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Generic Security Service Application Program Interface Version 2, Update 1

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

The Generic Security Service Application Program Interface (GSS-API), Version 2, as defined in [RFC-2078], provides security services to callers in a generic fashion, supportable with a range of underlying mechanisms and technologies and hence allowing source-level portability of applications to different environments. This specification defines GSS-API services and primitives at a level independent of underlying mechanism and programming language environment, and is to be complemented by other, related specifications:

- documents defining specific parameter bindings for particular language environments
- documents defining token formats, protocols, and procedures to be implemented in order to realize GSS-API services atop particular security mechanisms

This memo obsoletes [RFC-2078], making specific, incremental changes in response to implementation experience and liaison requests. It is intended, therefore, that this memo or a successor version thereto will become the basis for subsequent progression of the GSS-API specification on the standards track.

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1: GSS-API Characteristics and Concepts

GSS-API operates in the following paradigm. A typical GSS-API caller is itself a communications protocol, calling on GSS-API in order to protect its communications with authentication, integrity, and/or confidentiality security services. A GSS-API caller accepts tokens provided to it by its local GSS-API implementation and transfers the tokens to a peer on a remote system; that peer passes the received tokens to its local GSS-API implementation for processing. The security services available through GSS-API in this fashion are implementable (and have been implemented) over a range of underlying mechanisms based on secret-key and public-key cryptographic technologies.

The GSS-API separates the operations of initializing a security context between peers, achieving peer entity authentication (GSS_Init_sec_context() and GSS_Accept_sec_context() calls), from the operations of providing per-message data origin authentication and data integrity protection (GSS_GetMIC() and GSS_VerifyMIC() calls) for messages subsequently transferred in conjunction with that context. (The definition for the peer entity authentication service, and other definitions used in this document, corresponds to that provided in [ISO-7498-2].) When establishing a security context, the GSS-API enables a context initiator to optionally permit its credentials to be delegated, meaning that the context acceptor may initiate further security contexts on behalf of the initiating caller. Per-message GSS_Wrap() and GSS_Unwrap() calls provide the data origin authentication and data integrity services which GSS_GetMIC() and GSS_VerifyMIC() offer, and also support selection of confidentiality services as a caller option. Additional calls provide supportive functions to the GSS-API's users.

The following paragraphs provide an example illustrating the dataflows involved in use of the GSS-API by a client and server in a mechanism-independent fashion, establishing a security context and transferring a protected message. The example assumes that credential acquisition has already been completed. The example also assumes that the underlying authentication technology is capable of authenticating a client to a server using elements carried within a single token, and of authenticating the server to the client (mutual authentication) with a single returned token; this assumption holds for some presently-documented CAT mechanisms but is not necessarily true for other cryptographic technologies and associated protocols.

The client calls GSS_Init_sec_context() to establish a security context to the server identified by targ_name, and elects to set the mutual_req_flag so that mutual authentication is performed in the course of context establishment. GSS_Init_sec_context() returns an

output_token to be passed to the server, and indicates GSS_S_CONTINUE_NEEDED status pending completion of the mutual authentication sequence. Had mutual_req_flag not been set, the initial call to GSS_Init_sec_context() would have returned GSS_S_COMPLETE status. The client sends the output_token to the server.

The server passes the received token as the input_token parameter to GSS_Accept_sec_context(). GSS_Accept_sec_context indicates GSS_S_COMPLETE status, provides the client's authenticated identity in the src_name result, and provides an output_token to be passed to the client. The server sends the output_token to the client.

The client passes the received token as the input_token parameter to a successor call to GSS_Init_sec_context(), which processes data included in the token in order to achieve mutual authentication from the client's viewpoint. This call to GSS_Init_sec_context() returns GSS_S_COMPLETE status, indicating successful mutual authentication and the completion of context establishment for this example.

The client generates a data message and passes it to GSS_Wrap(). GSS_Wrap() performs data origin authentication, data integrity, and (optionally) confidentiality processing on the message and encapsulates the result into output_message, indicating GSS_S_COMPLETE status. The client sends the output_message to the server.

The server passes the received message to GSS_Unwrap(). GSS_Unwrap() inverts the encapsulation performed by GSS_Wrap(), deciphers the message if the optional confidentiality feature was applied, and validates the data origin authentication and data integrity checking quantities. GSS_Unwrap() indicates successful validation by returning GSS_S_COMPLETE status along with the resultant output_message.

For purposes of this example, we assume that the server knows by out-of-band means that this context will have no further use after one protected message is transferred from client to server. Given this premise, the server now calls GSS_Delete_sec_context() to flush context-level information. Optionally, the server-side application may provide a token buffer to GSS_Delete_sec_context(), to receive a context_token to be transferred to the client in order to request that client-side context-level information be deleted.

If a context_token is transferred, the client passes the context_token to GSS_Process_context_token(), which returns GSS_S_COMPLETE status after deleting context-level information at the client system.

The GSS-API design assumes and addresses several basic goals, including:

Mechanism independence: The GSS-API defines an interface to cryptographically implemented strong authentication and other security services at a generic level which is independent of particular underlying mechanisms. For example, GSS-API-provided services have been implemented using secret-key technologies (e.g., Kerberos, per [RFC-1964]) and with public-key approaches (e.g., SPKM, per [RFC-2025]).

Protocol environment independence: The GSS-API is independent of the communications protocol suites with which it is employed, permitting use in a broad range of protocol environments. In appropriate environments, an intermediate implementation "veneer" which is oriented to a particular communication protocol may be interposed between applications which call that protocol and the GSS-API (e.g., as defined in [RFC-2203] for Open Network Computing Remote Procedure Call (RPC)), thereby invoking GSS-API facilities in conjunction with that protocol's communications invocations.

Protocol association independence: The GSS-API's security context construct is independent of communications protocol association constructs. This characteristic allows a single GSS-API implementation to be utilized by a variety of invoking protocol modules on behalf of those modules' calling applications. GSS-API services can also be invoked directly by applications, wholly independent of protocol associations.

Suitability to a range of implementation placements: GSS-API clients are not constrained to reside within any Trusted Computing Base (TCB) perimeter defined on a system where the GSS-API is implemented; security services are specified in a manner suitable to both intra-TCB and extra-TCB callers.

1.1: GSS-API Constructs

This section describes the basic elements comprising the GSS-API.

