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Generic Security Service API Version 2 : C-bindings

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This document specifies C language bindings for Version 2, Update 1 of the Generic Security Service Application Program Interface (GSS-API), which is described at a language-independent conceptual level in RFC-2743 [GSSAPI]. It obsoletes RFC-1509, making specific incremental changes in response to implementation experience and liaison requests. It is intended, therefore, that this memo or a successor version thereof will become the basis for subsequent progression of the GSS-API specification on the standards track.

The Generic Security Service Application Programming Interface provides security services to its callers, and is intended for implementation atop a variety of underlying cryptographic mechanisms. Typically, GSS-API callers will be application protocols into which security enhancements are integrated through invocation of services provided by the GSS-API. The GSS-API allows a caller application to authenticate a principal identity associated with a peer application, to delegate rights to a peer, and to apply security services such as confidentiality and integrity on a per-message basis.

1. Introduction

The Generic Security Service Application Programming Interface [GSSAPI] provides security services to calling applications. It allows a communicating application to authenticate the user associated with another application, to delegate rights to another application, and to apply security services such as confidentiality and integrity on a per-message basis.

There are four stages to using the GSS-API:

- a) The application acquires a set of credentials with which it may prove its identity to other processes. The application's credentials vouch for its global identity, which may or may not be related to any local username under which it may be running.
- b) A pair of communicating applications establish a joint security context using their credentials. The security context is a pair of GSS-API data structures that contain shared state information, which is required in order that per-message security services may be provided. Examples of state that might be shared between applications as part of a security context are cryptographic keys, and message sequence numbers. As part of the establishment of a security context, the context initiator is authenticated to the responder, and may require that the responder is authenticated in turn. The initiator may optionally give the responder the right to initiate further security contexts, acting as an agent or delegate of the initiator. This transfer of rights is termed delegation, and is achieved by creating a set of credentials, similar to those used by the initiating application, but which may be used by the responder.

To establish and maintain the shared information that makes up the security context, certain GSS-API calls will return a token data structure, which is an opaque data type that may contain cryptographically protected data. The caller of such a GSS-API routine is responsible for transferring the token to the peer application, encapsulated if necessary in an application-application protocol. On receipt of such a token, the peer application should pass it to a corresponding GSS-API routine which will decode the token and extract the information, updating the security context state information accordingly.

c) Per-message services are invoked to apply either:

integrity and data origin authentication, or confidentiality, integrity and data origin authentication to application data, which are treated by GSS-API as arbitrary octet-strings. An application transmitting a message that it wishes to protect will call the appropriate GSS-API routine (`gss_get_mic` or `gss_wrap`) to apply protection, specifying the appropriate security context, and send the resulting token to the receiving application. The receiver will pass the received token (and, in the case of data protected by `gss_get_mic`, the accompanying message-data) to the corresponding decoding routine (`gss_verify_mic` or `gss_unwrap`) to remove the protection and validate the data.

d) At the completion of a communications session (which may extend across several transport connections), each application calls a GSS-API routine to delete the security context. Multiple contexts may also be used (either successively or simultaneously) within a single communications association, at the option of the applications.

2. GSS-API Routines

This section lists the routines that make up the GSS-API, and offers a brief description of the purpose of each routine. Detailed descriptions of each routine are listed in alphabetical order in section 5.

Table 2-1 GSS-API Credential-management Routines

Routine -----	Section -----	Function -----
<code>gss_acquire_cred</code>	5.2	Assume a global identity; Obtain a GSS-API credential handle for pre-existing credentials.
<code>gss_add_cred</code>	5.3	Construct credentials incrementally
<code>gss_inquire_cred</code>	5.21	Obtain information about a credential
<code>gss_inquire_cred_by_mech</code>	5.22	Obtain per-mechanism information about a credential.
<code>gss_release_cred</code>	5.27	Discard a credential handle.

Table 2-2 GSS-API Context-Level Routines

Routine -----	Section -----	Function -----
gss_init_sec_context	5.19	Initiate a security context with a peer application
gss_accept_sec_context	5.1	Accept a security context initiated by a peer application
gss_delete_sec_context	5.9	Discard a security context
gss_process_context_token	5.25	Process a token on a security context from a peer application
gss_context_time	5.7	Determine for how long a context will remain valid
gss_inquire_context	5.20	Obtain information about a security context
gss_wrap_size_limit	5.34	Determine token-size limit for gss_wrap on a context
gss_export_sec_context	5.14	Transfer a security context to another process
gss_import_sec_context	5.17	Import a transferred context

Table 2-3 GSS-API Per-message Routines

Routine -----	Section -----	Function -----
gss_get_mic	5.15	Calculate a cryptographic message integrity code (MIC) for a message; integrity service
gss_verify_mic	5.32	Check a MIC against a message; verify integrity of a received message
gss_wrap	5.33	Attach a MIC to a message, and optionally encrypt the message content; confidentiality service
gss_unwrap	5.31	Verify a message with attached MIC, and decrypt message content if necessary.

Table 2-4 GSS-API Name manipulation Routines

Routine -----	Section -----	Function -----
gss_import_name	5.16	Convert a contiguous string name to internal-form
gss_display_name	5.10	Convert internal-form name to text
gss_compare_name	5.6	Compare two internal-form names
gss_release_name	5.28	Discard an internal-form name
gss_inquire_names_for_mech	5.24	List the name-types supported by the specified mechanism
gss_inquire_mechs_for_name	5.23	List mechanisms that support the specified name-type
gss_canonicalize_name	5.5	Convert an internal name to an MN
gss_export_name	5.13	Convert an MN to export form
gss_duplicate_name	5.12	Create a copy of an internal name

Table 2-5 GSS-API Miscellaneous Routines

Routine -----	Section -----	Function -----
gss_add_oid_set_member	5.4	Add an object identifier to a set
gss_display_status	5.11	Convert a GSS-API status code to text
gss_indicate_mechs	5.18	Determine available underlying authentication mechanisms
gss_release_buffer	5.26	Discard a buffer
gss_release_oid_set	5.29	Discard a set of object identifiers
gss_create_empty_oid_set	5.8	Create a set containing no object identifiers
gss_test_oid_set_member	5.30	Determines whether an object identifier is a member of a set.

Individual GSS-API implementations may augment these routines by providing additional mechanism-specific routines if required functionality is not available from the generic forms. Applications are encouraged to use the generic routines wherever possible on portability grounds.

3. Data Types and Calling Conventions

The following conventions are used by the GSS-API C-language bindings:

3.1. Integer types

GSS-API uses the following integer data type:

OM_uint32 32-bit unsigned integer

Where guaranteed minimum bit-count is important, this portable data type is used by the GSS-API routine definitions. Individual GSS-API implementations will include appropriate typedef definitions to map this type onto a built-in data type. If the platform supports the X/Open xom.h header file, the OM_uint32 definition contained therein should be used; the GSS-API header file in Appendix A contains logic that will detect the prior inclusion of xom.h, and will not attempt to re-declare OM_uint32. If the X/Open header file is not available on the platform, the GSS-API implementation should use the smallest natural unsigned integer type that provides at least 32 bits of precision.

3.2. String and similar data

Many of the GSS-API routines take arguments and return values that describe contiguous octet-strings. All such data is passed between the GSS-API and the caller using the gss_buffer_t data type. This data type is a pointer to a buffer descriptor, which consists of a length field that contains the total number of bytes in the datum, and a value field which contains a pointer to the actual datum:

```
typedef struct gss_buffer_desc_struct {  
    size_t    length;  
    void      *value;  
} gss_buffer_desc, *gss_buffer_t;
```

Storage for data returned to the application by a GSS-API routine using the gss_buffer_t conventions is allocated by the GSS-API routine. The application may free this storage by invoking the gss_release_buffer routine. Allocation of the gss_buffer_desc object is always the responsibility of the application; unused gss_buffer_desc objects may be initialized to the value GSS_C_EMPTY_BUFFER.

3.2.1. Opaque data types

Certain multiple-word data items are considered opaque data types at the GSS-API, because their internal structure has no significance either to the GSS-API or to the caller. Examples of such opaque data types are the `input_token` parameter to `gss_init_sec_context` (which is opaque to the caller), and the `input_message` parameter to `gss_wrap` (which is opaque to the GSS-API). Opaque data is passed between the GSS-API and the application using the `gss_buffer_t` datatype.

3.2.2. Character strings

Certain multiple-word data items may be regarded as simple ISO Latin-1 character strings. Examples are the printable strings passed to `gss_import_name` via the `input_name_buffer` parameter. Some GSS-API routines also return character strings. All such character strings are passed between the application and the GSS-API implementation using the `gss_buffer_t` datatype, which is a pointer to a `gss_buffer_desc` object.

When a `gss_buffer_desc` object describes a printable string, the `length` field of the `gss_buffer_desc` should only count printable characters within the string. In particular, a trailing NUL character should NOT be included in the length count, nor should either the GSS-API implementation or the application assume the presence of an uncounted trailing NUL.

3.3. Object Identifiers

Certain GSS-API procedures take parameters of the type `gss_OID`, or Object identifier. This is a type containing ISO-defined tree-structured values, and is used by the GSS-API caller to select an underlying security mechanism and to specify namespaces. A value of type `gss_OID` has the following structure:

```
typedef struct gss_OID_desc_struct {
    OM_uint32    length;
    void         *elements;
} gss_OID_desc, *gss_OID;
```

The `elements` field of this structure points to the first byte of an octet string containing the ASN.1 BER encoding of the value portion of the normal BER TLV encoding of the `gss_OID`. The `length` field contains the number of bytes in this value. For example, the `gss_OID` value corresponding to `{iso(1) identified-organization(3) icd-ecma(12) member-company(2) dec(1011) cryptoAlgorithms(7) DASS(5)}`, meaning the DASS X.509 authentication mechanism, has a `length` field of 7 and an `elements` field pointing to seven octets containing the

following octal values: 53,14,2,207,163,7,5. GSS-API implementations should provide constant `gss_OID` values to allow applications to request any supported mechanism, although applications are encouraged on portability grounds to accept the default mechanism. `gss_OID` values should also be provided to allow applications to specify particular name types (see section 3.10). Applications should treat `gss_OID_desc` values returned by GSS-API routines as read-only. In particular, the application should not attempt to deallocate them with `free()`. The `gss_OID_desc` datatype is equivalent to the X/Open `OM_object_identifier` datatype[XOM].

3.4. Object Identifier Sets

Certain GSS-API procedures take parameters of the type `gss_OID_set`. This type represents one or more object identifiers (section 2.3). A `gss_OID_set` object has the following structure:

```
typedef struct gss_OID_set_desc_struct {
    size_t      count;
    gss_OID     elements;
} gss_OID_set_desc, *gss_OID_set;
```

The `count` field contains the number of OIDs within the set. The `elements` field is a pointer to an array of `gss_OID_desc` objects, each of which describes a single OID. `gss_OID_set` values are used to name the available mechanisms supported by the GSS-API, to request the use of specific mechanisms, and to indicate which mechanisms a given credential supports.

All OID sets returned to the application by GSS-API are dynamic objects (the `gss_OID_set_desc`, the "elements" array of the set, and the "elements" array of each member OID are all dynamically allocated), and this storage must be deallocated by the application using the `gss_release_oid_set()` routine.

3.5. Credentials

A credential handle is a caller-opaque atomic datum that identifies a GSS-API credential data structure. It is represented by the caller-opaque type `gss_cred_id_t`, which should be implemented as a pointer or arithmetic type. If a pointer implementation is chosen, care must be taken to ensure that two `gss_cred_id_t` values may be compared with the `==` operator.

GSS-API credentials can contain mechanism-specific principal authentication data for multiple mechanisms. A GSS-API credential is composed of a set of credential-elements, each of which is applicable to a single mechanism. A credential may contain at most one

credential-element for each supported mechanism. A credential-element identifies the data needed by a single mechanism to authenticate a single principal, and conceptually contains two credential-references that describe the actual mechanism-specific authentication data, one to be used by GSS-API for initiating contexts, and one to be used for accepting contexts. For mechanisms that do not distinguish between acceptor and initiator credentials, both references would point to the same underlying mechanism-specific authentication data.

Credentials describe a set of mechanism-specific principals, and give their holder the ability to act as any of those principals. All principal identities asserted by a single GSS-API credential should belong to the same entity, although enforcement of this property is an implementation-specific matter. The GSS-API does not make the actual credentials available to applications; instead a credential handle is used to identify a particular credential, held internally by GSS-API. The combination of GSS-API credential handle and mechanism identifies the principal whose identity will be asserted by the credential when used with that mechanism.

The `gss_init_sec_context` and `gss_accept_sec_context` routines allow the value `GSS_C_NO_CREDENTIAL` to be specified as their credential handle parameter. This special credential-handle indicates a desire by the application to act as a default principal. While individual GSS-API implementations are free to determine such default behavior as appropriate to the mechanism, the following default behavior by these routines is recommended for portability:

`gss_init_sec_context`

- 1) If there is only a single principal capable of initiating security contexts for the chosen mechanism that the application is authorized to act on behalf of, then that principal shall be used, otherwise
- 2) If the platform maintains a concept of a default network-identity for the chosen mechanism, and if the application is authorized to act on behalf of that identity for the purpose of initiating security contexts, then the principal corresponding to that identity shall be used, otherwise
- 3) If the platform maintains a concept of a default local identity, and provides a means to map local identities into network-identities for the chosen mechanism, and if the application is authorized to act on behalf of the network-identity image of the default local identity for the purpose of

initiating security contexts using the chosen mechanism, then the principal corresponding to that identity shall be used, otherwise

- 4) A user-configurable default identity should be used.

`gss_accept_sec_context`

- 1) If there is only a single authorized principal identity capable of accepting security contexts for the chosen mechanism, then that principal shall be used, otherwise
- 2) If the mechanism can determine the identity of the target principal by examining the context-establishment token, and if the accepting application is authorized to act as that principal for the purpose of accepting security contexts using the chosen mechanism, then that principal identity shall be used, otherwise
- 3) If the mechanism supports context acceptance by any principal, and if mutual authentication was not requested, any principal that the application is authorized to accept security contexts under using the chosen mechanism may be used, otherwise
- 4) A user-configurable default identity shall be used.

The purpose of the above rules is to allow security contexts to be established by both initiator and acceptor using the default behavior wherever possible. Applications requesting default behavior are likely to be more portable across mechanisms and platforms than ones that use `gss_acquire_cred` to request a specific identity.

3.6. Contexts

The `gss_ctx_id_t` data type contains a caller-opaque atomic value that identifies one end of a GSS-API security context. It should be implemented as a pointer or arithmetic type. If a pointer type is chosen, care should be taken to ensure that two `gss_ctx_id_t` values may be compared with the `==` operator.

The security context holds state information about each end of a peer communication, including cryptographic state information.

3.7. Authentication tokens

A token is a caller-opaque type that GSS-API uses to maintain synchronization between the context data structures at each end of a GSS-API security context. The token is a cryptographically protected octet-string, generated by the underlying mechanism at one end of a GSS-API security context for use by the peer mechanism at the other end. Encapsulation (if required) and transfer of the token are the responsibility of the peer applications. A token is passed between the GSS-API and the application using the `gss_buffer_t` conventions.

3.8. Interprocess tokens

Certain GSS-API routines are intended to transfer data between processes in multi-process programs. These routines use a caller-opaque octet-string, generated by the GSS-API in one process for use by the GSS-API in another process. The calling application is responsible for transferring such tokens between processes in an OS-specific manner. Note that, while GSS-API implementors are encouraged to avoid placing sensitive information within interprocess tokens, or to cryptographically protect them, many implementations will be unable to avoid placing key material or other sensitive data within them. It is the application's responsibility to ensure that interprocess tokens are protected in transit, and transferred only to processes that are trustworthy. An interprocess token is passed between the GSS-API and the application using the `gss_buffer_t` conventions.

3.9. Status values

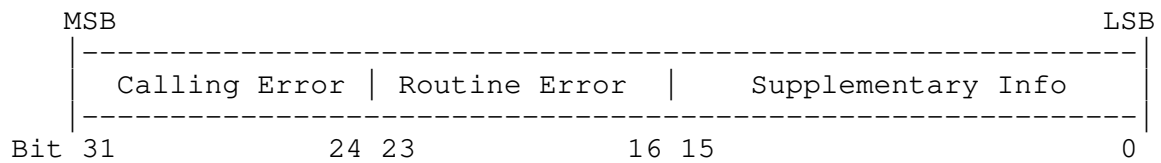
Every GSS-API routine returns two distinct values to report status information to the caller: GSS status codes and Mechanism status codes.

3.9.1. GSS status codes

GSS-API routines return GSS status codes as their `OM_uint32` function value. These codes indicate errors that are independent of the underlying mechanism(s) used to provide the security service. The errors that can be indicated via a GSS status code are either generic API routine errors (errors that are defined in the GSS-API specification) or calling errors (errors that are specific to these language bindings).

A GSS status code can indicate a single fatal generic API error from the routine and a single calling error. In addition, supplementary status information may be indicated via the setting of bits in the supplementary info field of a GSS status code.

These errors are encoded into the 32-bit GSS status code as follows:



Hence if a GSS-API routine returns a GSS status code whose upper 16 bits contain a non-zero value, the call failed. If the calling error field is non-zero, the invoking application's call of the routine was erroneous. Calling errors are defined in table 5-1. If the routine error field is non-zero, the routine failed for one of the routine-specific reasons listed below in table 5-2. Whether or not the upper 16 bits indicate a failure or a success, the routine may indicate additional information by setting bits in the supplementary info field of the status code. The meaning of individual bits is listed below in table 5-3.

