free()** frees all the dynamically allocated components of the PDU. It does not itself free the structure pointed to by *pdu*.

The function **snmp\_pdu\_decode()** decodes the PDU pointed to by *buf* and stores the result into *pdu*. If an error occurs in a variable binding the (1 based) index of this binding is stored in the variable pointed to by *ip*.

The function **snmp\_pdu\_encode()** encodes the PDU *pdu* into the an octetstring in buffer, and if authentication and privacy are used, calculates a message digest and encrypts the PDU data in the buffer *buf*.

The function **snmp\_pdu\_decode\_header()** decodes the header of the PDU pointed to by *buf*. The uncoded PDU contents remain in the buffer.

The function **snmp\_pdu\_decode\_scoped()** decodes the scoped PDU pointed to by *buf*.

The function **snmp\_pdu\_decode\_secmode()** verifies the authentication parameter contained in the PDU (if present) and if the PDU is encrypted, decrypts the PDU contents pointed to by *buf*. If successful, a plain text scoped PDU is stored in the buffer.

The function **snmp\_pdu\_init\_secparams()** calculates the initialization vector for the privacy protocol in use before the PDU pointed to by *pdu* may be encrypted or decrypted.

The function **snmp\_pdu\_dump()** dumps the PDU in a human readable form by calling **snmp\_printf()**.

The function **snmp\_passwd\_to\_keys()** calculates a binary private authentication key corresponding to a plain text human readable password string. The calculated key is placed in the *auth\_key* field of the *user*.

The function **snmp\_get\_local\_keys()** calculates a localized authentication and privacy keys for a specified SNMPv3 engine. The calculated keys are placed in the *auth\_key* and *priv\_key* fields of the *user*.

The function **snmp\_calc\_keychange()** calculates a binary key change octet string based on the contents of an old and a new binary localized key. The result is placed in the buffer pointer to by *keychange* and may be used by an SNMPv3 user who wishes to change his/her password or localized key.

The function **TRUTH\_MK()** takes a C truth value (zero or non-zero) and makes an SNMP truth value (2 or 1). The function **TRUTH\_GET()** takes an SNMP truth value and makes a C truth value (0 or 1). The function **TRUTH\_OK()** checks, whether its argument is a legal SNMP truth value.

## DIAGNOSTICS

When an error occurs in any of the function the function pointed to by the global pointer

```
extern void (*snmp_error)(const char *, ...);
```

with a `printf(3)` style format string. There is a default error handler in the library that prints a message starting with 'SNMP:' followed by the error message to standard error.

The function pointed to by

```
extern void (*snmp_printf)(const char *, ...);
```

is called by the **snmp\_pdu\_dump()** function. The default handler is `printf(3)`.

## ERRORS

**snmp\_pdu\_decode()** will return one of the following return codes:

[SNMP\_CODE\_OK]

Success.

[SNMP\_CODE\_FAILED]

The ASN.1 coding was wrong.

[SNMP\_CODE\_BADLEN]

A variable binding value had a wrong length field.

[SNMP\_CODE\_OORANGE]

A variable binding value was out of the allowed range.



**[SNMP\_CODE\_BADVERS]**

The PDU is of an unsupported version.

**[SNMP\_CODE\_BADENQ]**

There was an ASN.1 value with an unsupported tag.

**[SNMP\_CODE\_BADSECLEVEL]**

The requested securityLevel contained in the PDU is not supported.

**[SNMP\_CODE\_BADDIGEST]**

The PDU authentication parameter received in the PDU did not match the calculated message digest.

**[SNMP\_CODE\_EDECRYPT]**

Error occurred while trying to decrypt the PDU.

**snmp\_pdu\_encode()** will return one of the following return codes:

**[SNMP\_CODE\_OK]**

Success.

**[SNMP\_CODE\_FAILED]**

Encoding failed.

**SEE ALSO**

gensnmptree(1), bsnmpd(1), bsnmpagent(3), bsnmpclient(3), bsnmplib(3)

**CAVEAT**

The SNMPv3 message digests, encryption and decryption, and key routines use the cryptographic functions from crypto(3). The library may optionally be built without references to the crypto(3) library. In such case only plain text SNMPv3 PDUs without message digests may be processed correctly.

**STANDARDS**

This implementation conforms to the applicable IETF RFCs and ITU-T recommendations.

**AUTHORS**

The Begemot SNMP library was originally written by Hartmut Brandt <harti@FreeBSD.org>

Shteryana Shopova <syrix@FreeBSD.org> added support for the SNMPv3 message processing and User-Based Security model message authentication and privacy.