1.1.1: Credentials

1.1.1.1: Credential Constructs and Concepts

Credentials provide the prerequisites which permit GSS-API peers to establish security contexts with each other. A caller may designate that the credential elements which are to be applied for context initiation or acceptance be selected by default. Alternately, those GSS-API callers which need to make explicit selection of particular

credentials structures may make references to those credentials through GSS-API-provided credential handles ("cred_handles"). In all cases, callers' credential references are indirect, mediated by GSS-API implementations and not requiring callers to access the selected credential elements.

A single credential structure may be used to initiate outbound contexts and to accept inbound contexts. Callers needing to operate in only one of these modes may designate this fact when credentials are acquired for use, allowing underlying mechanisms to optimize their processing and storage requirements. The credential elements defined by a particular mechanism may contain multiple cryptographic keys, e.g., to enable authentication and message encryption to be performed with different algorithms.

A GSS-API credential structure may contain multiple credential elements, each containing mechanism-specific information for a particular underlying mechanism (mech_type), but the set of elements within a given credential structure represent a common entity. A credential structure's contents will vary depending on the set of mech_types supported by a particular GSS-API implementation. Each credential element identifies the data needed by its mechanism in order to establish contexts on behalf of a particular principal, and may contain separate credential references for use in context initiation and context acceptance. Multiple credential elements within a given credential having overlapping combinations of mechanism, usage mode, and validity period are not permitted.

Commonly, a single mech_type will be used for all security contexts established by a particular initiator to a particular target. A major motivation for supporting credential sets representing multiple mech_types is to allow initiators on systems which are equipped to handle multiple types to initiate contexts to targets on other systems which can accommodate only a subset of the set supported at the initiator's system.

1.1.1.2: Credential Management

It is the responsibility of underlying system-specific mechanisms and OS functions below the GSS-API to ensure that the ability to acquire and use credentials associated with a given identity is constrained to appropriate processes within a system. This responsibility should be taken seriously by implementors, as the ability for an entity to utilize a principal's credentials is equivalent to the entity's ability to successfully assert that principal's identity.

Once a set of GSS-API credentials is established, the transferability of that credentials set to other processes or analogous constructs within a system is a local matter, not defined by the GSS-API. An example local policy would be one in which any credentials received as a result of login to a given user account, or of delegation of rights to that account, are accessible by, or transferable to, processes running under that account.

The credential establishment process (particularly when performed on behalf of users rather than server processes) is likely to require access to passwords or other quantities which should be protected locally and exposed for the shortest time possible. As a result, it will often be appropriate for preliminary credential establishment to be performed through local means at user login time, with the result(s) cached for subsequent reference. These preliminary credentials would be set aside (in a system-specific fashion) for subsequent use, either:

to be accessed by an invocation of the GSS-API GSS_Acquire_cred() call, returning an explicit handle to reference that credential

to comprise default credential elements to be installed, and to be used when default credential behavior is requested on behalf of a process

1.1.1.3: Default Credential Resolution

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. In support of application portability, support for the default resolution behavior described below for initiator credentials (GSS_Init_sec_context() usage) is mandated; support for the default resolution behavior described below for acceptor credentials (GSS_Accept_sec_context() usage) is recommended. If default credential resolution fails, GSS_S_NO_CRED status is to be returned.

GSS_Init_sec_context:

(i) If there is only a single principal capable of initiating security contexts that the application is authorized to act on behalf of, then that principal shall be used, otherwise

(ii) If the platform maintains a concept of a default network-identity, 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

(iii) If the platform maintains a concept of a default local identity, and provides a means to map local identities into network-identities, 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, then the principal corresponding to that identity shall be used, otherwise

(iv) A user-configurable default identity should be used.

GSS_Accept_sec_context:

(i) If there is only a single authorized principal identity capable of accepting security contexts, then that principal shall be used, otherwise

(ii) 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, then that principal identity shall be used, otherwise

(iii) If the mechanism supports context acceptance by any principal, and mutual authentication was not requested, any principal that the application is authorized to accept security contexts under may be used, otherwise

(iv) 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 those that use GSS_Acquire_cred() to request a specific identity.

1.1.2: Tokens

Tokens are data elements transferred between GSS-API callers, and are divided into two classes. Context-level tokens are exchanged in order to establish and manage a security context between peers. Per-message tokens relate to an established context and are exchanged to provide

protective security services (i.e., data origin authentication, integrity, and optional confidentiality) for corresponding data messages.

The first context-level token obtained from GSS_Init_sec_context() is required to indicate at its very beginning a globally-interpretable mechanism identifier, i.e., an Object Identifier (OID) of the security mechanism. The remaining part of this token as well as the whole content of all other tokens are specific to the particular underlying mechanism used to support the GSS-API. Section 3.1 of this document provides, for designers of GSS-API mechanisms, the description of the header of the first context-level token which is then followed by mechanism-specific information.

Tokens' contents are opaque from the viewpoint of GSS-API callers. They are generated within the GSS-API implementation at an end system, provided to a GSS-API caller to be transferred to the peer GSS-API caller at a remote end system, and processed by the GSS-API implementation at that remote end system.

Context-level tokens may be output by GSS-API calls (and should be transferred to GSS-API peers) whether or not the calls' status indicators indicate successful completion. Per-message tokens, in contrast, are to be returned only upon successful completion of per-message calls. Zero-length tokens are never returned by GSS routines for transfer to a peer. Token transfer may take place in an in-band manner, integrated into the same protocol stream used by the GSS-API callers for other data transfers, or in an out-of-band manner across a logically separate channel.

Different GSS-API tokens are used for different purposes (e.g., context initiation, context acceptance, protected message data on an established context), and it is the responsibility of a GSS-API caller receiving tokens to distinguish their types, associate them with corresponding security contexts, and pass them to appropriate GSS-API processing routines. Depending on the caller protocol environment, this distinction may be accomplished in several ways.

The following examples illustrate means through which tokens' types may be distinguished:

- implicit tagging based on state information (e.g., all tokens on a new association are considered to be context establishment tokens until context establishment is completed, at which point all tokens are considered to be wrapped data objects for that context),

- explicit tagging at the caller protocol level,

- a hybrid of these approaches.

Commonly, the encapsulated data within a token includes internal mechanism-specific tagging information, enabling mechanism-level processing modules to distinguish tokens used within the mechanism for different purposes. Such internal mechanism-level tagging is recommended to mechanism designers, and enables mechanisms to determine whether a caller has passed a particular token for processing by an inappropriate GSS-API routine.