Table 3-1 Calling Errors

Name	Value in field	Meaning
-----	-----	-----
GSS_S_CALL_INACCESSIBLE_READ	1	A required input parameter could not be read
GSS_S_CALL_INACCESSIBLE_WRITE	2	A required output parameter could not be written.
GSS_S_CALL_BAD_STRUCTURE	3	A parameter was malformed

Table 3-2 Routine Errors

Name ----	Value in field -----	Meaning -----
GSS_S_BAD_MECH	1	An unsupported mechanism was requested
GSS_S_BAD_NAME	2	An invalid name was supplied
GSS_S_BAD_NAME_TYPE	3	A supplied name was of an unsupported type
GSS_S_BAD_BINDINGS	4	Incorrect channel bindings were supplied
GSS_S_BAD_STATUS	5	An invalid status code was supplied
GSS_S_BAD_MIC	6	A token had an invalid MIC
GSS_S_NO_CRED	7	No credentials were supplied, or the credentials were unavailable or inaccessible.
GSS_S_NO_CONTEXT	8	No context has been established
GSS_S_DEFECTIVE_TOKEN	9	A token was invalid
GSS_S_DEFECTIVE_CREDENTIAL	10	A credential was invalid
GSS_S_CREDENTIALS_EXPIRED	11	The referenced credentials have expired
GSS_S_CONTEXT_EXPIRED	12	The context has expired
GSS_S_FAILURE	13	Miscellaneous failure (see text)
GSS_S_BAD_QOP	14	The quality-of-protection requested could not be provided
GSS_S_UNAUTHORIZED	15	The operation is forbidden by local security policy
GSS_S_UNAVAILABLE	16	The operation or option is unavailable
GSS_S_DUPLICATE_ELEMENT	17	The requested credential element already exists
GSS_S_NAME_NOT_MN	18	The provided name was not a mechanism name

Table 3-3 Supplementary Status Bits

Name ----	Bit Number -----	Meaning -----
GSS_S_CONTINUE_NEEDED	0 (LSB)	Returned only by <code>gss_init_sec_context</code> or <code>gss_accept_sec_context</code> . The routine must be called again to complete its function. See routine documentation for detailed description
GSS_S_DUPLICATE_TOKEN	1	The token was a duplicate of an earlier token
GSS_S_OLD_TOKEN	2	The token's validity period has expired
GSS_S_UNSEQ_TOKEN	3	A later token has already been processed
GSS_S_GAP_TOKEN	4	An expected per-message token was not received

The routine documentation also uses the name `GSS_S_COMPLETE`, which is a zero value, to indicate an absence of any API errors or supplementary information bits.

All `GSS_S_XXX` symbols equate to complete `OM_uint32` status codes, rather than to bitfield values. For example, the actual value of the symbol `GSS_S_BAD_NAME_TYPE` (value 3 in the routine error field) is $3 \ll 16$. The macros `GSS_CALLING_ERROR()`, `GSS_ROUTINE_ERROR()` and `GSS_SUPPLEMENTARY_INFO()` are provided, each of which takes a GSS status code and removes all but the relevant field. For example, the value obtained by applying `GSS_ROUTINE_ERROR` to a status code removes the calling errors and supplementary info fields, leaving only the routine errors field. The values delivered by these macros may be directly compared with a `GSS_S_XXX` symbol of the appropriate type. The macro `GSS_ERROR()` is also provided, which when applied to a GSS status code returns a non-zero value if the status code indicated a calling or routine error, and a zero value otherwise. All macros defined by GSS-API evaluate their argument(s) exactly once.

A GSS-API implementation may choose to signal calling errors in a platform-specific manner instead of, or in addition to the routine value; routine errors and supplementary info should be returned via major status values only.

The GSS major status code `GSS_S_FAILURE` is used to indicate that the underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code will provide more details about the error.

3.9.2. Mechanism-specific status codes

GSS-API routines return a `minor_status` parameter, which is used to indicate specialized errors from the underlying security mechanism. This parameter may contain a single mechanism-specific error, indicated by a `OM_uint32` value.

The `minor_status` parameter will always be set by a GSS-API routine, even if it returns a calling error or one of the generic API errors indicated above as fatal, although most other output parameters may remain unset in such cases. However, output parameters that are expected to return pointers to storage allocated by a routine must always be set by the routine, even in the event of an error, although in such cases the GSS-API routine may elect to set the returned parameter value to `NULL` to indicate that no storage was actually allocated. Any length field associated with such pointers (as in a `gss_buffer_desc` structure) should also be set to zero in such cases.

3.10. Names

A name is used to identify a person or entity. GSS-API authenticates the relationship between a name and the entity claiming the name.

Since different authentication mechanisms may employ different namespaces for identifying their principals, GSSAPI's naming support is necessarily complex in multi-mechanism environments (or even in some single-mechanism environments where the underlying mechanism supports multiple namespaces).

Two distinct representations are defined for names:

An internal form. This is the GSS-API "native" format for names, represented by the implementation-specific `gss_name_t` type. It is opaque to GSS-API callers. A single `gss_name_t` object may contain multiple names from different namespaces, but all names should refer to the same entity. An example of such an internal name would be the name returned from a call to the `gss_inquire_cred` routine, when applied to a credential containing credential elements for multiple authentication mechanisms employing different namespaces. This `gss_name_t` object will contain a distinct name for the entity for each authentication mechanism.

For GSS-API implementations supporting multiple namespaces, objects of type `gss_name_t` must contain sufficient information to determine the namespace to which each primitive name belongs.

Mechanism-specific contiguous octet-string forms. A format capable of containing a single name (from a single namespace). Contiguous string names are always accompanied by an object identifier specifying the namespace to which the name belongs, and their format is dependent on the authentication mechanism that employs the name. Many, but not all, contiguous string names will be printable, and may therefore be used by GSS-API applications for communication with their users.

Routines (`gss_import_name` and `gss_display_name`) are provided to convert names between contiguous string representations and the internal `gss_name_t` type. `gss_import_name` may support multiple syntaxes for each supported namespace, allowing users the freedom to choose a preferred name representation. `gss_display_name` should use an implementation-chosen printable syntax for each supported name-type.

If an application calls `gss_display_name()`, passing the internal name resulting from a call to `gss_import_name()`, there is no guarantee the the resulting contiguous string name will be the same as the original imported string name. Nor do name-space identifiers necessarily survive unchanged after a journey through the internal name-form. An example of this might be a mechanism that authenticates X.500 names, but provides an algorithmic mapping of Internet DNS names into X.500. That mechanism's implementation of `gss_import_name()` might, when presented with a DNS name, generate an internal name that contained both the original DNS name and the equivalent X.500 name. Alternatively, it might only store the X.500 name. In the latter case, `gss_display_name()` would most likely generate a printable X.500 name, rather than the original DNS name.

The process of authentication delivers to the context acceptor an internal name. Since this name has been authenticated by a single mechanism, it contains only a single name (even if the internal name presented by the context initiator to `gss_init_sec_context` had multiple components). Such names are termed internal mechanism names, or "MN"s and the names emitted by `gss_accept_sec_context()` are always of this type. Since some applications may require MNs without wanting to incur the overhead of an authentication operation, a second function, `gss_canonicalize_name()`, is provided to convert a general internal name into an MN.

Comparison of internal-form names may be accomplished via the `gss_compare_name()` routine, which returns true if the two names being compared refer to the same entity. This removes the need for the application program to understand the syntaxes of the various printable names that a given GSS-API implementation may support. Since GSS-API assumes that all primitive names contained within a

given internal name refer to the same entity, `gss_compare_name()` can return true if the two names have at least one primitive name in common. If the implementation embodies knowledge of equivalence relationships between names taken from different namespaces, this knowledge may also allow successful comparison of internal names containing no overlapping primitive elements.

When used in large access control lists, the overhead of invoking `gss_import_name()` and `gss_compare_name()` on each name from the ACL may be prohibitive. As an alternative way of supporting this case, GSS-API defines a special form of the contiguous string name which may be compared directly (e.g. with `memcmp()`). Contiguous names suitable for comparison are generated by the `gss_export_name()` routine, which requires an MN as input. Exported names may be re-imported by the `gss_import_name()` routine, and the resulting internal name will also be an MN. The `gss_OID` constant `GSS_C_NT_EXPORT_NAME` identifies the "export name" type, and the value of this constant is given in Appendix A. Structurally, an exported name object consists of a header containing an OID identifying the mechanism that authenticated the name, and a trailer containing the name itself, where the syntax of the trailer is defined by the individual mechanism specification. The precise format of an export name is defined in the language-independent GSS-API specification [GSSAPI].

Note that the results obtained by using `gss_compare_name()` will in general be different from those obtained by invoking `gss_canonicalize_name()` and `gss_export_name()`, and then comparing the exported names. The first series of operation determines whether two (unauthenticated) names identify the same principal; the second whether a particular mechanism would authenticate them as the same principal. These two operations will in general give the same results only for MNs.

The `gss_name_t` datatype should be implemented as a pointer type. To allow the compiler to aid the application programmer by performing type-checking, the use of `(void *)` is discouraged. A pointer to an implementation-defined type is the preferred choice.

Storage is allocated by routines that return `gss_name_t` values. A procedure, `gss_release_name`, is provided to free storage associated with an internal-form name.

3.11. Channel Bindings

GSS-API supports the use of user-specified tags to identify a given context to the peer application. These tags are intended to be used to identify the particular communications channel that carries the context. Channel bindings are communicated to the GSS-API using the following structure:

```
typedef struct gss_channel_bindings_struct {
    OM_uint32      initiator_addrtype;
    gss_buffer_desc initiator_address;
    OM_uint32      acceptor_addrtype;
    gss_buffer_desc acceptor_address;
    gss_buffer_desc application_data;
} *gss_channel_bindings_t;
```

The `initiator_addrtype` and `acceptor_addrtype` fields denote the type of addresses contained in the `initiator_address` and `acceptor_address` buffers. The address type should be one of the following:

GSS_C_AF_UNSPEC	Unspecified address type
GSS_C_AF_LOCAL	Host-local address type
GSS_C_AF_INET	Internet address type (e.g. IP)
GSS_C_AF_IMPLINK	ARPAnet IMP address type
GSS_C_AF_PUP	pup protocols (eg BSP) address type
GSS_C_AF_CHAOS	MIT CHAOS protocol address type
GSS_C_AF_NS	XEROX NS address type
GSS_C_AF_NBS	nbs address type
GSS_C_AF_ECMA	ECMA address type
GSS_C_AF_DATAKIT	datakit protocols address type
GSS_C_AF_CCITT	CCITT protocols
GSS_C_AF_SNA	IBM SNA address type
GSS_C_AF_DECnet	DECnet address type
GSS_C_AF_DLI	Direct data link interface address type
GSS_C_AF_LAT	LAT address type
GSS_C_AF_HYLINK	NSC Hyperchannel address type
GSS_C_AF_APPLETALK	AppleTalk address type
GSS_C_AF_BSC	BISYNC 2780/3780 address type
GSS_C_AF_DSS	Distributed system services address type
GSS_C_AF_OSI	OSI TP4 address type
GSS_C_AF_X25	X.25
GSS_C_AF_NULLADDR	No address specified

Note that these symbols name address families rather than specific addressing formats. For address families that contain several alternative address forms, the `initiator_address` and `acceptor_address` fields must contain sufficient information to determine which address

form is used. When not otherwise specified, addresses should be specified in network byte-order (that is, native byte-ordering for the address family).

Conceptually, the GSS-API concatenates the `initiator_addrtype`, `initiator_address`, `acceptor_addrtype`, `acceptor_address` and `application_data` to form an octet string. The mechanism calculates a MIC over this octet string, and binds the MIC to the context establishment token emitted by `gss_init_sec_context`. The same bindings are presented by the context acceptor to `gss_accept_sec_context`, and a MIC is calculated in the same way. The calculated MIC is compared with that found in the token, and if the MICs differ, `gss_accept_sec_context` will return a `GSS_S_BAD_BINDINGS` error, and the context will not be established. Some mechanisms may include the actual channel binding data in the token (rather than just a MIC); applications should therefore not use confidential data as channel-binding components.

Individual mechanisms may impose additional constraints on addresses and address types that may appear in channel bindings. For example, a mechanism may verify that the `initiator_address` field of the channel bindings presented to `gss_init_sec_context` contains the correct network address of the host system. Portable applications should therefore ensure that they either provide correct information for the address fields, or omit addressing information, specifying `GSS_C_AF_NULLADDR` as the address-types.

3.12. Optional parameters

Various parameters are described as optional. This means that they follow a convention whereby a default value may be requested. The following conventions are used for omitted parameters. These conventions apply only to those parameters that are explicitly documented as optional.

3.12.1. `gss_buffer_t` types

Specify `GSS_C_NO_BUFFER` as a value. For an input parameter this signifies that default behavior is requested, while for an output parameter it indicates that the information that would be returned via the parameter is not required by the application.

3.12.2. Integer types (input)

Individual parameter documentation lists values to be used to indicate default actions.

3.12.3. Integer types (output)

Specify NULL as the value for the pointer.

3.12.4. Pointer types

Specify NULL as the value.

3.12.5. Object IDs

Specify GSS_C_NO_OID as the value.

3.12.6. Object ID Sets

Specify GSS_C_NO_OID_SET as the value.

3.12.7. Channel Bindings

Specify GSS_C_NO_CHANNEL_BINDINGS to indicate that channel bindings are not to be used.

4. Additional Controls

This section discusses the optional services that a context initiator may request of the GSS-API at context establishment. Each of these services is requested by setting a flag in the req_flags input parameter to gss_init_sec_context.

The optional services currently defined are:

Delegation - The (usually temporary) transfer of rights from initiator to acceptor, enabling the acceptor to authenticate itself as an agent of the initiator.

Mutual Authentication - In addition to the initiator authenticating its identity to the context acceptor, the context acceptor should also authenticate itself to the initiator.

Replay detection - In addition to providing message integrity services, gss_get_mic and gss_wrap should include message numbering information to enable gss_verify_mic and gss_unwrap to detect if a message has been duplicated.

Out-of-sequence detection - In addition to providing message integrity services, gss_get_mic and gss_wrap should include message sequencing information to enable gss_verify_mic and gss_unwrap to detect if a message has been received out of sequence.

Anonymous authentication - The establishment of the security context should not reveal the initiator's identity to the context acceptor.

Any currently undefined bits within such flag arguments should be ignored by GSS-API implementations when presented by an application, and should be set to zero when returned to the application by the GSS-API implementation.

Some mechanisms may not support all optional services, and some mechanisms may only support some services in conjunction with others. Both `gss_init_sec_context` and `gss_accept_sec_context` inform the applications which services will be available from the context when the establishment phase is complete, via the `ret_flags` output parameter. In general, if the security mechanism is capable of providing a requested service, it should do so, even if additional services must be enabled in order to provide the requested service. If the mechanism is incapable of providing a requested service, it should proceed without the service, leaving the application to abort the context establishment process if it considers the requested service to be mandatory.

Some mechanisms may specify that support for some services is optional, and that implementors of the mechanism need not provide it. This is most commonly true of the confidentiality service, often because of legal restrictions on the use of data-encryption, but may apply to any of the services. Such mechanisms are required to send at least one token from acceptor to initiator during context establishment when the initiator indicates a desire to use such a service, so that the initiating GSS-API can correctly indicate whether the service is supported by the acceptor's GSS-API.

4.1. Delegation

The GSS-API allows delegation to be controlled by the initiating application via a boolean parameter to `gss_init_sec_context()`, the routine that establishes a security context. Some mechanisms do not support delegation, and for such mechanisms attempts by an application to enable delegation are ignored.

The acceptor of a security context for which the initiator enabled delegation will receive (via the `delegated_cred_handle` parameter of `gss_accept_sec_context`) a credential handle that contains the delegated identity, and this credential handle may be used to initiate subsequent GSS-API security contexts as an agent or delegate of the initiator. If the original initiator's identity is "A" and the delegate's identity is "B", then, depending on the underlying mechanism, the identity embodied by the delegated credential may be

either "A" or "B acting for A".

For many mechanisms that support delegation, a simple boolean does not provide enough control. Examples of additional aspects of delegation control that a mechanism might provide to an application are duration of delegation, network addresses from which delegation is valid, and constraints on the tasks that may be performed by a delegate. Such controls are presently outside the scope of the GSS-API. GSS-API implementations supporting mechanisms offering additional controls should provide extension routines that allow these controls to be exercised (perhaps by modifying the initiator's GSS-API credential prior to its use in establishing a context). However, the simple delegation control provided by GSS-API should always be able to over-ride other mechanism-specific delegation controls - If the application instructs `gss_init_sec_context()` that delegation is not desired, then the implementation must not permit delegation to occur. This is an exception to the general rule that a mechanism may enable services even if they are not requested - delegation may only be provided at the explicit request of the application.

4.2. Mutual authentication

Usually, a context acceptor will require that a context initiator authenticate itself so that the acceptor may make an access-control decision prior to performing a service for the initiator. In some cases, the initiator may also request that the acceptor authenticate itself. GSS-API allows the initiating application to request this mutual authentication service by setting a flag when calling `gss_init_sec_context`.

The initiating application is informed as to whether or not the context acceptor has authenticated itself. Note that some mechanisms may not support mutual authentication, and other mechanisms may always perform mutual authentication, whether or not the initiating application requests it. In particular, mutual authentication may be required by some mechanisms in order to support replay or out-of-sequence message detection, and for such mechanisms a request for either of these services will automatically enable mutual authentication.

4.3. Replay and out-of-sequence detection

The GSS-API may provide detection of mis-ordered message once a security context has been established. Protection may be applied to messages by either application, by calling either `gss_get_mic` or `gss_wrap`, and verified by the peer application by calling `gss_verify_mic` or `gss_unwrap`.

`gss_get_mic` calculates a cryptographic MIC over an application message, and returns that MIC in a token. The application should pass both the token and the message to the peer application, which presents them to `gss_verify_mic`.

`gss_wrap` calculates a cryptographic MIC of an application message, and places both the MIC and the message inside a single token. The Application should pass the token to the peer application, which presents it to `gss_unwrap` to extract the message and verify the MIC.