Development of GSS-API mechanisms based on a particular underlying cryptographic technique and protocol (i.e., conformant to a specific GSS-API mechanism definition) does not necessarily imply that GSS-API callers using that GSS-API mechanism will be able to interoperate with peers invoking the same technique and protocol outside the GSS-API paradigm, or with peers implementing a different GSS-API mechanism based on the same underlying technology. The format of GSS-API tokens defined in conjunction with a particular mechanism, and the techniques used to integrate those tokens into callers' protocols, may not be interoperable with the tokens used by non-GSS-API callers of the same underlying technique.

1.1.3: Security Contexts

Security contexts are established between peers, using credentials established locally in conjunction with each peer or received by peers via delegation. Multiple contexts may exist simultaneously between a pair of peers, using the same or different sets of credentials. Coexistence of multiple contexts using different credentials allows graceful rollover when credentials expire. Distinction among multiple contexts based on the same credentials serves applications by distinguishing different message streams in a security sense.

The GSS-API is independent of underlying protocols and addressing structure, and depends on its callers to transport GSS-API-provided data elements. As a result of these factors, it is a caller responsibility to parse communicated messages, separating GSS-API-related data elements from caller-provided data. The GSS-API is independent of connection vs. connectionless orientation of the underlying communications service.

No correlation between security context and communications protocol association is dictated. (The optional channel binding facility, discussed in Section 1.1.6 of this document, represents an intentional exception to this rule, supporting additional protection

features within GSS-API supporting mechanisms.) This separation allows the GSS-API to be used in a wide range of communications environments, and also simplifies the calling sequences of the individual calls. In many cases (depending on underlying security protocol, associated mechanism, and availability of cached information), the state information required for context setup can be sent concurrently with initial signed user data, without interposing additional message exchanges. Messages may be protected and transferred in both directions on an established GSS-API security context concurrently; protection of messages in one direction does not interfere with protection of messages in the reverse direction.

GSS-API implementations are expected to retain inquirable context data on a context until the context is released by a caller, even after the context has expired, although underlying cryptographic data elements may be deleted after expiration in order to limit their exposure.

1.1.4: Mechanism Types

In order to successfully establish a security context with a target peer, it is necessary to identify an appropriate underlying mechanism type (mech_type) which both initiator and target peers support. The definition of a mechanism embodies not only the use of a particular cryptographic technology (or a hybrid or choice among alternative cryptographic technologies), but also definition of the syntax and semantics of data element exchanges which that mechanism will employ in order to support security services.

It is recommended that callers initiating contexts specify the "default" mech_type value, allowing system-specific functions within or invoked by the GSS-API implementation to select the appropriate mech_type, but callers may direct that a particular mech_type be employed when necessary.

For GSS-API purposes, the phrase "negotiating mechanism" refers to a mechanism which itself performs negotiation in order to select a concrete mechanism which is shared between peers and is then used for context establishment. Only those mechanisms which are defined in their specifications as negotiating mechanisms are to yield selected mechanisms with different identifier values than the value which is input by a GSS-API caller, except for the case of a caller requesting the "default" mech_type.

The means for identifying a shared mech_type to establish a security context with a peer will vary in different environments and circumstances; examples include (but are not limited to):

use of a fixed mech_type, defined by configuration, within an environment

syntactic convention on a target-specific basis, through examination of a target's name lookup of a target's name in a naming service or other database in order to identify mech_types supported by that target

explicit negotiation between GSS-API callers in advance of security context setup

use of a negotiating mechanism

When transferred between GSS-API peers, mech_type specifiers (per Section 3 of this document, represented as Object Identifiers (OIDs)) serve to qualify the interpretation of associated tokens. (The structure and encoding of Object Identifiers is defined in [ISOIEC-8824] and [ISOIEC-8825].) Use of hierarchically structured OIDs serves to preclude ambiguous interpretation of mech_type specifiers. The OID representing the DASS ([RFC-1507]) MechType, for example, is 1.3.12.2.1011.7.5, and that of the Kerberos V5 mechanism ([RFC-1964]), having been advanced to the level of Proposed Standard, is 1.2.840.113554.1.2.2.

1.1.5: Naming

The GSS-API avoids prescribing naming structures, treating the names which are transferred across the interface in order to initiate and accept security contexts as opaque objects. This approach supports the GSS-API's goal of implementability atop a range of underlying security mechanisms, recognizing the fact that different mechanisms process and authenticate names which are presented in different forms. Generalized services offering translation functions among arbitrary sets of naming environments are outside the scope of the GSS-API; availability and use of local conversion functions to translate among the naming formats supported within a given end system is anticipated.

Different classes of name representations are used in conjunction with different GSS-API parameters:

- Internal form (denoted in this document by INTERNAL NAME), opaque to callers and defined by individual GSS-API implementations. GSS-API implementations supporting multiple namespace types must maintain internal tags to disambiguate the interpretation of particular names. A Mechanism Name (MN) is a special case of INTERNAL NAME, guaranteed to contain elements

corresponding to one and only one mechanism; calls which are guaranteed to emit MNs or which require MNs as input are so identified within this specification.

- Contiguous string ("flat") form (denoted in this document by OCTET STRING); accompanied by OID tags identifying the namespace to which they correspond. Depending on tag value, flat names may or may not be printable strings for direct acceptance from and presentation to users. Tagging of flat names allows GSS-API callers and underlying GSS-API mechanisms to disambiguate name types and to determine whether an associated name's type is one which they are capable of processing, avoiding aliasing problems which could result from misinterpreting a name of one type as a name of another type.

- The GSS-API Exported Name Object, a special case of flat name designated by a reserved OID value, carries a canonicalized form of a name suitable for binary comparisons.

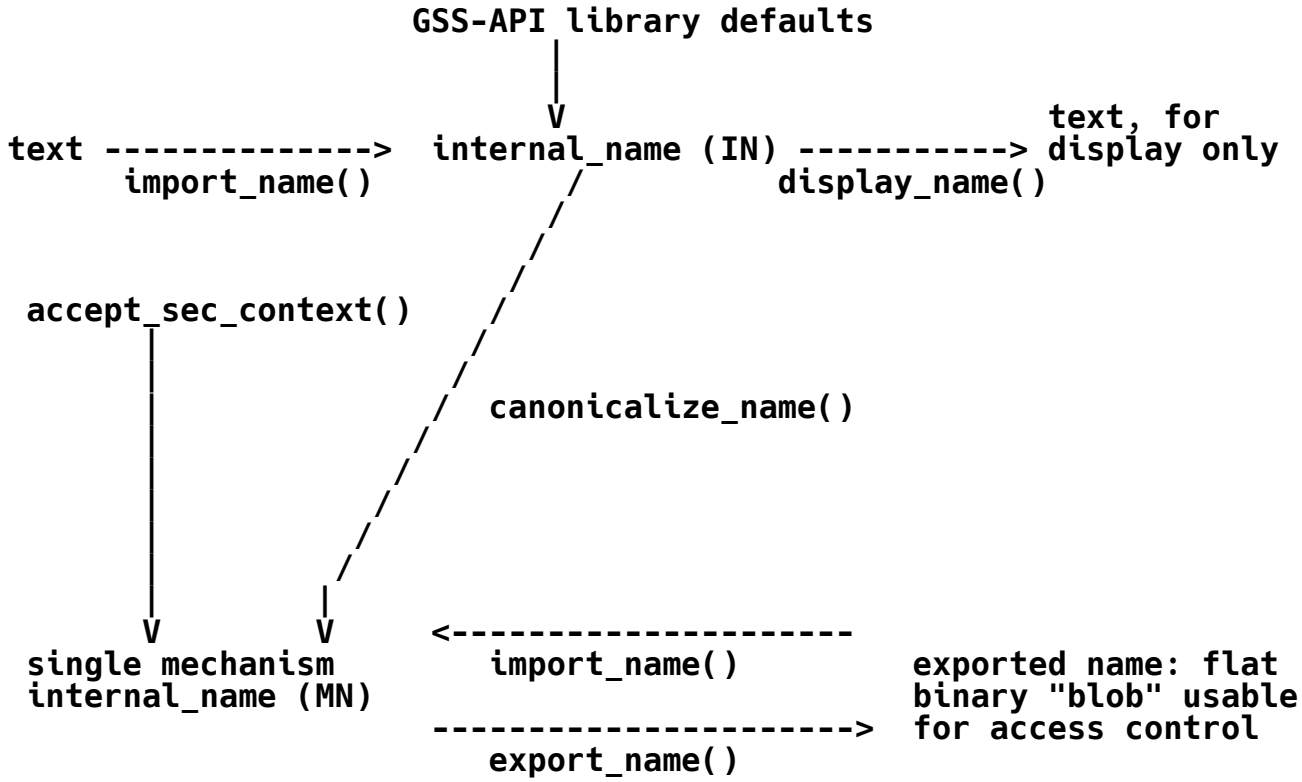
In addition to providing means for names to be tagged with types, this specification defines primitives to support a level of naming environment independence for certain calling applications. To provide basic services oriented towards the requirements of callers which need not themselves interpret the internal syntax and semantics of names, GSS-API calls for name comparison (GSS_Compare_name()), human-readable display (GSS_Display_name()), input conversion (GSS_Import_name()), internal name deallocation (GSS_Release_name()), and internal name duplication (GSS_Duplicate_name()) functions are defined. (It is anticipated that these proposed GSS-API calls will be implemented in many end systems based on system-specific name manipulation primitives already extant within those end systems; inclusion within the GSS-API is intended to offer GSS-API callers a portable means to perform specific operations, supportive of authorization and audit requirements, on authenticated names.)

GSS_Import_name() implementations can, where appropriate, support more than one printable syntax corresponding to a given namespace (e.g., alternative printable representations for X.500 Distinguished Names), allowing flexibility for their callers to select among alternative representations. GSS_Display_name() implementations output a printable syntax selected as appropriate to their operational environments; this selection is a local matter. Callers desiring portability across alternative printable syntaxes should refrain from implementing comparisons based on printable name forms and should instead use the GSS_Compare_name() call to determine whether or not one internal-format name matches another.

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 symbolic constant GSS_C_NT_EXPORT_NAME identifies the "export name" type. 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 exported name is defined in Section 3.2 of this specification.

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 operations 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 following diagram illustrates the intended dataflow among name-related GSS-API processing routines.



1.1.6: Channel Bindings

The GSS-API accommodates the concept of caller-provided channel binding ("chan_binding") information. Channel bindings are used to strengthen the quality with which peer entity authentication is provided during context establishment, by limiting the scope within which an intercepted context establishment token can be reused by an attacker. Specifically, they enable GSS-API callers to bind the establishment of a security context to relevant characteristics (e.g., addresses, transformed representations of encryption keys) of the underlying communications channel, of protection mechanisms applied to that communications channel, and to application-specific data.

The caller initiating a security context must determine the appropriate channel binding values to provide as input to the GSS_Init_sec_context() call, and consistent values must be provided to GSS_Accept_sec_context() by the context's target, in order for both peers' GSS-API mechanisms to validate that received tokens possess correct channel-related characteristics. Use or non-use of the GSS-API channel binding facility is a caller option. GSS-API mechanisms can operate in an environment where NULL channel bindings are presented; mechanism implementors are encouraged, but not

required, to make use of caller-provided channel binding data within their mechanisms. Callers should not assume that underlying mechanisms provide confidentiality protection for channel binding information.

When non-NULL channel bindings are provided by callers, certain mechanisms can offer enhanced security value by interpreting the bindings' content (rather than simply representing those bindings, or integrity check values computed on them, within tokens) and will therefore depend on presentation of specific data in a defined format. To this end, agreements among mechanism implementors are defining conventional interpretations for the contents of channel binding arguments, including address specifiers (with content dependent on communications protocol environment) for context initiators and acceptors. (These conventions are being incorporated in GSS-API mechanism specifications and into the GSS-API C language bindings specification.) In order for GSS-API callers to be portable across multiple mechanisms and achieve the full security functionality which each mechanism can provide, it is strongly recommended that GSS-API callers provide channel bindings consistent with these conventions and those of the networking environment in which they operate.

1.2: GSS-API Features and Issues

This section describes aspects of GSS-API operations, of the security services which the GSS-API provides, and provides commentary on design issues.