Either pair of routines may be capable of detecting out-of-sequence message delivery, or duplication of messages. Details of such mis-ordered messages are indicated through supplementary status bits in the major status code returned by `gss_verify_mic` or `gss_unwrap`. The relevant supplementary bits are:

`GSS_S_DUPLICATE_TOKEN` - The token is a duplicate of one that has already been received and processed. Only contexts that claim to provide replay detection may set this bit.

`GSS_S_OLD_TOKEN` - The token is too old to determine whether or not it is a duplicate. Contexts supporting out-of-sequence detection but not replay detection should always set this bit if `GSS_S_UNSEQ_TOKEN` is set; contexts that support replay detection should only set this bit if the token is so old that it cannot be checked for duplication.

`GSS_S_UNSEQ_TOKEN` - A later token has already been processed.

`GSS_S_GAP_TOKEN` - An earlier token has not yet been received.

A mechanism need not maintain a list of all tokens that have been processed in order to support these status codes. A typical mechanism might retain information about only the most recent "N" tokens processed, allowing it to distinguish duplicates and missing tokens within the most recent "N" messages; the receipt of a token older than the most recent "N" would result in a `GSS_S_OLD_TOKEN` status.

4.4. Anonymous Authentication

In certain situations, an application may wish to initiate the authentication process to authenticate a peer, without revealing its own identity. As an example, consider an application providing access to a database containing medical information, and offering unrestricted access to the service. A client of such a service might wish to authenticate the service (in order to establish trust in any information retrieved from it), but might not wish the service to be able to obtain the client's identity (perhaps due to privacy concerns about the specific inquiries, or perhaps simply to avoid being placed on mailing-lists).

In normal use of the GSS-API, the initiator's identity is made available to the acceptor as a result of the context establishment process. However, context initiators may request that their identity not be revealed to the context acceptor. Many mechanisms do not support anonymous authentication, and for such mechanisms the request will not be honored. An authentication token will be still be generated, but the application is always informed if a requested service is unavailable, and has the option to abort context establishment if anonymity is valued above the other security services that would require a context to be established.

In addition to informing the application that a context is established anonymously (via the `ret_flags` outputs from `gss_init_sec_context` and `gss_accept_sec_context`), the optional `src_name` output from `gss_accept_sec_context` and `gss_inquire_context` will, for such contexts, return a reserved internal-form name, defined by the implementation.

When presented to `gss_display_name`, this reserved internal-form name will result in a printable name that is syntactically distinguishable from any valid principal name supported by the implementation, associated with a name-type object identifier with the value `GSS_C_NT_ANONYMOUS`, whose value is given in Appendix A. The printable form of an anonymous name should be chosen such that it implies anonymity, since this name may appear in, for example, audit logs. For example, the string "<anonymous>" might be a good choice, if no valid printable names supported by the implementation can begin with "<" and end with ">".

4.5. Confidentiality

If a context supports the confidentiality service, `gss_wrap` may be used to encrypt application messages. Messages are selectively encrypted, under the control of the `conf_req_flag` input parameter to `gss_wrap`.

4.6. Inter-process context transfer

GSS-API V2 provides routines (`gss_export_sec_context` and `gss_import_sec_context`) which allow a security context to be transferred between processes on a single machine. The most common use for such a feature is a client-server design where the server is implemented as a single process that accepts incoming security contexts, which then launches child processes to deal with the data on these contexts. In such a design, the child processes must have access to the security context data structure created within the parent by its call to `gss_accept_sec_context` so that they can use per-message protection services and delete the security context when the communication session ends.

Since the security context data structure is expected to contain sequencing information, it is impractical in general to share a context between processes. Thus GSS-API provides a call (`gss_export_sec_context`) that the process which currently owns the context can call to declare that it has no intention to use the context subsequently, and to create an inter-process token containing information needed by the adopting process to successfully import the context. After successful completion of `gss_export_sec_context`, the original security context is made inaccessible to the calling process by GSS-API, and any context handles referring to this context are no longer valid. The originating process transfers the inter-process token to the adopting process, which passes it to `gss_import_sec_context`, and a fresh `gss_ctx_id_t` is created such that it is functionally identical to the original context.

The inter-process token may contain sensitive data from the original security context (including cryptographic keys). Applications using inter-process tokens to transfer security contexts must take appropriate steps to protect these tokens in transit.

Implementations are not required to support the inter-process transfer of security contexts. The ability to transfer a security context is indicated when the context is created, by `gss_init_sec_context` or `gss_accept_sec_context` setting the `GSS_C_TRANS_FLAG` bit in their `ret_flags` parameter.

4.7. The use of incomplete contexts

Some mechanisms may allow the per-message services to be used before the context establishment process is complete. For example, a mechanism may include sufficient information in its initial context-level token for the context acceptor to immediately decode messages protected with `gss_wrap` or `gss_get_mic`. For such a mechanism, the initiating application need not wait until subsequent context-level

tokens have been sent and received before invoking the per-message protection services.

The ability of a context to provide per-message services in advance of complete context establishment is indicated by the setting of the `GSS_C_PROT_READY_FLAG` bit in the `ret_flags` parameter from `gss_init_sec_context` and `gss_accept_sec_context`. Applications wishing to use per-message protection services on partially-established contexts should check this flag before attempting to invoke `gss_wrap` or `gss_get_mic`.

5. GSS-API Routine Descriptions

In addition to the explicit major status codes documented here, the code `GSS_S_FAILURE` may be returned by any routine, indicating an implementation-specific or mechanism-specific error condition, further details of which are reported via the `minor_status` parameter.

5.1. `gss_accept_sec_context`

```
OM_uint32 gss_accept_sec_context (
    OM_uint32          *minor_status,
    gss_ctx_id_t       *context_handle,
    const gss_cred_id_t acceptor_cred_handle,
    const gss_buffer_t  input_token_buffer,
    const gss_channel_bindings_t input_chan_bindings,
    const gss_name_t    *src_name,
    gss_OID             *mech_type,
    gss_buffer_t        output_token,
    OM_uint32           *ret_flags,
    OM_uint32           *time_rec,
    gss_cred_id_t       *delegated_cred_handle)
```

Purpose:

Allows a remotely initiated security context between the application and a remote peer to be established. The routine may return a `output_token` which should be transferred to the peer application, where the peer application will present it to `gss_init_sec_context`. If no token need be sent, `gss_accept_sec_context` will indicate this by setting the `length` field of the `output_token` argument to zero. To complete the context establishment, one or more reply tokens may be required from the peer application; if so, `gss_accept_sec_context` will return a status flag of `GSS_S_CONTINUE_NEEDED`, in which case it should be called again when the reply token is received from the peer application, passing the token to `gss_accept_sec_context` via the `input_token` parameters.

Portable applications should be constructed to use the token length and return status to determine whether a token needs to be sent or waited for. Thus a typical portable caller should always invoke `gss_accept_sec_context` within a loop:

```
gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;

do {
    receive_token_from_peer(input_token);
    maj_stat = gss_accept_sec_context(&min_stat,
                                     &context_hdl,
                                     cred_hdl,
                                     input_token,
                                     input_bindings,
                                     &client_name,
                                     &mech_type,
                                     output_token,
                                     &ret_flags,
                                     &time_rec,
                                     &deleg_cred);

    if (GSS_ERROR(maj_stat)) {
        report_error(maj_stat, min_stat);
    };
    if (output_token->length != 0) {
        send_token_to_peer(output_token);

        gss_release_buffer(&min_stat, output_token);
    };
    if (GSS_ERROR(maj_stat)) {
        if (context_hdl != GSS_C_NO_CONTEXT)
            gss_delete_sec_context(&min_stat,
                                  &context_hdl,
                                  GSS_C_NO_BUFFER);

        break;
    };
} while (maj_stat & GSS_S_CONTINUE_NEEDED);
```

Whenever the routine returns a major status that includes the value `GSS_S_CONTINUE_NEEDED`, the context is not fully established and the following restrictions apply to the output parameters:

The value returned via the `time_rec` parameter is undefined Unless the accompanying `ret_flags` parameter contains the bit `GSS_C_PROT_READY_FLAG`, indicating that per-message services may be applied in advance of a successful completion status, the value returned via the `mech_type` parameter may be undefined until the routine returns a major status value of `GSS_S_COMPLETE`.

The values of the GSS_C_DELEG_FLAG, GSS_C_MUTUAL_FLAG, GSS_C_REPLAY_FLAG, GSS_C_SEQUENCE_FLAG, GSS_C_CONF_FLAG, GSS_C_INTEG_FLAG and GSS_C_ANON_FLAG bits returned via the ret_flags parameter should contain the values that the implementation expects would be valid if context establishment were to succeed.

The values of the GSS_C_PROT_READY_FLAG and GSS_C_TRANS_FLAG bits within ret_flags should indicate the actual state at the time gss_accept_sec_context returns, whether or not the context is fully established.

Although this requires that GSS-API implementations set the GSS_C_PROT_READY_FLAG in the final ret_flags returned to a caller (i.e. when accompanied by a GSS_S_COMPLETE status code), applications should not rely on this behavior as the flag was not defined in Version 1 of the GSS-API. Instead, applications should be prepared to use per-message services after a successful context establishment, according to the GSS_C_INTEG_FLAG and GSS_C_CONF_FLAG values.

All other bits within the ret_flags argument should be set to zero. While the routine returns GSS_S_CONTINUE_NEEDED, the values returned via the ret_flags argument indicate the services that the implementation expects to be available from the established context.

If the initial call of gss_accept_sec_context() fails, the implementation should not create a context object, and should leave the value of the context_handle parameter set to GSS_C_NO_CONTEXT to indicate this. In the event of a failure on a subsequent call, the implementation is permitted to delete the "half-built" security context (in which case it should set the context_handle parameter to GSS_C_NO_CONTEXT), but the preferred behavior is to leave the security context (and the context_handle parameter) untouched for the application to delete (using gss_delete_sec_context).

During context establishment, the informational status bits GSS_S_OLD_TOKEN and GSS_S_DUPLICATE_TOKEN indicate fatal errors, and GSS-API mechanisms should always return them in association with a routine error of GSS_S_FAILURE. This requirement for pairing did not exist in version 1 of the GSS-API specification, so applications that wish to run over version 1 implementations must special-case these codes.

Parameters:

context_handle	gss_ctx_id_t, read/modify context handle for new context. Supply GSS_C_NO_CONTEXT for first call; use value returned in subsequent calls. Once gss_accept_sec_context() has returned a value via this parameter, resources have been assigned to the corresponding context, and must be freed by the application after use with a call to gss_delete_sec_context().
acceptor_cred_handle	gss_cred_id_t, read Credential handle claimed by context acceptor. Specify GSS_C_NO_CREDENTIAL to accept the context as a default principal. If GSS_C_NO_CREDENTIAL is specified, but no default acceptor principal is defined, GSS_S_NO_CRED will be returned.
input_token_buffer	buffer, opaque, read token obtained from remote application.
input_chan_bindings	channel bindings, read, optional Application-specified bindings. Allows application to securely bind channel identification information to the security context. If channel bindings are not used, specify GSS_C_NO_CHANNEL_BINDINGS.
src_name	gss_name_t, modify, optional Authenticated name of context initiator. After use, this name should be deallocated by passing it to gss_release_name(). If not required, specify NULL.
mech_type	Object ID, modify, optional Security mechanism used. The returned OID value will be a pointer into static storage, and should be treated as read-only by the caller (in particular, it does not need to be freed). If not required, specify NULL.
output_token	buffer, opaque, modify Token to be passed to peer application. If the length field of the returned token buffer is 0, then no token need be passed to the peer application. If a non-zero length field is returned, the associated storage must be freed after use by the application with a call to gss_release_buffer().

`ret_flags`

bit-mask, modify, optional Contains various independent flags, each of which indicates that the context supports a specific service option. If not needed, specify NULL. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically-ANDed with the `ret_flags` value to test whether a given option is supported by the context. The flags are:

`GSS_C_DELEG_FLAG`

True - Delegated credentials are available via the `delegated_cred_handle` parameter

False - No credentials were delegated

`GSS_C_MUTUAL_FLAG`

True - Remote peer asked for mutual authentication

False - Remote peer did not ask for mutual authentication

`GSS_C_REPLAY_FLAG`

True - replay of protected messages will be detected

False - replayed messages will not be detected

`GSS_C_SEQUENCE_FLAG`

True - out-of-sequence protected messages will be detected

False - out-of-sequence messages will not be detected

`GSS_C_CONF_FLAG`

True - Confidentiality service may be invoked by calling the `gss_wrap` routine

False - No confidentiality service (via `gss_wrap`) available. `gss_wrap` will provide message encapsulation, data-origin authentication and integrity services only.

`GSS_C_INTEG_FLAG`

True - Integrity service may be invoked by calling either `gss_get_mic` or `gss_wrap` routines.

False - Per-message integrity service unavailable.

`GSS_C_ANON_FLAG`

True - The initiator does not wish to be authenticated; the `src_name` parameter (if requested) contains

an anonymous internal name.

False - The initiator has been authenticated normally.

GSS_C_PROT_READY_FLAG

True - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available if the accompanying major status return value is either GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED.

False - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the accompanying major status return value is GSS_S_COMPLETE.

GSS_C_TRANS_FLAG

True - The resultant security context may be transferred to other processes via a call to gss_export_sec_context().

False - The security context is not transferable.

All other bits should be set to zero.

time_rec Integer, modify, optional
number of seconds for which the context will remain valid. Specify NULL if not required.

delegated_cred_handle gss_cred_id_t, modify, optional credential handle for credentials received from context initiator. Only valid if deleg_flag in ret_flags is true, in which case an explicit credential handle (i.e. not GSS_C_NO_CREDENTIAL) will be returned; if deleg_flag is false, gss_accept_context() will set this parameter to GSS_C_NO_CREDENTIAL. If a credential handle is returned, the associated resources must be released by the application after use with a call to gss_release_cred(). Specify NULL if not required.

minor_status Integer, modify
Mechanism specific status code.

GSS_S_CONTINUE_NEEDED Indicates that a token from the peer application is required to complete the context, and that gss_accept_sec_context must be called again with that token.

GSS_S_DEFECTIVE_TOKEN Indicates that consistency checks performed on the input_token failed.

GSS_S_DEFECTIVE_CREDENTIAL Indicates that consistency checks performed on the credential failed.

GSS_S_NO_CRED The supplied credentials were not valid for context acceptance, or the credential handle did not reference any credentials.

GSS_S_CREDENTIALS_EXPIRED The referenced credentials have expired.

GSS_S_BAD_BINDINGS The input_token contains different channel bindings to those specified via the input_chan_bindings parameter.

GSS_S_NO_CONTEXT Indicates that the supplied context handle did not refer to a valid context.

GSS_S_BAD_SIG The input_token contains an invalid MIC.

GSS_S_OLD_TOKEN The input_token was too old. This is a fatal error during context establishment.

GSS_S_DUPLICATE_TOKEN The input_token is valid, but is a duplicate of a token already processed. This is a fatal error during context establishment.

GSS_S_BAD_MECH The received token specified a mechanism that is not supported by the implementation or the provided credential.

5.2. gss_acquire_cred

```
OM_uint32 gss_acquire_cred (
    OM_uint32          *minor_status,
    const gss_name_t    desired_name,
    OM_uint32          time_req,
    const gss_OID_set    desired_mechs,
    gss_cred_usage_t    cred_usage,
    gss_cred_id_t        *output_cred_handle,
    gss_OID_set          *actual_mechs,
    OM_uint32          *time_rec)
```


Purpose:

Allows an application to acquire a handle for a pre-existing credential by name. GSS-API implementations must impose a local access-control policy on callers of this routine to prevent unauthorized callers from acquiring credentials to which they are not entitled. This routine is not intended to provide a "login to the network" function, as such a function would involve the creation of new credentials rather than merely acquiring a handle to existing credentials. Such functions, if required, should be defined in implementation-specific extensions to the API.

If `desired_name` is `GSS_C_NO_NAME`, the call is interpreted as a request for a credential handle that will invoke default behavior when passed to `gss_init_sec_context()` (if `cred_usage` is `GSS_C_INITIATE` or `GSS_C_BOTH`) or `gss_accept_sec_context()` (if `cred_usage` is `GSS_C_ACCEPT` or `GSS_C_BOTH`).

Mechanisms should honor the `desired_mechs` parameter, and return a credential that is suitable to use only with the requested mechanisms. An exception to this is the case where one underlying credential element can be shared by multiple mechanisms; in this case it is permissible for an implementation to indicate all mechanisms with which the credential element may be used. If `desired_mechs` is an empty set, behavior is undefined.

This routine is expected to be used primarily by context acceptors, since implementations are likely to provide mechanism-specific ways of obtaining GSS-API initiator credentials from the system login process. Some implementations may therefore not support the acquisition of `GSS_C_INITIATE` or `GSS_C_BOTH` credentials via `gss_acquire_cred` for any name other than `GSS_C_NO_NAME`, or a name produced by applying either `gss_inquire_cred` to a valid credential, or `gss_inquire_context` to an active context.

If credential acquisition is time-consuming for a mechanism, the mechanism may choose to delay the actual acquisition until the credential is required (e.g. by `gss_init_sec_context` or `gss_accept_sec_context`). Such mechanism-specific implementation decisions should be invisible to the calling application; thus a call of `gss_inquire_cred` immediately following the call of `gss_acquire_cred` must return valid credential data, and may therefore incur the overhead of a deferred credential acquisition.

Parameters:

`desired_name` `gss_name_t`, read
Name of principal whose credential should be acquired

`time_req` Integer, read, optional
number of seconds that credentials should remain valid. Specify `GSS_C_INDEFINITE` to request that the credentials have the maximum permitted lifetime.

`desired_mechs` Set of Object IDs, read, optional
set of underlying security mechanisms that may be used. `GSS_C_NO_OID_SET` may be used to obtain an implementation-specific default.

`cred_usage` `gss_cred_usage_t`, read
`GSS_C_BOTH` - Credentials may be used either to initiate or accept security contexts.
`GSS_C_INITIATE` - Credentials will only be used to initiate security contexts.
`GSS_C_ACCEPT` - Credentials will only be used to accept security contexts.