1.2.1: Status Reporting and Optional Service Support

1.2.1.1: Status Reporting

Each GSS-API call provides two status return values. Major_status values provide a mechanism-independent indication of call status (e.g., GSS_S_COMPLETE, GSS_S_FAILURE, GSS_S_CONTINUE_NEEDED), sufficient to drive normal control flow within the caller in a generic fashion. Table 1 summarizes the defined major_status return codes in tabular fashion.

Sequencing-related informatory major_status codes (GSS_S_DUPLICATE_TOKEN, GSS_S_OLD_TOKEN, GSS_S_UNSEQ_TOKEN, and GSS_S_GAP_TOKEN) can be indicated in conjunction with either GSS_S_COMPLETE or GSS_S_FAILURE status for GSS-API per-message calls. For context establishment calls, these sequencing-related codes will be indicated only in conjunction with GSS_S_FAILURE status (never in

conjunction with GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED), and, therefore, always correspond to fatal failures if encountered during the context establishment phase.

Table 1: GSS-API Major Status Codes

FATAL ERROR CODES	
GSS_S_BAD_BINDINGS	channel binding mismatch
GSS_S_BAD_MECH	unsupported mechanism requested
GSS_S_BAD_NAME	invalid name provided
GSS_S_BAD_NAMETYPE	name of unsupported type provided
GSS_S_BAD_STATUS	invalid input status selector
GSS_S_BAD_SIG	token had invalid integrity check
GSS_S_BAD_MIC	preferred alias for GSS_S_BAD_SIG
GSS_S_CONTEXT_EXPIRED	specified security context expired
GSS_S_CREDENTIALS_EXPIRED	expired credentials detected
GSS_S_DEFECTIVE_CREDENTIAL	defective credential detected
GSS_S_DEFECTIVE_TOKEN	defective token detected
GSS_S_FAILURE	failure, unspecified at GSS-API level
GSS_S_NO_CONTEXT	no valid security context specified
GSS_S_NO_CRED	no valid credentials provided
GSS_S_BAD_QOP	unsupported QOP value
GSS_S_UNAUTHORIZED	operation unauthorized
GSS_S_UNAVAILABLE	operation unavailable
GSS_S_DUPLICATE_ELEMENT	duplicate credential element requested
GSS_S_NAME_NOT_MN	name contains multi-mechanism elements
INFORMATORY STATUS CODES	
GSS_S_COMPLETE	normal completion
GSS_S_CONTINUE_NEEDED	continuation call to routine required
GSS_S_DUPLICATE_TOKEN	duplicate per-message token detected
GSS_S_OLD_TOKEN	timed-out per-message token detected
GSS_S_UNSEQ_TOKEN	reordered (early) per-message token detected
GSS_S_GAP_TOKEN	skipped predecessor token(s) detected

Minor_status provides more detailed status information which may include status codes specific to the underlying security mechanism. Minor_status values are not specified in this document.

GSS_S_CONTINUE_NEEDED major_status returns, and optional message outputs, are provided in GSS_Init_sec_context() and GSS_Accept_sec_context() calls so that different mechanisms' employment of different numbers of messages within their authentication sequences need not be reflected in separate code paths within calling applications. Instead, such cases are accommodated with sequences of continuation calls to GSS_Init_sec_context() and GSS_Accept_sec_context(). The same facility is used to encapsulate mutual authentication within the GSS-API's context initiation calls.

For mech_types which require interactions with third-party servers in order to establish a security context, GSS-API context establishment calls may block pending completion of such third-party interactions. On the other hand, no GSS-API calls pend on serialized interactions with GSS-API peer entities. As a result, local GSS-API status returns cannot reflect unpredictable or asynchronous exceptions occurring at remote peers, and reflection of such status information is a caller responsibility outside the GSS-API.

1.2.1.2: Optional Service Support

A context initiator may request various optional services at context establishment time. 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_GetMIC() and GSS_Wrap() should include message numbering information to enable GSS_VerifyMIC() and GSS_Unwrap() to detect if a message has been duplicated.

- Out-of-sequence detection - In addition to providing message integrity services, GSS_GetMIC() and GSS_Wrap() should include message sequencing information to enable GSS_VerifyMIC() 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.

- Available per-message confidentiality - requests that per-message confidentiality services be available on the context.

- Available per-message integrity - requests that per-message integrity services be available on the context.

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.

1.2.2: Per-Message Security Service Availability

When a context is established, two flags are returned to indicate the set of per-message protection security services which will be available on the context:

the integ_avail flag indicates whether per-message integrity and data origin authentication services are available

the conf_avail flag indicates whether per-message confidentiality services are available, and will never be returned TRUE unless the integ_avail flag is also returned TRUE

GSS-API callers desiring per-message security services should check the values of these flags at context establishment time, and must be aware that a returned FALSE value for integ_avail means that invocation of GSS_GetMIC() or GSS_Wrap() primitives on the associated context will apply no cryptographic protection to user data messages.

The GSS-API per-message integrity and data origin authentication services provide assurance to a receiving caller that protection was applied to a message by the caller's peer on the security context, corresponding to the entity named at context initiation. The GSS-API per-message confidentiality service provides assurance to a sending caller that the message's content is protected from access by entities other than the context's named peer.

The GSS-API per-message protection service primitives, as the category name implies, are oriented to operation at the granularity of protocol data units. They perform cryptographic operations on the data units, transfer cryptographic control information in tokens, and, in the case of GSS_Wrap(), encapsulate the protected data unit. As such, these primitives are not oriented to efficient data protection for stream-paradigm protocols (e.g., Telnet) if cryptography must be applied on an octet-by-octet basis.

1.2.3: Per-Message Replay Detection and Sequencing

Certain underlying mech_types offer support for replay detection and/or sequencing of messages transferred on the contexts they support. These optionally-selectable protection features are distinct from replay detection and sequencing features applied to the context establishment operation itself; the presence or absence of context-level replay or sequencing features is wholly a function of the underlying mech_type's capabilities, and is not selected or omitted as a caller option.

The caller initiating a context provides flags (replay_det_req_flag and sequence_req_flag) to specify whether the use of per-message replay detection and sequencing features is desired on the context being established. The GSS-API implementation at the initiator system can determine whether these features are supported (and whether they are optionally selectable) as a function of the selected mechanism, without need for bilateral negotiation with the target. When enabled, these features provide recipients with indicators as a result of GSS-API processing of incoming messages, identifying whether those messages were detected as duplicates or out-of-sequence. Detection of

such events does not prevent a suspect message from being provided to a recipient; the appropriate course of action on a suspect message is a matter of caller policy.