`output_cred_handle` `gss_cred_id_t`, modify
The returned credential handle. Resources associated with this credential handle must be released by the application after use with a call to `gss_release_cred()`.

`actual_mechs` Set of Object IDs, modify, optional
The set of mechanisms for which the credential is valid. Storage associated with the returned OID-set must be released by the application after use with a call to `gss_release_oid_set()`. Specify `NULL` if not required.

`time_rec` Integer, modify, optional
Actual number of seconds for which the returned credentials will remain valid. If the implementation does not support expiration of credentials, the value `GSS_C_INDEFINITE` will be returned. Specify `NULL` if not required

minor_status Integer, modify
 Mechanism specific status code.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_MECH Unavailable mechanism requested

GSS_S_BAD_NAMETYPE Type contained within desired_name parameter
 is not supported

GSS_S_BAD_NAME Value supplied for desired_name parameter is ill
 formed.

GSS_S_CREDENTIALS_EXPIRED The credentials could not be acquired
 Because they have expired.

GSS_S_NO_CRED No credentials were found for the specified name.

5.3. gss_add_cred

```
OM_uint32 gss_add_cred (
    OM_uint32          *minor_status,
    const gss_cred_id_t input_cred_handle,
    const gss_name_t    desired_name,
    const gss_OID        desired_mech,
    gss_cred_usage_t    cred_usage,
    OM_uint32          initiator_time_req,
    OM_uint32          acceptor_time_req,
    gss_cred_id_t        *output_cred_handle,
    gss_OID_set          *actual_mechs,
    OM_uint32          *initiator_time_rec,
    OM_uint32          *acceptor_time_rec)
```

Purpose:

Adds a credential-element to a credential. The credential-element is identified by the name of the principal to which it refers. GSS-API implementations must impose a local access-control policy on callers of this routine to prevent unauthorized callers from acquiring credential-elements to which they are not entitled. This routine is not intended to provide a "login to the network" function, as such a function would involve the creation of new mechanism-specific authentication data, rather than merely acquiring a GSS-API handle to existing data. Such functions, if required, should be defined in implementation-specific extensions to the API.

If `desired_name` is `GSS_C_NO_NAME`, the call is interpreted as a request to add a credential element that will invoke default behavior when passed to `gss_init_sec_context()` (if `cred_usage` is `GSS_C_INITIATE` or `GSS_C_BOTH`) or `gss_accept_sec_context()` (if `cred_usage` is `GSS_C_ACCEPT` or `GSS_C_BOTH`).

This routine is expected to be used primarily by context acceptors, since implementations are likely to provide mechanism-specific ways of obtaining GSS-API initiator credentials from the system login process. Some implementations may therefore not support the acquisition of `GSS_C_INITIATE` or `GSS_C_BOTH` credentials via `gss_acquire_cred` for any name other than `GSS_C_NO_NAME`, or a name produced by applying either `gss_inquire_cred` to a valid credential, or `gss_inquire_context` to an active context.

If credential acquisition is time-consuming for a mechanism, the mechanism may choose to delay the actual acquisition until the credential is required (e.g. by `gss_init_sec_context` or `gss_accept_sec_context`). Such mechanism-specific implementation decisions should be invisible to the calling application; thus a call of `gss_inquire_cred` immediately following the call of `gss_add_cred` must return valid credential data, and may therefore incur the overhead of a deferred credential acquisition.

This routine can be used to either compose a new credential containing all credential-elements of the original in addition to the newly-acquire credential-element, or to add the new credential-element to an existing credential. If `NULL` is specified for the `output_cred_handle` parameter argument, the new credential-element will be added to the credential identified by `input_cred_handle`; if a valid pointer is specified for the `output_cred_handle` parameter, a new credential handle will be created.

If `GSS_C_NO_CREDENTIAL` is specified as the `input_cred_handle`, `gss_add_cred` will compose a credential (and set the `output_cred_handle` parameter accordingly) based on default behavior. That is, the call will have the same effect as if the application had first made a call to `gss_acquire_cred()`, specifying the same usage and passing `GSS_C_NO_NAME` as the `desired_name` parameter to obtain an explicit credential handle embodying default behavior, passed this credential handle to `gss_add_cred()`, and finally called `gss_release_cred()` on the first credential handle.

If `GSS_C_NO_CREDENTIAL` is specified as the `input_cred_handle` parameter, a non-`NULL` `output_cred_handle` must be supplied.

Parameters:

minor_status Integer, modify
Mechanism specific status code.

input_cred_handle gss_cred_id_t, read, optional
The credential to which a credential-element will be added. If GSS_C_NO_CREDENTIAL is specified, the routine will compose the new credential based on default behavior (see description above). Note that, while the credential-handle is not modified by gss_add_cred(), the underlying credential will be modified if output_credential_handle is NULL.

desired_name gss_name_t, read.
Name of principal whose credential should be acquired.

desired_mech Object ID, read
Underlying security mechanism with which the credential may be used.

cred_usage gss_cred_usage_t, read
GSS_C_BOTH - Credential may be used either to initiate or accept security contexts.
GSS_C_INITIATE - Credential will only be used to initiate security contexts.
GSS_C_ACCEPT - Credential will only be used to accept security contexts.

initiator_time_req Integer, read, optional
number of seconds that the credential should remain valid for initiating security contexts. This argument is ignored if the composed credentials are of type GSS_C_ACCEPT. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted initiator lifetime.

acceptor_time_req Integer, read, optional
number of seconds that the credential should remain valid for accepting security contexts. This argument is ignored if the composed credentials are of type GSS_C_INITIATE.

Specify `GSS_C_INDEFINITE` to request that the credentials have the maximum permitted initiator lifetime.

`output_cred_handle` `gss_cred_id_t`, modify, optional
The returned credential handle, containing the new credential-element and all the credential-elements from `input_cred_handle`. If a valid pointer to a `gss_cred_id_t` is supplied for this parameter, `gss_add_cred` creates a new credential handle containing all credential-elements from the `input_cred_handle` and the newly acquired credential-element; if `NULL` is specified for this parameter, the newly acquired credential-element will be added to the credential identified by `input_cred_handle`.

The resources associated with any credential handle returned via this parameter must be released by the application after use with a call to `gss_release_cred()`.

`actual_mechs` Set of Object IDs, modify, optional
The complete set of mechanisms for which the new credential is valid. Storage for the returned OID-set must be freed by the application after use with a call to `gss_release_oid_set()`. Specify `NULL` if not required.

`initiator_time_rec` Integer, modify, optional
Actual number of seconds for which the returned credentials will remain valid for initiating contexts using the specified mechanism. If the implementation or mechanism does not support expiration of credentials, the value `GSS_C_INDEFINITE` will be returned. Specify `NULL` if not required

`acceptor_time_rec` Integer, modify, optional
Actual number of seconds for which the returned credentials will remain valid for accepting security contexts using the specified mechanism. If the implementation or mechanism does not support expiration of credentials, the value `GSS_C_INDEFINITE` will be returned. Specify `NULL` if not required

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_MECH Unavailable mechanism requested

GSS_S_BAD_NAMETYPE Type contained within `desired_name` parameter is not supported

GSS_S_BAD_NAME Value supplied for `desired_name` parameter is ill-formed.

GSS_S_DUPLICATE_ELEMENT The credential already contains an element for the requested mechanism with overlapping usage and validity period.

GSS_S_CREDENTIALS_EXPIRED The required credentials could not be added because they have expired.

GSS_S_NO_CRED No credentials were found for the specified name.

5.4. `gss_add_oid_set_member`

```
OM_uint32 gss_add_oid_set_member (
    OM_uint32      *minor_status,
    const gss_OID  member_oid,
    gss_OID_set     *oid_set)
```

Purpose:

Add an Object Identifier to an Object Identifier set. This routine is intended for use in conjunction with `gss_create_empty_oid_set` when constructing a set of mechanism OIDs for input to `gss_acquire_cred`. The `oid_set` parameter must refer to an OID-set that was created by GSS-API (e.g. a set returned by `gss_create_empty_oid_set()`). GSS-API creates a copy of the `member_oid` and inserts this copy into the set, expanding the storage allocated to the OID-set's elements array if necessary. The routine may add the new member OID anywhere within the elements array, and implementations should verify that the new `member_oid` is not already contained within the elements array; if the `member_oid` is already present, the `oid_set` should remain unchanged.

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code
---------------------------	---

member_oid	Object ID, read The object identifier to copied into the set.
oid_set	Set of Object ID, modify The set in which the object identifier should be inserted.

Function value: GSS status code

GSS_S_COMPLETE	Successful completion
----------------	-----------------------

5.5. gss_canonicalize_name

```
OM_uint32 gss_canonicalize_name (
    OM_uint32      *minor_status,
    const gss_name_t input_name,
    const gss_OID   mech_type,
    gss_name_t      *output_name)
```

Purpose:

Generate a canonical mechanism name (MN) from an arbitrary internal name. The mechanism name is the name that would be returned to a context acceptor on successful authentication of a context where the initiator used the input_name in a successful call to gss_acquire_cred, specifying an OID set containing <mech_type> as its only member, followed by a call to gss_init_sec_context, specifying <mech_type> as the authentication mechanism.

Parameters:

minor_status	Integer, modify Mechanism specific status code
input_name	gss_name_t, read The name for which a canonical form is desired
mech_type	Object ID, read The authentication mechanism for which the canonical form of the name is desired. The desired mechanism must be specified explicitly; no default is provided.

output_name gss_name_t, modify
 The resultant canonical name. Storage
 associated with this name must be freed by
 the application after use with a call to
 gss_release_name().

Function value: GSS status code

GSS_S_COMPLETE Successful completion.

GSS_S_BAD_MECH The identified mechanism is not supported.

GSS_S_BAD_NAME The provided internal name was ill-formed.

GSS_S_BAD_NAME_TYPE The provided internal name contains no elements
 that could be processed by the specified
 mechanism.

5.6. gss_compare_name

```
OM_uint32 gss_compare_name (
    OM_uint32      *minor_status,
    const gss_name_t name1,
    const gss_name_t name2,
    int             *name_equal)
```

Purpose:

Allows an application to compare two internal-form names to determine whether they refer to the same entity.

If either name presented to gss_compare_name denotes an anonymous principal, the routines should indicate that the two names do not refer to the same identity.

Parameters:

minor_status Integer, modify
 Mechanism specific status code.

name1 gss_name_t, read
 internal-form name

name2 gss_name_t, read
 internal-form name

name_equal boolean, modify
 non-zero - names refer to same entity
 zero - names refer to different entities
 (strictly, the names are not known
 to refer to the same identity).

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_NAME_TYPE The two names were of incomparable types.

GSS_S_BAD_NAME One or both of name1 or name2 was ill-formed.

5.7. gss_context_time

```
OM_uint32 gss_context_time (
    OM_uint32          *minor_status,
    const gss_ctx_id_t context_handle,
    OM_uint32          *time_rec)
```

Purpose:

Determines the number of seconds for which the specified context will remain valid.

Parameters:

minor_status Integer, modify
 Implementation specific status code.

context_handle gss_ctx_id_t, read
 Identifies the context to be interrogated.

time_rec Integer, modify
 Number of seconds that the context will remain
 valid. If the context has already expired,
 zero will be returned.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_CONTEXT_EXPIRED The context has already expired

GSS_S_NO_CONTEXT The context_handle parameter did not identify
 a valid context

5.8. gss_create_empty_oid_set

```
OM_uint32 gss_create_empty_oid_set (
    OM_uint32      *minor_status,
    gss_OID_set    *oid_set)
```

Purpose:

Create an object-identifier set containing no object identifiers, to which members may be subsequently added using the `gss_add_oid_set_member()` routine. These routines are intended to be used to construct sets of mechanism object identifiers, for input to `gss_acquire_cred`.

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code
<code>oid_set</code>	Set of Object IDs, modify The empty object identifier set. The routine will allocate the <code>gss_OID_set_desc</code> object, which the application must free after use with a call to <code>gss_release_oid_set()</code> .

Function value: GSS status code

`GSS_S_COMPLETE` Successful completion

5.9. gss_delete_sec_context

```
OM_uint32 gss_delete_sec_context (
    OM_uint32      *minor_status,
    gss_ctx_id_t   *context_handle,
    gss_buffer_t    output_token)
```

Purpose:

Delete a security context. `gss_delete_sec_context` will delete the local data structures associated with the specified security context, and may generate an `output_token`, which when passed to the peer `gss_process_context_token` will instruct it to do likewise. If no token is required by the mechanism, the GSS-API should set the length field of the `output_token` (if provided) to zero. No further security services may be obtained using the context specified by `context_handle`.

In addition to deleting established security contexts, `gss_delete_sec_context` must also be able to delete "half-built" security contexts resulting from an incomplete sequence of `gss_init_sec_context()`/`gss_accept_sec_context()` calls.

The `output_token` parameter is retained for compatibility with version 1 of the GSS-API. It is recommended that both peer applications invoke `gss_delete_sec_context` passing the value `GSS_C_NO_BUFFER` for the `output_token` parameter, indicating that no token is required, and that `gss_delete_sec_context` should simply delete local context data structures. If the application does pass a valid buffer to `gss_delete_sec_context`, mechanisms are encouraged to return a zero-length token, indicating that no peer action is necessary, and that no token should be transferred by the application.

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code.
<code>context_handle</code>	<code>gss_ctx_id_t</code> , modify context handle identifying context to delete. After deleting the context, the GSS-API will set this context handle to <code>GSS_C_NO_CONTEXT</code> .
<code>output_token</code>	buffer, opaque, modify, optional token to be sent to remote application to instruct it to also delete the context. It is recommended that applications specify <code>GSS_C_NO_BUFFER</code> for this parameter, requesting local deletion only. If a buffer parameter is provided by the application, the mechanism may return a token in it; mechanisms that implement only local deletion should set the length field of this token to zero to indicate to the application that no token is to be sent to the peer.
Function value:	GSS status code
<code>GSS_S_COMPLETE</code>	Successful completion
<code>GSS_S_NO_CONTEXT</code>	No valid context was supplied

5.10.gss_display_name

```
OM_uint32 gss_display_name (
    OM_uint32      *minor_status,
    const gss_name_t input_name,
    gss_buffer_t    output_name_buffer,
    gss_OID         *output_name_type)
```

Purpose:

Allows an application to obtain a textual representation of an opaque internal-form name for display purposes. The syntax of a printable name is defined by the GSS-API implementation.

If input_name denotes an anonymous principal, the implementation should return the gss_OID value GSS_C_NT_ANONYMOUS as the output_name_type, and a textual name that is syntactically distinct from all valid supported printable names in output_name_buffer.

If input_name was created by a call to gss_import_name, specifying GSS_C_NO_OID as the name-type, implementations that employ lazy conversion between name types may return GSS_C_NO_OID via the output_name_type parameter.

Parameters:

minor_status	Integer, modify Mechanism specific status code.
input_name	gss_name_t, read name to be displayed
output_name_buffer	buffer, character-string, modify buffer to receive textual name string. The application must free storage associated with this name after use with a call to gss_release_buffer().
output_name_type	Object ID, modify, optional The type of the returned name. The returned gss_OID will be a pointer into static storage, and should be treated as read-only by the caller (in particular, the application should not attempt to free it). Specify NULL if not required.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_NAME input_name was ill-formed

5.11.gss_display_status

```
OM_uint32 gss_display_status (
    OM_uint32      *minor_status,
    OM_uint32      status_value,
    int            status_type,
    const gss_OID  mech_type,
    OM_uint32      *message_context,
    gss_buffer_t    status_string)
```

Purpose:

Allows an application to obtain a textual representation of a GSS-API status code, for display to the user or for logging purposes. Since some status values may indicate multiple conditions, applications may need to call `gss_display_status` multiple times, each call generating a single text string. The `message_context` parameter is used by `gss_display_status` to store state information about which error messages have already been extracted from a given `status_value`; `message_context` must be initialized to 0 by the application prior to the first call, and `gss_display_status` will return a non-zero value in this parameter if there are further messages to extract.

The `message_context` parameter contains all state information required by `gss_display_status` in order to extract further messages from the `status_value`; even when a non-zero value is returned in this parameter, the application is not required to call `gss_display_status` again unless subsequent messages are desired. The following code extracts all messages from a given status code and prints them to `stderr`:

```
OM_uint32 message_context;
OM_uint32 status_code;
OM_uint32 maj_status;
OM_uint32 min_status;
gss_buffer_desc status_string;
```

...

```
message_context = 0;
```

```
do {
```

```

maj_status = gss_display_status (
    &min_status,
    status_code,
    GSS_C_GSS_CODE,
    GSS_C_NO_OID,
    &message_context,
    &status_string)

fprintf(stderr,
    "%. *s\n",
    (int)status_string.length,

    (char *)status_string.value);

gss_release_buffer(&min_status, &status_string);
} while (message_context != 0);

```

Parameters:

minor_status	Integer, modify Mechanism specific status code.
status_value	Integer, read Status value to be converted
status_type	Integer, read GSS_C_GSS_CODE - status_value is a GSS status code
GSS_C_MECH_CODE	- status_value is a mechanism status code
mech_type	Object ID, read, optional Underlying mechanism (used to interpret a minor status value) Supply GSS_C_NO_OID to obtain the system default.
message_context	Integer, read/modify Should be initialized to zero by the application prior to the first call. On return from gss_display_status(), a non-zero status_value parameter indicates that additional messages may be extracted from the status code via subsequent calls

to `gss_display_status()`, passing the same `status_value`, `status_type`, `mech_type`, and `message_context` parameters.

<code>status_string</code>	buffer, character string, modify textual interpretation of the <code>status_value</code> . Storage associated with this parameter must be freed by the application after use with a call to <code>gss_release_buffer()</code> .
Function value:	GSS status code
<code>GSS_S_COMPLETE</code>	Successful completion
<code>GSS_S_BAD_MECH</code>	Indicates that translation in accordance with an unsupported mechanism type was requested
<code>GSS_S_BAD_STATUS</code>	The status value was not recognized, or the status type was neither <code>GSS_C_GSS_CODE</code> nor <code>GSS_C_MECH_CODE</code> .