The semantics of the replay detection and sequencing services applied to received messages, as visible across the interface which the GSS-API provides to its clients, are as follows:

When replay_det_state is TRUE, the possible major_status returns for well-formed and correctly signed messages are as follows:

1. GSS_S_COMPLETE, without concurrent indication of GSS_S_DUPLICATE_TOKEN or GSS_S_OLD_TOKEN, indicates that the message was within the window (of time or sequence space) allowing replay events to be detected, and that the message was not a replay of a previously-processed message within that window.

2. GSS_S_DUPLICATE_TOKEN indicates that the cryptographic checkvalue on the received message was correct, but that the message was recognized as a duplicate of a previously-processed message. In addition to identifying duplicated tokens originated by a context's peer, this status may also be used to identify reflected copies of locally-generated tokens; it is recommended that mechanism designers include within their protocols facilities to detect and report such tokens.

3. GSS_S_OLD_TOKEN indicates that the cryptographic checkvalue on the received message was correct, but that the message is too old to be checked for duplication.

When sequence_state is TRUE, the possible major_status returns for well-formed and correctly signed messages are as follows:

1. GSS_S_COMPLETE, without concurrent indication of GSS_S_DUPLICATE_TOKEN, GSS_S_OLD_TOKEN, GSS_S_UNSEQ_TOKEN, or GSS_S_GAP_TOKEN, indicates that the message was within the window (of time or sequence space) allowing replay events to be detected, that the message was not a replay of a previously-processed message within that window, and that no predecessor sequenced messages are missing relative to the last received message (if any) processed on the context with a correct cryptographic checkvalue.

2. GSS_S_DUPLICATE_TOKEN indicates that the integrity check value on the received message was correct, but that the message was recognized as a duplicate of a previously-processed message. In addition to identifying duplicated tokens originated by a context's peer, this status may also be used to identify reflected

copies of locally-generated tokens; it is recommended that mechanism designers include within their protocols facilities to detect and report such tokens.

3. GSS_S_OLD_TOKEN indicates that the integrity check value on the received message was correct, but that the token is too old to be checked for duplication.

4. GSS_S_UNSEQ_TOKEN indicates that the cryptographic checkvalue on the received message was correct, but that it is earlier in a sequenced stream than a message already processed on the context. [Note: Mechanisms can be architected to provide a stricter form of sequencing service, delivering particular messages to recipients only after all predecessor messages in an ordered stream have been delivered. This type of support is incompatible with the GSS-API paradigm in which recipients receive all messages, whether in order or not, and provide them (one at a time, without intra-GSS-API message buffering) to GSS-API routines for validation. GSS-API facilities provide supportive functions, aiding clients to achieve strict message stream integrity in an efficient manner in conjunction with sequencing provisions in communications protocols, but the GSS-API does not offer this level of message stream integrity service by itself.]

5. GSS_S_GAP_TOKEN indicates that the cryptographic checkvalue on the received message was correct, but that one or more predecessor sequenced messages have not been successfully processed relative to the last received message (if any) processed on the context with a correct cryptographic checkvalue.

As the message stream integrity features (especially sequencing) may interfere with certain applications' intended communications paradigms, and since support for such features is likely to be resource intensive, it is highly recommended that mech_types supporting these features allow them to be activated selectively on initiator request when a context is established. A context initiator and target are provided with corresponding indicators (replay_det_state and sequence_state), signifying whether these features are active on a given context.

An example mech_type supporting per-message replay detection could (when replay_det_state is TRUE) implement the feature as follows: The underlying mechanism would insert timestamps in data elements output by GSS_GetMIC() and GSS_Wrap(), and would maintain (within a time-limited window) a cache (qualified by originator-recipient pair) identifying received data elements processed by GSS_VerifyMIC() and GSS_Unwrap(). When this feature is active, exception status returns (GSS_S_DUPLICATE_TOKEN, GSS_S_OLD_TOKEN) will be provided when

GSS_VerifyMIC() or GSS_Unwrap() is presented with a message which is either a detected duplicate of a prior message or which is too old to validate against a cache of recently received messages.

1.2.4: Quality of Protection

Some mech_types provide their users with fine granularity control over the means used to provide per-message protection, allowing callers to trade off security processing overhead dynamically against the protection requirements of particular messages. A per-message quality-of-protection parameter (analogous to quality-of-service, or QOS) selects among different QOP options supported by that mechanism. On context establishment for a multi-QOP mech_type, context-level data provides the prerequisite data for a range of protection qualities.

It is expected that the majority of callers will not wish to exert explicit mechanism-specific QOP control and will therefore request selection of a default QOP. Definitions of, and choices among, non-default QOP values are mechanism-specific, and no ordered sequences of QOP values can be assumed equivalent across different mechanisms. Meaningful use of non-default QOP values demands that callers be familiar with the QOP definitions of an underlying mechanism or mechanisms, and is therefore a non-portable construct. The GSS_S_BAD_QOP major_status value is defined in order to indicate that a provided QOP value is unsupported for a security context, most likely because that value is unrecognized by the underlying mechanism.

In the interests of interoperability, mechanisms which allow optional support of particular QOP values shall satisfy one of the following conditions. Either:

(i) All implementations of the mechanism are required to be capable of processing messages protected using any QOP value, regardless of whether they can apply protection corresponding to that QOP, or

(ii) The set of mutually-supported receiver QOP values must be determined during context establishment, and messages may be protected by either peer using only QOP values from this mutually-supported set.

NOTE: (i) is just a special-case of (ii), where implementations are required to support all QOP values on receipt.

1.2.5: Anonymity Support

In certain situations or environments, an application may wish to authenticate a peer and/or protect communications using GSS-API per-message services without revealing its own identity. For example, consider an application which provides read access to a research database, and which permits queries by arbitrary requestors. A client of such a service might wish to authenticate the service, to establish trust in the information received from it, but might not wish to disclose its identity to the service for privacy reasons.

In ordinary GSS-API usage, a context initiator's identity is made available to the context acceptor as part of the context establishment process. To provide for anonymity support, a facility (input anon_req_flag to GSS_Init_sec_context()) is provided through which context initiators may request that their identity not be provided to the context acceptor. Mechanisms are not required to honor this request, but a caller will be informed (via returned anon_state indicator from GSS_Init_sec_context()) whether or not the request is honored. Note that authentication as the anonymous principal does not necessarily imply that credentials are not required in order to establish a context.