5.12. `gss_duplicate_name`

```
OM_uint32 gss_duplicate_name (
    OM_uint32      *minor_status,
    const gss_name_t src_name,
    gss_name_t      *dest_name)
```

Purpose:

Create an exact duplicate of the existing internal name `src_name`. The new `dest_name` will be independent of `src_name` (i.e. `src_name` and `dest_name` must both be released, and the release of one shall not affect the validity of the other).

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code.
<code>src_name</code>	<code>gss_name_t</code> , read internal name to be duplicated.
<code>dest_name</code>	<code>gss_name_t</code> , modify The resultant copy of <code><src_name></code> . Storage associated with this name must be freed by the application after use with a call to <code>gss_release_name()</code> .

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_NAME The src_name parameter was ill-formed.

5.13. gss_export_name

```
OM_uint32 gss_export_name (
    OM_uint32          *minor_status,
    const gss_name_t   input_name,
    gss_buffer_t       exported_name)
```

Purpose:

To produce a canonical contiguous string representation of a mechanism name (MN), suitable for direct comparison (e.g. with memcmp) for use in authorization functions (e.g. matching entries in an access-control list). The <input_name> parameter must specify a valid MN (i.e. an internal name generated by gss_accept_sec_context or by gss_canonicalize_name).

Parameters:

minor_status Integer, modify
Mechanism specific status code

input_name gss_name_t, read
The MN to be exported

exported_name gss_buffer_t, octet-string, modify
The canonical contiguous string form of
<input_name>. Storage associated with
this string must freed by the application
after use with gss_release_buffer().

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_NAME_NOT_MN The provided internal name was not a mechanism name.

GSS_S_BAD_NAME The provided internal name was ill-formed.

GSS_S_BAD_NAME_TYPE The internal name was of a type not supported by the GSS-API implementation.

5.14. gss_export_sec_context

```
OM_uint32 gss_export_sec_context (
    OM_uint32      *minor_status,
    gss_ctx_id_t   *context_handle,
    gss_buffer_t    interprocess_token)
```

Purpose:

Provided to support the sharing of work between multiple processes. This routine will typically be used by the context-acceptor, in an application where a single process receives incoming connection requests and accepts security contexts over them, then passes the established context to one or more other processes for message exchange. `gss_export_sec_context()` deactivates the security context for the calling process and creates an interprocess token which, when passed to `gss_import_sec_context` in another process, will re-activate the context in the second process. Only a single instantiation of a given context may be active at any one time; a subsequent attempt by a context exporter to access the exported security context will fail.

The implementation may constrain the set of processes by which the interprocess token may be imported, either as a function of local security policy, or as a result of implementation decisions. For example, some implementations may constrain contexts to be passed only between processes that run under the same account, or which are part of the same process group.

The interprocess token may contain security-sensitive information (for example cryptographic keys). While mechanisms are encouraged to either avoid placing such sensitive information within interprocess tokens, or to encrypt the token before returning it to the application, in a typical object-library GSS-API implementation this may not be possible. Thus the application must take care to protect the interprocess token, and ensure that any process to which the token is transferred is trustworthy.

If creation of the interprocess token is successful, the implementation shall deallocate all process-wide resources associated with the security context, and set the `context_handle` to `GSS_C_NO_CONTEXT`. In the event of an error that makes it impossible to complete the export of the security context, the implementation must not return an interprocess token, and should strive to leave the security context referenced by the `context_handle` parameter untouched. If this is impossible, it is permissible for the implementation to delete the security context, providing it also sets the `context_handle` parameter to `GSS_C_NO_CONTEXT`.

Parameters:

`minor_status` Integer, modify
Mechanism specific status code

`context_handle` `gss_ctx_id_t`, modify
context handle identifying the context to transfer.

`interprocess_token` buffer, opaque, modify
token to be transferred to target process.
Storage associated with this token must be freed by the application after use with a call to `gss_release_buffer()`.

Function value: GSS status code

`GSS_S_COMPLETE` Successful completion

`GSS_S_CONTEXT_EXPIRED` The context has expired

`GSS_S_NO_CONTEXT` The context was invalid

`GSS_S_UNAVAILABLE` The operation is not supported.

5.15. `gss_get_mic`

```
OM_uint32 gss_get_mic (  
    OM_uint32          *minor_status,  
    const gss_ctx_id_t context_handle,  
    gss_qop_t          qop_req,  
    const gss_buffer_t message_buffer,  
    gss_buffer_t       msg_token)
```

Purpose:

Generates a cryptographic MIC for the supplied message, and places the MIC in a token for transfer to the peer application. The `qop_req` parameter allows a choice between several cryptographic algorithms, if supported by the chosen mechanism.

Since some application-level protocols may wish to use tokens emitted by `gss_wrap()` to provide "secure framing", implementations must support derivation of MICs from zero-length messages.

Parameters:

minor_status	Integer, modify Implementation specific status code.
context_handle	gss_ctx_id_t, read identifies the context on which the message will be sent
qop_req	gss_qop_t, read, optional Specifies requested quality of protection. Callers are encouraged, on portability grounds, to accept the default quality of protection offered by the chosen mechanism, which may be requested by specifying GSS_C_QOP_DEFAULT for this parameter. If an unsupported protection strength is requested, gss_get_mic will return a major_status of GSS_S_BAD_QOP.
message_buffer	buffer, opaque, read message to be protected
msg_token	buffer, opaque, modify buffer to receive token. The application must free storage associated with this buffer after use with a call to gss_release_buffer().
Function value:	GSS status code
GSS_S_COMPLETE	Successful completion
GSS_S_CONTEXT_EXPIRED	The context has already expired
GSS_S_NO_CONTEXT	The context_handle parameter did not identify a valid context
GSS_S_BAD_QOP	The specified QOP is not supported by the mechanism.

5.16. gss_import_name

```
OM_uint32 gss_import_name (
    OM_uint32          *minor_status,
    const gss_buffer_t input_name_buffer,
    const gss_OID       input_name_type,
    gss_name_t          *output_name)
```

Purpose:

Convert a contiguous string name to internal form. In general, the internal name returned (via the <output_name> parameter) will not be an MN; the exception to this is if the <input_name_type> indicates that the contiguous string provided via the <input_name_buffer> parameter is of type GSS_C_NT_EXPORT_NAME, in which case the returned internal name will be an MN for the mechanism that exported the name.

Parameters:

minor_status	Integer, modify Mechanism specific status code
input_name_buffer	buffer, octet-string, read buffer containing contiguous string name to convert
input_name_type	Object ID, read, optional Object ID specifying type of printable name. Applications may specify either GSS_C_NO_OID to use a mechanism-specific default printable syntax, or an OID recognized by the GSS-API implementation to name a specific namespace.
output_name	gss_name_t, modify returned name in internal form. Storage associated with this name must be freed by the application after use with a call to gss_release_name().
Function value:	GSS status code
GSS_S_COMPLETE	Successful completion
GSS_S_BAD_NAME_TYPE	The input_name_type was unrecognized
GSS_S_BAD_NAME	The input_name parameter could not be interpreted as a name of the specified type
GSS_S_BAD_MECH	The input name-type was GSS_C_NT_EXPORT_NAME, but the mechanism contained within the input-name is not supported

5.17. gss_import_sec_context

```
OM_uint32 gss_import_sec_context (
    OM_uint32      *minor_status,
    const gss_buffer_t interprocess_token,
    gss_ctx_id_t   *context_handle)
```

Purpose:

Allows a process to import a security context established by another process. A given interprocess token may be imported only once. See gss_export_sec_context.

Parameters:

minor_status Integer, modify
 Mechanism specific status code

interprocess_token buffer, opaque, modify
 token received from exporting process

context_handle gss_ctx_id_t, modify
 context handle of newly reactivated context.
 Resources associated with this context handle
 must be released by the application after use
 with a call to gss_delete_sec_context().

Function value: GSS status code

GSS_S_COMPLETE Successful completion.

GSS_S_NO_CONTEXT The token did not contain a valid context
reference.

GSS_S_DEFECTIVE_TOKEN The token was invalid.

GSS_S_UNAVAILABLE The operation is unavailable.

GSS_S_UNAUTHORIZED Local policy prevents the import of this context
 by the current process.

5.18. gss_indicate_mechs

```
OM_uint32 gss_indicate_mechs (
    OM_uint32      *minor_status,
    gss_OID_set    *mech_set)
```

Purpose:

Allows an application to determine which underlying security mechanisms are available.

Parameters:

minor_status	Integer, modify Mechanism specific status code.
mech_set	set of Object IDs, modify set of implementation-supported mechanisms. The returned gss_OID_set value will be a dynamically-allocated OID set, that should be released by the caller after use with a call to gss_release_oid_set().
Function value:	GSS status code
GSS_S_COMPLETE	Successful completion

5.19. gss_init_sec_context

```
OM_uint32 gss_init_sec_context (
    OM_uint32                *minor_status,
    const gss_cred_id_t      initiator_cred_handle,
    gss_ctx_id_t             *context_handle, \
    const gss_name_t         target_name,
    const gss_OID            mech_type,
    OM_uint32                req_flags,
    OM_uint32                time_req,
    const gss_channel_bindings_t input_chan_bindings,
    const gss_buffer_t        input_token,
    gss_OID                  *actual_mech_type,
    gss_buffer_t             output_token,
    OM_uint32                *ret_flags,
    OM_uint32                *time_rec )
```

Purpose:

Initiates the establishment of a security context between the application and a remote peer. Initially, the input_token parameter should be specified either as GSS_C_NO_BUFFER, or as a pointer to a gss_buffer_desc object whose length field contains the value zero. The routine may return a output_token which should be transferred to the peer application, where the peer application will present it to gss_accept_sec_context. If no token need be sent, gss_init_sec_context will indicate this by setting the length field

of the `output_token` argument to zero. To complete the context establishment, one or more reply tokens may be required from the peer application; if so, `gss_init_sec_context` will return a status containing the supplementary information bit `GSS_S_CONTINUE_NEEDED`. In this case, `gss_init_sec_context` should be called again when the reply token is received from the peer application, passing the reply token to `gss_init_sec_context` via the `input_token` parameters.

Portable applications should be constructed to use the token length and return status to determine whether a token needs to be sent or waited for. Thus a typical portable caller should always invoke `gss_init_sec_context` within a loop:

```
int context_established = 0;
gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;
...
input_token->length = 0;

while (!context_established) {
    maj_stat = gss_init_sec_context(&min_stat,
                                    cred_hdl,
                                    &context_hdl,
                                    target_name,
                                    desired_mech,
                                    desired_services,
                                    desired_time,
                                    input_bindings,
                                    input_token,
                                    &actual_mech,
                                    output_token,
                                    &actual_services,
                                    &actual_time);

    if (GSS_ERROR(maj_stat)) {
        report_error(maj_stat, min_stat);
    };

    if (output_token->length != 0) {
        send_token_to_peer(output_token);
        gss_release_buffer(&min_stat, output_token)
    };
    if (GSS_ERROR(maj_stat)) {

        if (context_hdl != GSS_C_NO_CONTEXT)
            gss_delete_sec_context(&min_stat,
                                   &context_hdl,
                                   GSS_C_NO_BUFFER);

        break;
    };
};
```



```
if (maj_stat & GSS_S_CONTINUE_NEEDED) {
    receive_token_from_peer(input_token);
} else {
    context_established = 1;
};
};
```

Whenever the routine returns a major status that includes the value `GSS_S_CONTINUE_NEEDED`, the context is not fully established and the following restrictions apply to the output parameters:

The value returned via the `time_rec` parameter is undefined Unless the accompanying `ret_flags` parameter contains the bit `GSS_C_PROT_READY_FLAG`, indicating that per-message services may be applied in advance of a successful completion status, the value returned via the `actual_mech_type` parameter is undefined until the routine returns a major status value of `GSS_S_COMPLETE`.

The values of the `GSS_C_DELEG_FLAG`, `GSS_C_MUTUAL_FLAG`, `GSS_C_REPLAY_FLAG`, `GSS_C_SEQUENCE_FLAG`, `GSS_C_CONF_FLAG`, `GSS_C_INTEG_FLAG` and `GSS_C_ANON_FLAG` bits returned via the `ret_flags` parameter should contain the values that the implementation expects would be valid if context establishment were to succeed. In particular, if the application has requested a service such as delegation or anonymous authentication via the `req_flags` argument, and such a service is unavailable from the underlying mechanism, `gss_init_sec_context` should generate a token that will not provide the service, and indicate via the `ret_flags` argument that the service will not be supported. The application may choose to abort the context establishment by calling `gss_delete_sec_context` (if it cannot continue in the absence of the service), or it may choose to transmit the token and continue context establishment (if the service was merely desired but not mandatory).

The values of the `GSS_C_PROT_READY_FLAG` and `GSS_C_TRANS_FLAG` bits within `ret_flags` should indicate the actual state at the time `gss_init_sec_context` returns, whether or not the context is fully established.

GSS-API implementations that support per-message protection are encouraged to set the `GSS_C_PROT_READY_FLAG` in the final `ret_flags` returned to a caller (i.e. when accompanied by a `GSS_S_COMPLETE` status code). However, applications should not rely on this behavior as the flag was not defined in Version 1 of the GSS-API. Instead, applications should determine what per-message services are available after a successful context establishment according to the `GSS_C_INTEG_FLAG` and `GSS_C_CONF_FLAG` values.

All other bits within the `ret_flags` argument should be set to zero.

If the initial call of `gss_init_sec_context()` fails, the implementation should not create a context object, and should leave the value of the `context_handle` parameter set to `GSS_C_NO_CONTEXT` to indicate this. In the event of a failure on a subsequent call, the implementation is permitted to delete the "half-built" security context (in which case it should set the `context_handle` parameter to `GSS_C_NO_CONTEXT`), but the preferred behavior is to leave the security context untouched for the application to delete (using `gss_delete_sec_context()`).

During context establishment, the informational status bits `GSS_S_OLD_TOKEN` and `GSS_S_DUPLICATE_TOKEN` indicate fatal errors, and GSS-API mechanisms should always return them in association with a routine error of `GSS_S_FAILURE`. This requirement for pairing did not exist in version 1 of the GSS-API specification, so applications that wish to run over version 1 implementations must special-case these codes.

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code.
<code>initiator_cred_handle</code>	<code>gss_cred_id_t</code> , read, optional handle for credentials claimed. Supply <code>GSS_C_NO_CREDENTIAL</code> to act as a default initiator principal. If no default initiator is defined, the function will return <code>GSS_S_NO_CRED</code> .
<code>context_handle</code>	<code>gss_ctx_id_t</code> , read/modify context handle for new context. Supply <code>GSS_C_NO_CONTEXT</code> for first call; use value returned by first call in continuation calls. Resources associated with this context-handle must be released by the application after use with a call to <code>gss_delete_sec_context()</code> .
<code>target_name</code>	<code>gss_name_t</code> , read Name of target
<code>mech_type</code>	OID, read, optional Object ID of desired mechanism. Supply <code>GSS_C_NO_OID</code> to obtain an implementation specific default

`req_flags` bit-mask, read

Contains various independent flags, each of which requests that the context support a specific service option. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically-ORed together to form the bit-mask value. The flags are:

`GSS_C_DELEG_FLAG`
True - Delegate credentials to remote peer
False - Don't delegate

`GSS_C_MUTUAL_FLAG`
True - Request that remote peer authenticate itself
False - Authenticate self to remote peer only

`GSS_C_REPLAY_FLAG`
True - Enable replay detection for messages protected with `gss_wrap` or `gss_get_mic`
False - Don't attempt to detect replayed messages

`GSS_C_SEQUENCE_FLAG`
True - Enable detection of out-of-sequence protected messages
False - Don't attempt to detect out-of-sequence messages

`GSS_C_CONF_FLAG`
True - Request that confidentiality service be made available (via `gss_wrap`)
False - No per-message confidentiality service is required.

`GSS_C_INTEG_FLAG`
True - Request that integrity service be made available (via `gss_wrap` or `gss_get_mic`)
False - No per-message integrity service is required.

GSS_C_ANON_FLAG
True - Do not reveal the initiator's identity to the acceptor.
False - Authenticate normally.

time_req Integer, read, optional
Desired number of seconds for which context should remain valid. Supply 0 to request a default validity period.

input_chan_bindings channel bindings, read, optional
Application-specified bindings. Allows application to securely bind channel identification information to the security context. Specify GSS_C_NO_CHANNEL_BINDINGS if channel bindings are not used.

input_token buffer, opaque, read, optional (see text)
Token received from peer application. Supply GSS_C_NO_BUFFER, or a pointer to a buffer containing the value GSS_C_EMPTY_BUFFER on initial call.

actual_mech_type OID, modify, optional
Actual mechanism used. The OID returned via this parameter will be a pointer to static storage that should be treated as read-only; In particular the application should not attempt to free it. Specify NULL if not required.

output_token buffer, opaque, modify
token to be sent to peer application. If the length field of the returned buffer is zero, no token need be sent to the peer application. Storage associated with this buffer must be freed by the application after use with a call to gss_release_buffer().

ret_flags bit-mask, modify, optional
Contains various independent flags, each of which indicates that the context supports a specific service option. Specify NULL if not required. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically-ANDed with the ret_flags value to test whether a given option is supported by the context. The flags are:

GSS_C_DELEG_FLAG

- True - Credentials were delegated to the remote peer
- False - No credentials were delegated

GSS_C_MUTUAL_FLAG

- True - The remote peer has authenticated itself.
- False - Remote peer has not authenticated itself.

GSS_C_REPLAY_FLAG

- True - replay of protected messages will be detected
- False - replayed messages will not be detected

GSS_C_SEQUENCE_FLAG

- True - out-of-sequence protected messages will be detected
- False - out-of-sequence messages will not be detected

GSS_C_CONF_FLAG

- True - Confidentiality service may be invoked by calling gss_wrap routine
- False - No confidentiality service (via gss_wrap) available. gss_wrap will provide message encapsulation, data-origin authentication and integrity services only.