Section 4.5 of this document defines the Object Identifier value used to identify an anonymous principal.

Four possible combinations of anon_state and mutual_state are possible, with the following results:

- anon_state == FALSE, mutual_state == FALSE: initiator authenticated to target.
- anon_state == FALSE, mutual_state == TRUE: initiator authenticated to target, target authenticated to initiator.
- anon_state == TRUE, mutual_state == FALSE: initiator authenticated as anonymous principal to target.
- anon_state == TRUE, mutual_state == TRUE: initiator authenticated as anonymous principal to target, target authenticated to initiator.

1.2.6: Initialization

No initialization calls (i.e., calls which must be invoked prior to invocation of other facilities in the interface) are defined in GSS-API. As an implication of this fact, GSS-API implementations must themselves be self-initializing.

1.2.7: Per-Message Protection During Context Establishment

A facility is defined in GSS-V2 to enable protection and buffering of data messages for later transfer while a security context's establishment is in GSS_S_CONTINUE_NEEDED status, to be used in cases where the caller side already possesses the necessary session key to enable this processing. Specifically, a new state Boolean, called prot_ready_state, is added to the set of information returned by GSS_Init_sec_context(), GSS_Accept_sec_context(), and GSS_Inquire_context().

For context establishment calls, this state Boolean is valid and interpretable when the associated major_status is either GSS_S_CONTINUE_NEEDED, or GSS_S_COMPLETE. Callers of GSS-API (both initiators and acceptors) can assume that per-message protection (via GSS_Wrap(), GSS_Unwrap(), GSS_GetMIC() and GSS_VerifyMIC()) is available and ready for use if either: prot_ready_state == TRUE, or major_status == GSS_S_COMPLETE, though mutual authentication (if requested) cannot be guaranteed until GSS_S_COMPLETE is returned. Callers making use of per-message protection services in advance of GSS_S_COMPLETE status should be aware of the possibility that a subsequent context establishment step may fail, and that certain context data (e.g., mech_type) as returned for subsequent calls may change.

This approach achieves full, transparent backward compatibility for GSS-API V1 callers, who need not even know of the existence of prot_ready_state, and who will get the expected behavior from GSS_S_COMPLETE, but who will not be able to use per-message protection before GSS_S_COMPLETE is returned.

It is not a requirement that GSS-V2 mechanisms ever return TRUE prot_ready_state before completion of context establishment (indeed, some mechanisms will not evolve usable message protection keys, especially at the context acceptor, before context establishment is complete). It is expected but not required that GSS-V2 mechanisms will return TRUE prot_ready_state upon completion of context establishment if they support per-message protection at all (however GSS-V2 applications should not assume that TRUE prot_ready_state will always be returned together with the GSS_S_COMPLETE major_status, since GSS-V2 implementations may continue to support GSS-V1 mechanism code, which will never return TRUE prot_ready_state).

When prot_ready_state is returned TRUE, mechanisms shall also set those context service indicator flags (deleg_state, mutual_state, replay_det_state, sequence_state, anon_state, trans_state, conf_avail, integ_avail) which represent facilities confirmed, at that time, to be available on the context being established. In

situations where prot_ready_state is returned before GSS_S_COMPLETE, it is possible that additional facilities may be confirmed and subsequently indicated when GSS_S_COMPLETE is returned.

1.2.8: Implementation Robustness

This section recommends aspects of GSS-API implementation behavior in the interests of overall robustness.

Invocation of GSS-API calls is to incur no undocumented side effects visible at the GSS-API level.

If a token is presented for processing on a GSS-API security context and that token generates a fatal error in processing or is otherwise determined to be invalid for that context, the context's state should not be disrupted for purposes of processing subsequent valid tokens.

Certain local conditions at a GSS-API implementation (e.g., unavailability of memory) may preclude, temporarily or permanently, the successful processing of tokens on a GSS-API security context, typically generating GSS_S_FAILURE major_status returns along with locally-significant minor_status. For robust operation under such conditions, the following recommendations are made:

- Failing calls should free any memory they allocate, so that callers may retry without causing further loss of resources.

- Failure of an individual call on an established context should not preclude subsequent calls from succeeding on the same context.

- Whenever possible, it should be possible for GSS_Delete_sec_context() calls to be successfully processed even if other calls cannot succeed, thereby enabling context-related resources to be released.

A failure of GSS_GetMIC() or GSS_Wrap() due to an attempt to use an unsupported QOP will not interfere with context validity, nor shall such a failure impact the ability of the application to subsequently invoke GSS_GetMIC() or GSS_Wrap() using a supported QOP. Any state information concerning sequencing of outgoing messages shall be unchanged by an unsuccessful call of GSS_GetMIC() or GSS_Wrap().

1.2.9: 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.

1.2.10: Interprocess 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 this call, 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 context handle 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() indicating a TRUE trans_state return value.

2: Interface Descriptions

This section describes the GSS-API's service interface, dividing the set of calls offered into four groups. Credential management calls are related to the acquisition and release of credentials by principals. Context-level calls are related to the management of security contexts between principals. Per-message calls are related to the protection of individual messages on established security contexts. Support calls provide ancillary functions useful to GSS-API callers. Table 2 groups and summarizes the calls in tabular fashion.

Table 2: GSS-API Calls

CREDENTIAL MANAGEMENT

GSS_Acquire_cred	acquire credentials for use
GSS_Release_cred	release credentials after use
GSS_Inquire_cred	display information about credentials