GSS_C_INTEG_FLAG

- True - Integrity service may be invoked by calling either gss_get_mic or gss_wrap routines.
- False - Per-message integrity service unavailable.

GSS_C_ANON_FLAG

- True - The initiator's identity has not been revealed, and will not be revealed if any emitted token is passed to the acceptor.
- False - The initiator's identity has been or will be authenticated normally.

GSS_C_PROT_READY_FLAG

True - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available for use if the accompanying major status return value is either GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED.

False - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the accompanying major status return value is GSS_S_COMPLETE.

GSS_C_TRANS_FLAG

True - The resultant security context may be transferred to other processes via a call to gss_export_sec_context().

False - The security context is not transferable.

All other bits should be set to zero.

time_rec Integer, modify, optional number of seconds for which the context will remain valid. If the implementation does not support context expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_CONTINUE_NEEDED Indicates that a token from the peer application is required to complete the context, and that gss_init_sec_context must be called again with that token.

GSS_S_DEFECTIVE_TOKEN Indicates that consistency checks performed on the input_token failed

GSS_S_DEFECTIVE_CREDENTIAL Indicates that consistency checks performed on the credential failed.

GSS_S_NO_CRED The supplied credentials were not valid for context initiation, or the credential handle did not reference any credentials.

GSS_S_CREDENTIALS_EXPIRED The referenced credentials have expired

GSS_S_BAD_BINDINGS The input_token contains different channel bindings to those specified via the input_chan_bindings parameter

GSS_S_BAD_SIG The input_token contains an invalid MIC, or a MIC that could not be verified

GSS_S_OLD_TOKEN The input_token was too old. This is a fatal error during context establishment

GSS_S_DUPLICATE_TOKEN The input_token is valid, but is a duplicate of a token already processed. This is a fatal error during context establishment.

GSS_S_NO_CONTEXT Indicates that the supplied context handle did not refer to a valid context

GSS_S_BAD_NAME_TYPE The provided target_name parameter contained an invalid or unsupported type of name

GSS_S_BAD_NAME The provided target_name parameter was ill-formed.

GSS_S_BAD_MECH The specified mechanism is not supported by the provided credential, or is unrecognized by the implementation.

5.20. gss_inquire_context

```
OM_uint32 gss_inquire_context (
    OM_uint32          *minor_status,
    const gss_ctx_id_t context_handle,
    gss_name_t         *src_name,
    gss_name_t         *targ_name,
    OM_uint32          *lifetime_rec,
    gss_OID            *mech_type,
    OM_uint32          *ctx_flags,
    int                *locally_initiated,
    int                *open )
```

Purpose:

Obtains information about a security context. The caller must already have obtained a handle that refers to the context, although the context need not be fully established.

Parameters:

minor_status	Integer, modify Mechanism specific status code
context_handle	gss_ctx_id_t, read A handle that refers to the security context.
src_name	gss_name_t, modify, optional The name of the context initiator. If the context was established using anonymous authentication, and if the application invoking gss_inquire_context is the context acceptor, an anonymous name will be returned. Storage associated with this name must be freed by the application after use with a call to gss_release_name(). Specify NULL if not required.
targ_name	gss_name_t, modify, optional The name of the context acceptor. Storage associated with this name must be freed by the application after use with a call to gss_release_name(). If the context acceptor did not authenticate itself, and if the initiator did not specify a target name in its call to gss_init_sec_context(), the value GSS_C_NO_NAME will be returned. Specify NULL if not required.
lifetime_rec	Integer, modify, optional The number of seconds for which the context will remain valid. If the context has expired, this parameter will be set to zero. If the implementation does not support context expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
mech_type	gss_OID, modify, optional The security mechanism providing the context. The returned OID will be a pointer to static storage that should be treated as read-only by the application; in particular the application should not attempt to free it. Specify NULL if not required.

`ctx_flags` bit-mask, modify, optional
Contains various independent flags, each of which indicates that the context supports (or is expected to support, if `ctx_open` is false) a specific service option. If not needed, specify NULL. Symbolic names are provided for each flag, and the symbolic names corresponding to the required flags should be logically-ANDed with the `ret_flags` value to test whether a given option is supported by the context. The flags are:

`GSS_C_DELEG_FLAG`
True - Credentials were delegated from the initiator to the acceptor.
False - No credentials were delegated

`GSS_C_MUTUAL_FLAG`
True - The acceptor was authenticated to the initiator
False - The acceptor did not authenticate itself.

`GSS_C_REPLAY_FLAG`
True - replay of protected messages will be detected
False - replayed messages will not be detected

`GSS_C_SEQUENCE_FLAG`
True - out-of-sequence protected messages will be detected
False - out-of-sequence messages will not be detected

`GSS_C_CONF_FLAG`
True - Confidentiality service may be invoked by calling `gss_wrap` routine
False - No confidentiality service (via `gss_wrap`) available. `gss_wrap` will provide message encapsulation, data-origin authentication and integrity services only.

`GSS_C_INTEG_FLAG`
True - Integrity service may be invoked by calling either `gss_get_mic` or `gss_wrap` routines.

False - Per-message integrity service unavailable.

GSS_C_ANON_FLAG

True - The initiator's identity will not be revealed to the acceptor.
The src_name parameter (if requested) contains an anonymous internal name.

False - The initiator has been authenticated normally.

GSS_C_PROT_READY_FLAG

True - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available for use.

False - Protection services (as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG) are available only if the context is fully established (i.e. if the open parameter is non-zero).

GSS_C_TRANS_FLAG

True - The resultant security context may be transferred to other processes via a call to gss_export_sec_context().

False - The security context is not transferable.

locally_initiated Boolean, modify
Non-zero if the invoking application is the context initiator.
Specify NULL if not required.

open Boolean, modify
Non-zero if the context is fully established;
Zero if a context-establishment token is expected from the peer application.
Specify NULL if not required.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_NO_CONTEXT The referenced context could not be accessed.

5.21. gss_inquire_cred

```
OM_uint32 gss_inquire_cred (
    OM_uint32          *minor_status,
    const gss_cred_id_t cred_handle,
    gss_name_t         *name,
    OM_uint32          *lifetime,
    gss_cred_usage_t   *cred_usage,
    gss_OID_set        *mechanisms )
```

Purpose:

Obtains information about a credential.

Parameters:

minor_status	Integer, modify Mechanism specific status code
cred_handle	gss_cred_id_t, read A handle that refers to the target credential. Specify GSS_C_NO_CREDENTIAL to inquire about the default initiator principal.
name	gss_name_t, modify, optional The name whose identity the credential asserts. Storage associated with this name should be freed by the application after use with a call to gss_release_name(). Specify NULL if not required.
lifetime	Integer, modify, optional The number of seconds for which the credential will remain valid. If the credential has expired, this parameter will be set to zero. If the implementation does not support credential expiration, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.
cred_usage	gss_cred_usage_t, modify, optional How the credential may be used. One of the following: GSS_C_INITIATE GSS_C_ACCEPT GSS_C_BOTH Specify NULL if not required.

mechanisms gss_OID_set, modify, optional
 Set of mechanisms supported by the credential.
 Storage associated with this OID set must be
 freed by the application after use with a call
 to gss_release_oid_set(). Specify NULL if not
 required.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_NO_CRED The referenced credentials could not be accessed.

GSS_S_DEFECTIVE_CREDENTIAL The referenced credentials were invalid.

GSS_S_CREDENTIALS_EXPIRED The referenced credentials have expired.
 If the lifetime parameter was not passed as NULL,
 it will be set to 0.

5.22. gss_inquire_cred_by_mech

```
OM_uint32 gss_inquire_cred_by_mech (
    OM_uint32          *minor_status,
    const gss_cred_id_t cred_handle,
    const gss_OID       mech_type,
    gss_name_t          *name,
    OM_uint32           *initiator_lifetime,
    OM_uint32           *acceptor_lifetime,
    gss_cred_usage_t    *cred_usage )
```

Purpose:

Obtains per-mechanism information about a credential.

Parameters:

minor_status Integer, modify
 Mechanism specific status code

cred_handle gss_cred_id_t, read
 A handle that refers to the target credential.
 Specify GSS_C_NO_CREDENTIAL to inquire about
 the default initiator principal.

mech_type gss_OID, read
 The mechanism for which information should be
 returned.

name gss_name_t, modify, optional
The name whose identity the credential asserts. Storage associated with this name must be freed by the application after use with a call to gss_release_name(). Specify NULL if not required.

initiator_lifetime Integer, modify, optional
The number of seconds for which the credential will remain capable of initiating security contexts under the specified mechanism. If the credential can no longer be used to initiate contexts, or if the credential usage for this mechanism is GSS_C_ACCEPT, this parameter will be set to zero. If the implementation does not support expiration of initiator credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

acceptor_lifetime Integer, modify, optional
The number of seconds for which the credential will remain capable of accepting security contexts under the specified mechanism. If the credential can no longer be used to accept contexts, or if the credential usage for this mechanism is GSS_C_INITIATE, this parameter will be set to zero.

If the implementation does not support expiration of acceptor credentials, the value GSS_C_INDEFINITE will be returned. Specify NULL if not required.

cred_usage gss_cred_usage_t, modify, optional
How the credential may be used with the specified mechanism. One of the following:
GSS_C_INITIATE
GSS_C_ACCEPT
GSS_C_BOTH
Specify NULL if not required.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_NO_CRED The referenced credentials could not be accessed.

GSS_S_DEFECTIVE_CREDENTIAL The referenced credentials were invalid.

GSS_S_CREDENTIALS_EXPIRED The referenced credentials have expired.
 If the lifetime parameter was not passed as NULL,
 it will be set to 0.

5.23. gss_inquire_mechs_for_name

```
OM_uint32 gss_inquire_mechs_for_name (
    OM_uint32          *minor_status,
    const gss_name_t   input_name,
    gss_OID_set        *mech_types )
```

Purpose:

Returns the set of mechanisms supported by the GSS-API implementation that may be able to process the specified name.

Each mechanism returned will recognize at least one element within the name. It is permissible for this routine to be implemented within a mechanism-independent GSS-API layer, using the type information contained within the presented name, and based on registration information provided by individual mechanism implementations. This means that the returned mech_types set may indicate that a particular mechanism will understand the name when in fact it would refuse to accept the name as input to gss_canonicalize_name, gss_init_sec_context, gss_acquire_cred or gss_add_cred (due to some property of the specific name, as opposed to the name type). Thus this routine should be used only as a pre-filter for a call to a subsequent mechanism-specific routine.

Parameters:

minor_status	Integer, modify Implementation specific status code.
input_name	gss_name_t, read The name to which the inquiry relates.
mech_types	gss_OID_set, modify Set of mechanisms that may support the specified name. The returned OID set must be freed by the caller after use with a call to gss_release_oid_set().

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_NAME The input_name parameter was ill-formed.

GSS_S_BAD_NAME_TYPE The input_name parameter contained an invalid or unsupported type of name

5.24. gss_inquire_names_for_mech

```
OM_uint32 gss_inquire_names_for_mech (
    OM_uint32      *minor_status,
    const gss_OID mechanism,
    gss_OID_set     *name_types)
```

Purpose:

Returns the set of nametypes supported by the specified mechanism.

Parameters:

minor_status	Integer, modify Implementation specific status code.
mechanism	gss_OID, read The mechanism to be interrogated.
name_types	gss_OID_set, modify Set of name-types supported by the specified mechanism. The returned OID set must be freed by the application after use with a call to gss_release_oid_set().

Function value: GSS status code

GSS_S_COMPLETE Successful completion

5.25. gss_process_context_token

```
OM_uint32 gss_process_context_token (
    OM_uint32      *minor_status,
    const gss_ctx_id_t context_handle,
    const gss_buffer_t token_buffer)
```

Purpose:

Provides a way to pass an asynchronous token to the security service. Most context-level tokens are emitted and processed synchronously by gss_init_sec_context and gss_accept_sec_context, and the application is informed as to whether further tokens are expected by the GSS_C_CONTINUE_NEEDED major status bit. Occasionally, a mechanism may need to emit a context-level token at a point when the peer entity is not expecting a token. For example, the initiator's final

call to `gss_init_sec_context` may emit a token and return a status of `GSS_S_COMPLETE`, but the acceptor's call to `gss_accept_sec_context` may fail. The acceptor's mechanism may wish to send a token containing an error indication to the initiator, but the initiator is not expecting a token at this point, believing that the context is fully established. `Gss_process_context_token` provides a way to pass such a token to the mechanism at any time.

Parameters:

`minor_status` Integer, modify
Implementation specific status code.

`context_handle` `gss_ctx_id_t`, read
context handle of context on which token is to be processed

`token_buffer` buffer, opaque, read
token to process

Function value: GSS status code

`GSS_S_COMPLETE` Successful completion

`GSS_S_DEFECTIVE_TOKEN` Indicates that consistency checks performed on the token failed

`GSS_S_NO_CONTEXT` The `context_handle` did not refer to a valid context

5.26. `gss_release_buffer`

```
OM_uint32 gss_release_buffer (
    OM_uint32      *minor_status,
    gss_buffer_t buffer)
```

Purpose:

Free storage associated with a buffer. The storage must have been allocated by a GSS-API routine. In addition to freeing the associated storage, the routine will zero the length field in the descriptor to which the buffer parameter refers, and implementations are encouraged to additionally set the pointer field in the descriptor to NULL. Any buffer object returned by a GSS-API routine may be passed to `gss_release_buffer` (even if there is no storage associated with the buffer).

Parameters:

minor_status Integer, modify
 Mechanism specific status code

buffer buffer, modify
 The storage associated with the buffer will be
 deleted. The gss_buffer_desc object will not
 be freed, but its length field will be zeroed.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

5.27. gss_release_cred

```
OM_uint32 gss_release_cred (  
    OM_uint32       *minor_status,  
    gss_cred_id_t *cred_handle)
```

Purpose:

Informs GSS-API that the specified credential handle is no longer required by the application, and frees associated resources. Implementations are encouraged to set the cred_handle to GSS_C_NO_CREDENTIAL on successful completion of this call.

Parameters:

cred_handle gss_cred_id_t, modify, optional
 Opaque handle identifying credential
 to be released. If GSS_C_NO_CREDENTIAL
 is supplied, the routine will complete
 successfully, but will do nothing.

minor_status Integer, modify
 Mechanism specific status code.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_NO_CRED Credentials could not be accessed.

5.28. gss_release_name

```
OM_uint32 gss_release_name (  
    OM_uint32 *minor_status,  
    gss_name_t *name)
```

Purpose:

Free GSSAPI-allocated storage associated with an internal-form name. Implementations are encouraged to set the name to GSS_C_NO_NAME on successful completion of this call.

Parameters:

minor_status Integer, modify
 Mechanism specific status code

name gss_name_t, modify
 The name to be deleted

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_BAD_NAME The name parameter did not contain a valid name

5.29. gss_release_oid_set

```
OM_uint32 gss_release_oid_set (  
    OM_uint32 *minor_status,  
    gss_OID_set *set)
```

Purpose:

Free storage associated with a GSSAPI-generated gss_OID_set object. The set parameter must refer to an OID-set that was returned from a GSS-API routine. gss_release_oid_set() will free the storage associated with each individual member OID, the OID set's elements array, and the gss_OID_set_desc.

Implementations are encouraged to set the gss_OID_set parameter to GSS_C_NO_OID_SET on successful completion of this routine.

Parameters:

minor_status Integer, modify
 Mechanism specific status code

set Set of Object IDs, modify
The storage associated with the gss_OID_set
will be deleted.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

5.30. gss_test_oid_set_member

```
OM_uint32 gss_test_oid_set_member (
    OM_uint32      *minor_status,
    const gss_OID   member,
    const gss_OID_set set,
    int            *present)
```

Purpose:

Interrogate an Object Identifier set to determine whether a specified Object Identifier is a member. This routine is intended to be used with OID sets returned by gss_indicate_mechs(), gss_acquire_cred(), and gss_inquire_cred(), but will also work with user-generated sets.

Parameters:

minor_status Integer, modify
Mechanism specific status code

member Object ID, read
The object identifier whose presence
is to be tested.

set Set of Object ID, read
The Object Identifier set.

present Boolean, modify
non-zero if the specified OID is a member
of the set, zero if not.

Function value: GSS status code

GSS_S_COMPLETE Successful completion

5.31. gss_unwrap

```
OM_uint32 gss_unwrap (
    OM_uint32          *minor_status,
    const gss_ctx_id_t context_handle,
    const gss_buffer_t input_message_buffer,
    gss_buffer_t       output_message_buffer,
    int                *conf_state,
    gss_qop_t          *qop_state)
```

Purpose:

Converts a message previously protected by gss_wrap back to a usable form, verifying the embedded MIC. The conf_state parameter indicates whether the message was encrypted; the qop_state parameter indicates the strength of protection that was used to provide the confidentiality and integrity services.

Since some application-level protocols may wish to use tokens emitted by gss_wrap() to provide "secure framing", implementations must support the wrapping and unwrapping of zero-length messages.

Parameters:

minor_status	Integer, modify Mechanism specific status code.
context_handle	gss_ctx_id_t, read Identifies the context on which the message arrived
input_message_buffer	buffer, opaque, read protected message
output_message_buffer	buffer, opaque, modify Buffer to receive unwrapped message. Storage associated with this buffer must be freed by the application after use with a call to gss_release_buffer().
conf_state	boolean, modify, optional Non-zero - Confidentiality and integrity protection were used Zero - Integrity service only was used Specify NULL if not required

qop_state gss_qop_t, modify, optional
 Quality of protection provided.
 Specify NULL if not required

Function value: GSS status code

GSS_S_COMPLETE Successful completion

GSS_S_DEFECTIVE_TOKEN The token failed consistency checks

GSS_S_BAD_SIG The MIC was incorrect

GSS_S_DUPLICATE_TOKEN The token was valid, and contained a correct
 MIC for the message, but it had already been
 processed

GSS_S_OLD_TOKEN The token was valid, and contained a correct MIC
 for the message, but it is too old to check for
 duplication.

GSS_S_UNSEQ_TOKEN The token was valid, and contained a correct MIC
 for the message, but has been verified out of
 sequence; a later token has already been
 received.

GSS_S_GAP_TOKEN The token was valid, and contained a correct MIC
 for the message, but has been verified out of
 sequence; an earlier expected token has not yet
 been received.

GSS_S_CONTEXT_EXPIRED The context has already expired

GSS_S_NO_CONTEXT The context_handle parameter did not identify
 a valid context

5.32. gss_verify_mic

```
OM_uint32 gss_verify_mic (  
    OM_uint32            *minor_status,  
    const gss_ctx_id_t context_handle,  
    const gss_buffer_t message_buffer,  
    const gss_buffer_t token_buffer,  
    gss_qop_t            *qop_state)
```

Purpose:

Verifies that a cryptographic MIC, contained in the token parameter, fits the supplied message. The `qop_state` parameter allows a message recipient to determine the strength of protection that was applied to the message.

Since some application-level protocols may wish to use tokens emitted by `gss_wrap()` to provide "secure framing", implementations must support the calculation and verification of MICs over zero-length messages.

Parameters:

<code>minor_status</code>	Integer, modify Mechanism specific status code.
<code>context_handle</code>	<code>gss_ctx_id_t</code> , read Identifies the context on which the message arrived
<code>message_buffer</code>	buffer, opaque, read Message to be verified
<code>token_buffer</code>	buffer, opaque, read Token associated with message
<code>qop_state</code>	<code>gss_qop_t</code> , modify, optional quality of protection gained from MIC Specify NULL if not required

Function value: GSS status code

`GSS_S_COMPLETE` Successful completion

`GSS_S_DEFECTIVE_TOKEN` The token failed consistency checks

`GSS_S_BAD_SIG` The MIC was incorrect

`GSS_S_DUPLICATE_TOKEN` The token was valid, and contained a correct MIC for the message, but it had already been processed

`GSS_S_OLD_TOKEN` The token was valid, and contained a correct MIC for the message, but it is too old to check for duplication.

GSS_S_UNSEQ_TOKEN The token was valid, and contained a correct MIC for the message, but has been verified out of sequence; a later token has already been received.

GSS_S_GAP_TOKEN The token was valid, and contained a correct MIC for the message, but has been verified out of sequence; an earlier expected token has not yet been received.

GSS_S_CONTEXT_EXPIRED The context has already expired

GSS_S_NO_CONTEXT The context_handle parameter did not identify a valid context

5.33. gss_wrap

```
OM_uint32 gss_wrap (
    OM_uint32          *minor_status,
    const gss_ctx_id_t context_handle,
    int                conf_req_flag,
    gss_qop_t          qop_req,
    const gss_buffer_t input_message_buffer,
    int                *conf_state,
    gss_buffer_t        output_message_buffer )
```

Purpose:

Attaches a cryptographic MIC and optionally encrypts the specified input_message. The output_message contains both the MIC and the message. The qop_req parameter allows a choice between several cryptographic algorithms, if supported by the chosen mechanism.

Since some application-level protocols may wish to use tokens emitted by gss_wrap() to provide "secure framing", implementations must support the wrapping of zero-length messages.

Parameters:

minor_status Integer, modify
 Mechanism specific status code.

context_handle gss_ctx_id_t, read
 Identifies the context on which the message
 will be sent

`conf_req_flag` `boolean, read`
Non-zero - Both confidentiality and integrity services are requested
Zero - Only integrity service is requested

`qop_req` `gss_qop_t, read, optional`
Specifies required quality of protection. A mechanism-specific default may be requested by setting `qop_req` to `GSS_C_QOP_DEFAULT`. If an unsupported protection strength is requested, `gss_wrap` will return a `major_status` of `GSS_S_BAD_QOP`.

`input_message_buffer` `buffer, opaque, read`
Message to be protected

`conf_state` `boolean, modify, optional`
Non-zero - Confidentiality, data origin authentication and integrity services have been applied
Zero - Integrity and data origin services only has been applied.
Specify `NULL` if not required

`output_message_buffer` `buffer, opaque, modify`
Buffer to receive protected message.
Storage associated with this message must be freed by the application after use with a call to `gss_release_buffer()`.

Function value: GSS status code

`GSS_S_COMPLETE` Successful completion

`GSS_S_CONTEXT_EXPIRED` The context has already expired

`GSS_S_NO_CONTEXT` The `context_handle` parameter did not identify a valid context

`GSS_S_BAD_QOP` The specified QOP is not supported by the mechanism.

5.34. gss_wrap_size_limit

```
OM_uint32 gss_wrap_size_limit (
    OM_uint32          *minor_status,
    const gss_ctx_id_t context_handle,
    int                conf_req_flag,
    gss_qop_t          qop_req,
    OM_uint32          req_output_size,
    OM_uint32          *max_input_size)
```

Purpose:

Allows an application to determine the maximum message size that, if presented to gss_wrap with the same conf_req_flag and qop_req parameters, will result in an output token containing no more than req_output_size bytes.

This call is intended for use by applications that communicate over protocols that impose a maximum message size. It enables the application to fragment messages prior to applying protection.

GSS-API implementations are recommended but not required to detect invalid QOP values when gss_wrap_size_limit() is called. This routine guarantees only a maximum message size, not the availability of specific QOP values for message protection.

Successful completion of this call does not guarantee that gss_wrap will be able to protect a message of length max_input_size bytes, since this ability may depend on the availability of system resources at the time that gss_wrap is called. However, if the implementation itself imposes an upper limit on the length of messages that may be processed by gss_wrap, the implementation should not return a value via max_input_bytes that is greater than this length.

Parameters:

minor_status	Integer, modify Mechanism specific status code
context_handle	gss_ctx_id_t, read A handle that refers to the security over which the messages will be sent.
conf_req_flag	Boolean, read Indicates whether gss_wrap will be asked to apply confidentiality protection in

addition to integrity protection. See the routine description for `gss_wrap` for more details.

<code>qop_req</code>	<code>gss_qop_t</code> , read Indicates the level of protection that <code>gss_wrap</code> will be asked to provide. See the routine description for <code>gss_wrap</code> for more details.
<code>req_output_size</code>	Integer, read The desired maximum size for tokens emitted by <code>gss_wrap</code> .
<code>max_input_size</code>	Integer, modify The maximum input message size that may be presented to <code>gss_wrap</code> in order to guarantee that the emitted token shall be no larger than <code>req_output_size</code> bytes.
Function value:	GSS status code
<code>GSS_S_COMPLETE</code>	Successful completion
<code>GSS_S_NO_CONTEXT</code>	The referenced context could not be accessed.
<code>GSS_S_CONTEXT_EXPIRED</code>	The context has expired.
<code>GSS_S_BAD_QOP</code>	The specified QOP is not supported by the mechanism.

6. Security Considerations

This document specifies a service interface for security facilities and services; as such, security considerations appear throughout the specification. Nonetheless, it is appropriate to summarize certain specific points relevant to GSS-API implementors and calling applications. Usage of the GSS-API interface does not in itself provide security services or assurance; instead, these attributes are dependent on the underlying mechanism(s) which support a GSS-API implementation. Callers must be attentive to the requests made to GSS-API calls and to the status indicators returned by GSS-API, as these specify the security service characteristics which GSS-API will provide. When the interprocess context transfer facility is used, appropriate local controls should be applied to constrain access to interprocess tokens and to the sensitive data which they contain.

Appendix A. GSS-API C header file gssapi.h

C-language GSS-API implementations should include a copy of the following header-file.

```
#ifndef GSSAPI_H_
#define GSSAPI_H_

/*
 * First, include stddef.h to get size_t defined.
 */
#include <stddef.h>

/*
 * If the platform supports the xom.h header file, it should be
 * included here.
 */
#include <xom.h>

/*
 * Now define the three implementation-dependent types.
 */
typedef <platform-specific> gss_ctx_id_t;
typedef <platform-specific> gss_cred_id_t;
typedef <platform-specific> gss_name_t;

/*
 * The following type must be defined as the smallest natural
 * unsigned integer supported by the platform that has at least
 * 32 bits of precision.
 */
typedef <platform-specific> gss_uint32;

#ifdef OM_STRING
/*
 * We have included the xom.h header file.  Verify that OM_uint32
 * is defined correctly.
 */

#if sizeof(gss_uint32) != sizeof(OM_uint32)
#error Incompatible definition of OM_uint32 from xom.h
#endif

typedef OM_object_identifier gss_OID_desc, *gss_OID;
```

```
#else

/*
 * We can't use X/Open definitions, so roll our own.
 */

typedef gss_uint32 OM_uint32;

typedef struct gss_OID_desc_struct {
    OM_uint32 length;
    void      *elements;
} gss_OID_desc, *gss_OID;

#endif

typedef struct gss_OID_set_desc_struct {
    size_t      count;
    gss_OID     elements;
} gss_OID_set_desc, *gss_OID_set;

typedef struct gss_buffer_desc_struct {
    size_t length;
    void *value;
} gss_buffer_desc, *gss_buffer_t;

typedef struct gss_channel_bindings_struct {
    OM_uint32 initiator_addrtype;
    gss_buffer_desc initiator_address;
    OM_uint32 acceptor_addrtype;
    gss_buffer_desc acceptor_address;
    gss_buffer_desc application_data;
} *gss_channel_bindings_t;

/*
 * For now, define a QOP-type as an OM_uint32
 */
typedef OM_uint32 gss_qop_t;

typedef int gss_cred_usage_t;

/*
 * Flag bits for context-level services.
 */
```

```
#define GSS_C_DELEG_FLAG      1
#define GSS_C_MUTUAL_FLAG    2
#define GSS_C_REPLAY_FLAG    4
#define GSS_C_SEQUENCE_FLAG  8
#define GSS_C_CONF_FLAG     16
#define GSS_C_INTEG_FLAG    32
#define GSS_C_ANON_FLAG     64
#define GSS_C_PROT_READY_FLAG 128
#define GSS_C_TRANS_FLAG    256

/*
 * Credential usage options
 */
#define GSS_C_BOTH      0
#define GSS_C_INITIATE 1
#define GSS_C_ACCEPT   2

/*
 * Status code types for gss_display_status
 */
#define GSS_C_GSS_CODE 1
#define GSS_C_MECH_CODE 2

/*
 * The constant definitions for channel-bindings address families
 */
#define GSS_C_AF_UNSPEC      0
#define GSS_C_AF_LOCAL      1
#define GSS_C_AF_INET       2
#define GSS_C_AF_IMPLINK    3
#define GSS_C_AF_PUP        4
#define GSS_C_AF_CHAOS      5
#define GSS_C_AF_NS         6
#define GSS_C_AF_NBS        7
#define GSS_C_AF_ECMA       8
#define GSS_C_AF_DATAKIT    9
#define GSS_C_AF_CCITT      10
#define GSS_C_AF_SNA        11
#define GSS_C_AF_DECnet     12
#define GSS_C_AF_DLI        13
#define GSS_C_AF_LAT        14
#define GSS_C_AF_HYLINK     15
#define GSS_C_AF_APPLETALK  16
#define GSS_C_AF_BSC        17
#define GSS_C_AF_DSS        18
#define GSS_C_AF_OSI        19
#define GSS_C_AF_X25        21
```

```
#define GSS_C_AF_NULLADDR    255

/*
 * Various Null values
 */
#define GSS_C_NO_NAME ((gss_name_t) 0)
#define GSS_C_NO_BUFFER ((gss_buffer_t) 0)
#define GSS_C_NO_OID ((gss_OID) 0)
#define GSS_C_NO_OID_SET ((gss_OID_set) 0)
#define GSS_C_NO_CONTEXT ((gss_ctx_id_t) 0)
#define GSS_C_NO_CREDENTIAL ((gss_cred_id_t) 0)
#define GSS_C_NO_CHANNEL_BINDINGS ((gss_channel_bindings_t) 0)
#define GSS_C_EMPTY_BUFFER {0, NULL}

/*
 * Some alternate names for a couple of the above
 * values.  These are defined for V1 compatibility.
 */
#define GSS_C_NULL_OID GSS_C_NO_OID
#define GSS_C_NULL_OID_SET GSS_C_NO_OID_SET

/*
 * Define the default Quality of Protection for per-message
 * services.  Note that an implementation that offers multiple
 * levels of QOP may define GSS_C_QOP_DEFAULT to be either zero
 * (as done here) to mean "default protection", or to a specific
 * explicit QOP value.  However, a value of 0 should always be
 * interpreted by a GSS-API implementation as a request for the
 * default protection level.
 */
#define GSS_C_QOP_DEFAULT 0

/*
 * Expiration time of 2^32-1 seconds means infinite lifetime for a
 * credential or security context
 */
#define GSS_C_INDEFINITE 0xfffffffful

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {10, (void *)"\x2a\x86\x48\x86\xf7\x12"
 * "\x01\x02\x01\x01"},
 * corresponding to an object-identifier value of
 * {iso(1) member-body(2) United States(840) mit(113554)
 * infosys(1) gssapi(2) generic(1) user_name(1)}.  The constant
 * GSS_C_NT_USER_NAME should be initialized to point
 * to that gss_OID_desc.
```

```

*/
extern gss_OID GSS_C_NT_USER_NAME;

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {10, (void *)"\x2a\x86\x48\x86\xf7\x12"
 *      "\x01\x02\x01\x02"},
 * corresponding to an object-identifier value of
 * {iso(1) member-body(2) United States(840) mit(113554)
 * infosys(1) gssapi(2) generic(1) machine_uid_name(2)}.
 * The constant GSS_C_NT_MACHINE_UID_NAME should be
 * initialized to point to that gss_OID_desc.
 */
extern gss_OID GSS_C_NT_MACHINE_UID_NAME;

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {10, (void *)"\x2a\x86\x48\x86\xf7\x12"
 *      "\x01\x02\x01\x03"},
 * corresponding to an object-identifier value of
 * {iso(1) member-body(2) United States(840) mit(113554)
 * infosys(1) gssapi(2) generic(1) string_uid_name(3)}.
 * The constant GSS_C_NT_STRING_UID_NAME should be
 * initialized to point to that gss_OID_desc.
 */
extern gss_OID GSS_C_NT_STRING_UID_NAME;

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {6, (void *)"\x2b\x06\x01\x05\x06\x02"},
 * corresponding to an object-identifier value of
 * {iso(1) org(3) dod(6) internet(1) security(5)
 * nametypes(6) gss-host-based-services(2)}. The constant
 * GSS_C_NT_HOSTBASED_SERVICE_X should be initialized to point
 * to that gss_OID_desc. This is a deprecated OID value, and
 * implementations wishing to support hostbased-service names
 * should instead use the GSS_C_NT_HOSTBASED_SERVICE OID,
 * defined below, to identify such names;
 * GSS_C_NT_HOSTBASED_SERVICE_X should be accepted a synonym
 * for GSS_C_NT_HOSTBASED_SERVICE when presented as an input
 * parameter, but should not be emitted by GSS-API
 * implementations
 */
extern gss_OID GSS_C_NT_HOSTBASED_SERVICE_X;

```

```

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {10, (void *)"\x2a\x86\x48\x86\xf7\x12"
 *      "\x01\x02\x01\x04"}, corresponding to an
 * object-identifier value of {iso(1) member-body(2)
 * Unites States(840) mit(113554) infosys(1) gssapi(2)
 * generic(1) service_name(4)}. The constant
 * GSS_C_NT_HOSTBASED_SERVICE should be initialized
 * to point to that gss_OID_desc.
 */
extern gss_OID GSS_C_NT_HOSTBASED_SERVICE;

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {6, (void *)"\x2b\x06\x01\x05\x06\x03"},
 * corresponding to an object identifier value of
 * {1(iso), 3(org), 6(dod), 1(internet), 5(security),
 * 6(nametypes), 3(gss-anonymous-name)}. The constant
 * and GSS_C_NT_ANONYMOUS should be initialized to point
 * to that gss_OID_desc.
 */
extern gss_OID GSS_C_NT_ANONYMOUS;

/*
 * The implementation must reserve static storage for a
 * gss_OID_desc object containing the value
 * {6, (void *)"\x2b\x06\x01\x05\x06\x04"},
 * corresponding to an object-identifier value of
 * {1(iso), 3(org), 6(dod), 1(internet), 5(security),
 * 6(nametypes), 4(gss-api-exported-name)}. The constant
 * GSS_C_NT_EXPORT_NAME should be initialized to point
 * to that gss_OID_desc.
 */
extern gss_OID GSS_C_NT_EXPORT_NAME;

/* Major status codes */

#define GSS_S_COMPLETE 0

/*
 * Some "helper" definitions to make the status code macros obvious.
 */
#define GSS_C_CALLING_ERROR_OFFSET 24
#define GSS_C_ROUTINE_ERROR_OFFSET 16

```



```

#define GSS_C_SUPPLEMENTARY_OFFSET 0
#define GSS_C_CALLING_ERROR_MASK 0377ul
#define GSS_C_ROUTINE_ERROR_MASK 0377ul
#define GSS_C_SUPPLEMENTARY_MASK 0177777ul

/*
 * The macros that test status codes for error conditions.
 * Note that the GSS_ERROR() macro has changed slightly from
 * the V1 GSS-API so that it now evaluates its argument
 * only once.
 */
#define GSS_CALLING_ERROR(x) \
(x & (GSS_C_CALLING_ERROR_MASK << GSS_C_CALLING_ERROR_OFFSET))
#define GSS_ROUTINE_ERROR(x) \
(x & (GSS_C_ROUTINE_ERROR_MASK << GSS_C_ROUTINE_ERROR_OFFSET))
#define GSS_SUPPLEMENTARY_INFO(x) \
(x & (GSS_C_SUPPLEMENTARY_MASK << GSS_C_SUPPLEMENTARY_OFFSET))
#define GSS_ERROR(x) \
(x & ((GSS_C_CALLING_ERROR_MASK << GSS_C_CALLING_ERROR_OFFSET) | \
      (GSS_C_ROUTINE_ERROR_MASK << GSS_C_ROUTINE_ERROR_OFFSET)))

/*
 * Now the actual status code definitions
 */

/*
 * Calling errors:
 */
#define GSS_S_CALL_INACCESSIBLE_READ \
(1ul << GSS_C_CALLING_ERROR_OFFSET)
#define GSS_S_CALL_INACCESSIBLE_WRITE \
(2ul << GSS_C_CALLING_ERROR_OFFSET)
#define GSS_S_CALL_BAD_STRUCTURE \
(3ul << GSS_C_CALLING_ERROR_OFFSET)

/*
 * Routine errors:
 */
#define GSS_S_BAD_MECH (1ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_NAME (2ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_NAME_TYPE (3ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_BINDINGS (4ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_STATUS (5ul <<

```

```

GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_SIG (6ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_MIC GSS_S_BAD_SIG
#define GSS_S_NO_CRED (7ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_NO_CONTEXT (8ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_DEFECTIVE_TOKEN (9ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_DEFECTIVE_CREDENTIAL (10ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_CREDENTIALS_EXPIRED (11ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_CONTEXT_EXPIRED (12ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_FAILURE (13ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_BAD_QOP (14ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_UNAUTHORIZED (15ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_UNAVAILABLE (16ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_DUPLICATE_ELEMENT (17ul <<
GSS_C_ROUTINE_ERROR_OFFSET)
#define GSS_S_NAME_NOT_MN (18ul <<
GSS_C_ROUTINE_ERROR_OFFSET)

/*
 * Supplementary info bits:
 */
#define GSS_S_CONTINUE_NEEDED \
    (1ul << (GSS_C_SUPPLEMENTARY_OFFSET + 0))
#define GSS_S_DUPLICATE_TOKEN \
    (1ul << (GSS_C_SUPPLEMENTARY_OFFSET + 1))
#define GSS_S_OLD_TOKEN \
    (1ul << (GSS_C_SUPPLEMENTARY_OFFSET + 2))
#define GSS_S_UNSEQ_TOKEN \
    (1ul << (GSS_C_SUPPLEMENTARY_OFFSET + 3))
#define GSS_S_GAP_TOKEN \
    (1ul << (GSS_C_SUPPLEMENTARY_OFFSET + 4))

/*
 * Finally, function prototypes for the GSS-API routines.
 */

```

```

OM_uint32 gss_acquire_cred
    (OM_uint32 ,
     const gss_name_t,
     OM_uint32,
     const gss_OID_set,
     gss_cred_usage_t,
     gss_cred_id_t ,
     gss_OID_set ,
     OM_uint32 *
    );
/* minor_status */
/* desired_name */
/* time_req */
/* desired_mechs */
/* cred_usage */
/* output_cred_handle */
/* actual_mechs */
/* time_rec */

OM_uint32 gss_release_cred
    (OM_uint32 ,
     gss_cred_id_t *
    );
/* minor_status */
/* cred_handle */

OM_uint32 gss_init_sec_context
    (OM_uint32 ,
     const gss_cred_id_t,
     gss_ctx_id_t ,
     const gss_name_t,
     const gss_OID,
     OM_uint32,
     OM_uint32,
     const gss_channel_bindings_t,
     const gss_buffer_t,
     gss_OID ,
     gss_buffer_t,
     OM_uint32 ,
     OM_uint32 *
    );
/* minor_status */
/* initiator_cred_handle */
/* context_handle */
/* target_name */
/* mech_type */
/* req_flags */
/* time_req */
/* input_chan_bindings */
/* input_token */
/* actual_mech_type */
/* output_token */
/* ret_flags */
/* time_rec */

OM_uint32 gss_accept_sec_context
    (OM_uint32 ,
     gss_ctx_id_t ,
     const gss_cred_id_t,
     const gss_buffer_t,
     const gss_channel_bindings_t,
     gss_name_t ,
     gss_OID ,
     gss_buffer_t,
     OM_uint32 ,
     OM_uint32 ,
     gss_cred_id_t *
    );
/* minor_status */
/* context_handle */
/* acceptor_cred_handle */
/* input_token_buffer */
/* input_chan_bindings */
/* src_name */
/* mech_type */
/* output_token */
/* ret_flags */
/* time_rec */
/* delegated_cred_handle */

```

```
OM_uint32 gss_process_context_token
    (OM_uint32 ,
     const gss_ctx_id_t,
     const gss_buffer_t
    );
/* minor_status */
/* context_handle */
/* token_buffer */

OM_uint32 gss_delete_sec_context
    (OM_uint32 ,
     gss_ctx_id_t ,
     gss_buffer_t
    );
/* minor_status */
/* context_handle */
/* output_token */

OM_uint32 gss_context_time
    (OM_uint32 ,
     const gss_ctx_id_t,
     OM_uint32 *
    );
/* minor_status */
/* context_handle */
/* time_rec */

OM_uint32 gss_get_mic
    (OM_uint32 ,
     const gss_ctx_id_t,
     gss_qop_t,
     const gss_buffer_t,
     gss_buffer_t
    );
/* minor_status */
/* context_handle */
/* qop_req */
/* message_buffer */
/* message_token */

OM_uint32 gss_verify_mic
    (OM_uint32 ,
     const gss_ctx_id_t,
     const gss_buffer_t,
     const gss_buffer_t,
     gss_qop_t *
    );
/* minor_status */
/* context_handle */
/* message_buffer */
/* token_buffer */
/* qop_state */

OM_uint32 gss_wrap
    (OM_uint32 ,
     const gss_ctx_id_t,
     int,
     gss_qop_t,
     const gss_buffer_t,
     int ,
     gss_buffer_t
    );
/* minor_status */
/* context_handle */
/* conf_req_flag */
/* qop_req */
/* input_message_buffer */
/* conf_state */
/* output_message_buffer */
```

```
OM_uint32 gss_unwrap
(OM_uint32 ,
 const gss_ctx_id_t,
 const gss_buffer_t,
 gss_buffer_t,
 int ,
 gss_qop_t *
);
/* minor_status */
/* context_handle */
/* input_message_buffer */
/* output_message_buffer */
/* conf_state */
/* qop_state */

OM_uint32 gss_display_status
(OM_uint32 ,
 OM_uint32,
 int,
 const gss_OID,
 OM_uint32 ,
 gss_buffer_t
);
/* minor_status */
/* status_value */
/* status_type */
/* mech_type */
/* message_context */
/* status_string */

OM_uint32 gss_indicate_mechs
(OM_uint32 ,
 gss_OID_set *
);
/* minor_status */
/* mech_set */

OM_uint32 gss_compare_name
(OM_uint32 ,
 const gss_name_t,
 const gss_name_t,
 int *
);
/* minor_status */
/* name1 */
/* name2 */
/* name_equal */

OM_uint32 gss_display_name
(OM_uint32 ,
 const gss_name_t,
 gss_buffer_t,
 gss_OID *
);
/* minor_status */
/* input_name */
/* output_name_buffer */
/* output_name_type */

OM_uint32 gss_import_name
(OM_uint32 ,
 const gss_buffer_t,
 const gss_OID,
 gss_name_t *
);
/* minor_status */
/* input_name_buffer */
/* input_name_type */
/* output_name */
```

```
OM_uint32 gss_export_name
    (OM_uint32,
     const gss_name_t,
     gss_buffer_t
    );
    /* minor_status */
    /* input_name */
    /* exported_name */

OM_uint32 gss_release_name
    (OM_uint32 *,
     gss_name_t *
    );
    /* minor_status */
    /* input_name */

OM_uint32 gss_release_buffer
    (OM_uint32 ,
     gss_buffer_t
    );
    /* minor_status */
    /* buffer */

OM_uint32 gss_release_oid_set
    (OM_uint32 ,
     gss_OID_set *
    );
    /* minor_status */
    /* set */

OM_uint32 gss_inquire_cred
    (OM_uint32 ,
     const gss_cred_id_t,
     gss_name_t ,
     OM_uint32 ,
     gss_cred_usage_t ,
     gss_OID_set *
    );
    /* minor_status */
    /* cred_handle */
    /* name */
    /* lifetime */
    /* cred_usage */
    /* mechanisms */

OM_uint32 gss_inquire_context (
    OM_uint32 ,
    const gss_ctx_id_t,
    gss_name_t ,
    gss_name_t ,
    OM_uint32 ,
    gss_OID ,
    OM_uint32 ,
    int ,
    int *
    );
    /* minor_status */
    /* context_handle */
    /* src_name */
    /* targ_name */
    /* lifetime_rec */
    /* mech_type */
    /* ctx_flags */
    /* locally_initiated */
    /* open */
```

```

OM_uint32 gss_wrap_size_limit (
    OM_uint32 ,
    const gss_ctx_id_t,
    int,
    gss_qop_t,
    OM_uint32,
    OM_uint32 *
    );
/* minor_status */
/* context_handle */
/* conf_req_flag */
/* qop_req */
/* req_output_size */
/* max_input_size */

OM_uint32 gss_add_cred (
    OM_uint32 ,
    const gss_cred_id_t,
    const gss_name_t,
    const gss_OID,
    gss_cred_usage_t,
    OM_uint32,
    OM_uint32,
    gss_cred_id_t ,
    gss_OID_set ,
    OM_uint32 ,
    OM_uint32 *
    );
/* minor_status */
/* input_cred_handle */
/* desired_name */
/* desired_mech */
/* cred_usage */
/* initiator_time_req */
/* acceptor_time_req */
/* output_cred_handle */
/* actual_mechs */
/* initiator_time_rec */
/* acceptor_time_rec */

OM_uint32 gss_inquire_cred_by_mech (
    OM_uint32 ,
    const gss_cred_id_t,
    const gss_OID,
    gss_name_t ,
    OM_uint32 ,
    OM_uint32 ,
    gss_cred_usage_t *
    );
/* minor_status */
/* cred_handle */
/* mech_type */
/* name */
/* initiator_lifetime */
/* acceptor_lifetime */
/* cred_usage */

OM_uint32 gss_export_sec_context (
    OM_uint32 ,
    gss_ctx_id_t ,
    gss_buffer_t
    );
/* minor_status */
/* context_handle */
/* interprocess_token */

OM_uint32 gss_import_sec_context (
    OM_uint32 ,
    const gss_buffer_t,
    gss_ctx_id_t *
    );
/* minor_status */
/* interprocess_token */
/* context_handle */

```

```

OM_uint32 gss_create_empty_oid_set (
    OM_uint32 ,                /* minor_status */
    gss_OID_set *              /* oid_set */
);

OM_uint32 gss_add_oid_set_member (
    OM_uint32 ,                /* minor_status */
    const gss_OID,             /* member_oid */
    gss_OID_set *              /* oid_set */
);

OM_uint32 gss_test_oid_set_member (
    OM_uint32 ,                /* minor_status */
    const gss_OID,             /* member */
    const gss_OID_set,         /* set */
    int *                      /* present */
);

OM_uint32 gss_inquire_names_for_mech (
    OM_uint32 ,                /* minor_status */
    const gss_OID,             /* mechanism */
    gss_OID_set *              /* name_types */
);

OM_uint32 gss_inquire_mechs_for_name (
    OM_uint32 ,                /* minor_status */
    const gss_name_t,          /* input_name */
    gss_OID_set *              /* mech_types */
);

OM_uint32 gss_canonicalize_name (
    OM_uint32 ,                /* minor_status */
    const gss_name_t,          /* input_name */
    const gss_OID,             /* mech_type */
    gss_name_t *               /* output_name */
);

OM_uint32 gss_duplicate_name (
    OM_uint32 ,                /* minor_status */
    const gss_name_t,          /* src_name */
    gss_name_t *               /* dest_name */
);

/*
 * The following routines are obsolete variants of gss_get_mic,
 * gss_verify_mic, gss_wrap and gss_unwrap. They should be
 * provided by GSS-API V2 implementations for backwards
 * compatibility with V1 applications. Distinct entrypoints

```



```

* (as opposed to #defines) should be provided, both to allow
* GSS-API V1 applications to link against GSS-API V2
* implementations,
* and to retain the slight parameter type differences between the
* obsolete versions of these routines and their current forms.
*/

OM_uint32 gss_sign
    (OM_uint32 ,          /* minor_status */
     gss_ctx_id_t,       /* context_handle */
     int,                /* qop_req */
     gss_buffer_t,       /* message_buffer */
     gss_buffer_t,       /* message_token */
    );

OM_uint32 gss_verify
    (OM_uint32 ,          /* minor_status */
     gss_ctx_id_t,       /* context_handle */
     gss_buffer_t,       /* message_buffer */
     gss_buffer_t,       /* token_buffer */
     int *               /* qop_state */
    );

OM_uint32 gss_seal
    (OM_uint32 ,          /* minor_status */
     gss_ctx_id_t,       /* context_handle */
     int,                /* conf_req_flag */
     int,                /* qop_req */
     gss_buffer_t,       /* input_message_buffer */
     int ,               /* conf_state */
     gss_buffer_t,       /* output_message_buffer */
    );

OM_uint32 gss_unseal
    (OM_uint32 ,          /* minor_status */
     gss_ctx_id_t,       /* context_handle */
     gss_buffer_t,       /* input_message_buffer */
     gss_buffer_t,       /* output_message_buffer */
     int ,               /* conf_state */
     int *               /* qop_state */
    );

#endif /* GSSAPI_H_ */

```

Appendix B. Additional constraints for application binary portability

The purpose of this C-bindings document is to encourage source-level portability of applications across GSS-API implementations on different platforms and atop different mechanisms. Additional goals that have not been explicitly addressed by this document are link-time and run-time portability.

Link-time portability provides the ability to compile an application against one implementation of GSS-API, and then link it against a different implementation on the same platform. It is a stricter requirement than source-level portability.

Run-time portability differs from link-time portability only on those platforms that implement dynamically loadable GSS-API implementations, but do not offer load-time symbol resolution. On such platforms, run-time portability is a stricter requirement than link-time portability, and will typically include the precise placement of the various GSS-API routines within library entrypoint vectors.

Individual platforms will impose their own rules that must be followed to achieve link-time (and run-time, if different) portability. In order to ensure either form of binary portability, an ABI specification must be written for GSS-API implementations on that platform. However, it is recognized that there are some issues that are likely to be common to all such ABI specifications. This appendix is intended to be a repository for such common issues, and contains some suggestions that individual ABI specifications may choose to reference. Since machine architectures vary greatly, it may not be possible or desirable to follow these suggestions on all platforms.

B.1. Pointers

While ANSI-C provides a single pointer type for each declared type, plus a single (void *) type, some platforms (notably those using segmented memory architectures) augment this with various modified pointer types (e.g. far pointers, near pointers). These language bindings assume ANSI-C, and thus do not address such non-standard implementations. GSS-API implementations for such platforms must choose an appropriate memory model, and should use it consistently throughout. For example, if a memory model is chosen that requires the use of far pointers when passing routine parameters, then far pointers should also be used within the structures defined by GSS-API.

B.2. Internal structure alignment

GSS-API defines several data-structures containing differently-sized fields. An ABI specification should include a detailed description of how the fields of such structures are aligned, and if there is any internal padding in these data structures. The use of compiler defaults for the platform is recommended.

B.3. Handle types

The C bindings specify that the `gss_cred_id_t` and `gss_ctx_id_t` types should be implemented as either pointer or arithmetic types, and that if pointer types are used, care should be taken to ensure that two handles may be compared with the `==` operator. Note that ANSI-C does not guarantee that two pointer values may be compared with the `==` operator unless either the two pointers point to members of a single array, or at least one of the pointers contains a NULL value.

For binary portability, additional constraints are required. The following is an attempt at defining platform-independent constraints.

The size of the handle type must be the same as `sizeof(void *)`, using the appropriate memory model.

The `==` operator for the chosen type must be a simple bit-wise comparison. That is, for two in-memory handle objects `h1` and `h2`, the boolean value of the expression

```
(h1 == h2)
```

should always be the same as the boolean value of the expression

```
(memcmp(&h1, &h2, sizeof(h1)) == 0)
```

The actual use of the type `(void *)` for handle types is discouraged, not for binary portability reasons, but since it effectively disables much of the compile-time type-checking that the compiler can otherwise perform, and is therefore not "programmer-friendly". If a pointer implementation is desired, and if the platform's implementation of pointers permits, the handles should be implemented as pointers to distinct implementation-defined types.

B.4. The `gss_name_t` type

The `gss_name_t` type, representing the internal name object, should be implemented as a pointer type. The use of the `(void *)` type is discouraged as it does not allow the compiler to perform strong type-checking. However, the pointer type chosen should be of the

same size as the (void *) type. Provided this rule is obeyed, ABI specifications need not further constrain the implementation of gss_name_t objects.

B.5. The int and size_t types

Some platforms may support differently sized implementations of the "int" and "size_t" types, perhaps chosen through compiler switches, and perhaps dependent on memory model. An ABI specification for such a platform should include required implementations for these types. It is recommended that the default implementation (for the chosen memory model, if appropriate) is chosen.

B.6. Procedure-calling conventions

Some platforms support a variety of different binary conventions for calling procedures. Such conventions cover things like the format of the stack frame, the order in which the routine parameters are pushed onto the stack, whether or not a parameter count is pushed onto the stack, whether some argument(s) or return values are to be passed in registers, and whether the called routine or the caller is responsible for removing the stack frame on return. For such platforms, an ABI specification should specify which calling convention is to be used for GSS-API implementations.

References

- [GSSAPI] Linn, J., "Generic Security Service Application Program Interface Version 2, Update 1", RFC 2743, January 2000.
- [XOM] OSI Object Management API Specification, Version 2.0 t", X.400 API Association & X/Open Company Limited, August 24, 1990 Specification of datatypes and routines for manipulating information objects.

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