GSS_Add_cred	construct credentials incrementally
GSS_Inquire_cred_by_mech	display per-mechanism credential information
CONTEXT-LEVEL CALLS	
GSS_Init_sec_context	initiate outbound security context
GSS_Accept_sec_context	accept inbound security context
GSS_Delete_sec_context	flush context when no longer needed
GSS_Process_context_token	process received control token on context
GSS_Context_time	indicate validity time remaining on context
GSS_Inquire_context	display information about context
GSS_Wrap_size_limit	determine GSS_Wrap token size limit
GSS_Export_sec_context	transfer context to other process
GSS_Import_sec_context	import transferred context
PER-MESSAGE CALLS	
GSS_GetMIC	apply integrity check, receive as token separate from message
GSS_VerifyMIC	validate integrity check token along with message
GSS_Wrap	sign, optionally encrypt, encapsulate
GSS_Unwrap	decapsulate, decrypt if needed, validate integrity check
SUPPORT CALLS	
GSS_Display_status	translate status codes to printable form
GSS_Indicate_mechs	indicate mech_types supported on local system
GSS_Compare_name	compare two names for equality
GSS_Display_name	translate name to printable form
GSS_Import_name	convert printable name to normalized form
GSS_Release_name	free storage of normalized-form name
GSS_Release_buffer	free storage of general GSS-allocated object
GSS_Release_OID_set	free storage of OID set object
GSS_Create_empty_OID_set	create empty OID set
GSS_Add_OID_set_member	add member to OID set
GSS_Test_OID_set_member	test if OID is member of OID set
GSS_Inquire_names_for_mech	indicate name types supported by

	mechanism
GSS_Inquire_mechs_for_name	indicates mechanisms supporting name type
GSS_Canonicalize_name	translate name to per-mechanism form
GSS_Export_name	externalize per-mechanism name
GSS_Duplicate_name	duplicate name object

2.1: Credential management calls

These GSS-API calls provide functions related to the management of credentials. Their characterization with regard to whether or not they may block pending exchanges with other network entities (e.g., directories or authentication servers) depends in part on OS-specific (extra-GSS-API) issues, so is not specified in this document.

The GSS_Acquire_cred() call is defined within the GSS-API in support of application portability, with a particular orientation towards support of portable server applications. It is recognized that (for certain systems and mechanisms) credentials for interactive users may be managed differently from credentials for server processes; in such environments, it is the GSS-API implementation's responsibility to distinguish these cases and the procedures for making this distinction are a local matter. The GSS_Release_cred() call provides a means for callers to indicate to the GSS-API that use of a credentials structure is no longer required. The GSS_Inquire_cred() call allows callers to determine information about a credentials structure. The GSS_Add_cred() call enables callers to append elements to an existing credential structure, allowing iterative construction of a multi-mechanism credential. The GSS_Inquire_cred_by_mech() call enables callers to extract per-mechanism information describing a credentials structure.

2.1.1: GSS_Acquire_cred call

Inputs:

o desired_name INTERNAL NAME, -- NULL requests locally-determined -- default

o lifetime_req INTEGER, -- in seconds; 0 requests default

o desired_mechs SET OF OBJECT IDENTIFIER, -- NULL requests -- system-selected default

o cred_usage INTEGER -- 0=INITIATE-AND-ACCEPT, 1=INITIATE-ONLY, -- 2=ACCEPT-ONLY

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_cred_handle CREDENTIAL HANDLE, -- if returned non-NULL,
-- caller must release with GSS_Release_cred()

o actual_mechs SET OF OBJECT IDENTIFIER, -- if returned non-NULL,
-- caller must release with GSS_Release_oid_set()

o lifetime_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

Return major_status codes:

o GSS_S_COMPLETE indicates that requested credentials were successfully established, for the duration indicated in lifetime_rec, suitable for the usage requested in cred_usage, for the set of mech_types indicated in actual_mechs, and that those credentials can be referenced for subsequent use with the handle returned in output_cred_handle.

o GSS_S_BAD_MECH indicates that a mech_type unsupported by the GSS-API implementation type was requested, causing the credential establishment operation to fail.

o GSS_S_BAD_NAMETYPE indicates that the provided desired_name is uninterpretable or of a type unsupported by the applicable underlying GSS-API mechanism(s), so no credentials could be established for the accompanying desired_name.

o GSS_S_BAD_NAME indicates that the provided desired_name is inconsistent in terms of internally-incorporated type specifier information, so no credentials could be established for the accompanying desired_name.

o GSS_S_CREDENTIALS_EXPIRED indicates that underlying credential elements corresponding to the requested desired_name have expired, so requested credentials could not be established.

o GSS_S_NO_CRED indicates that no credential elements corresponding to the requested desired_name and usage could be accessed, so requested credentials could not be established. In particular, this status should be returned upon temporary user-fixable conditions

preventing successful credential establishment and upon lack of authorization to establish and use credentials associated with the identity named in the input desired_name argument.

o GSS_S_FAILURE indicates that credential establishment failed for reasons unspecified at the GSS-API level.

GSS_Acquire_cred() is used to acquire credentials so that a principal can (as a function of the input cred_usage parameter) initiate and/or accept security contexts under the identity represented by the desired_name input argument. On successful completion, the returned output_cred_handle result provides a handle for subsequent references to the acquired credentials. Typically, single-user client processes requesting that default credential behavior be applied for context establishment purposes will have no need to invoke this call.

A caller may provide the value NULL (GSS_C_NO_NAME) for desired_name, which will be 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. It is possible that multiple pre-established credentials may exist for the same principal identity (for example, as a result of multiple user login sessions) when GSS_Acquire_cred() is called; the means used in such cases to select a specific credential are local matters. The input lifetime_req argument to GSS_Acquire_cred() may provide useful information for local GSS-API implementations to employ in making this disambiguation in a manner which will best satisfy a caller's intent.

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 resulting from applying GSS_Inquire_context() to an active context, or a name resulting from applying GSS_Inquire_cred() against a credential handle corresponding to default behavior. It is important to recognize that the explicit name which is yielded by resolving a default reference may change over time, e.g., as a result of local credential element management operations outside GSS-API; once resolved, however, the value of such an explicit name will remain constant.

The lifetime_rec result indicates the length of time for which the acquired credentials will be valid, as an offset from the present. A mechanism may return a reserved value indicating INDEFINITE if no

constraints on credential lifetime are imposed. A caller of GSS_Acquire_cred() can request a length of time for which acquired credentials are to be valid (lifetime_req argument), beginning at the present, or can request credentials with a default validity interval. (Requests for postdated credentials are not supported within the GSS-API.) Certain mechanisms and implementations may bind in credential validity period specifiers at a point preliminary to invocation of the GSS_Acquire_cred() call (e.g., in conjunction with user login procedures). As a result, callers requesting non-default values for lifetime_req must recognize that such requests cannot always be honored and must be prepared to accommodate the use of returned credentials with different lifetimes as indicated in lifetime_rec.

The caller of GSS_Acquire_cred() can explicitly specify a set of mech_types which are to be accommodated in the returned credentials (desired_mechs argument), or can request credentials for a system-defined default set of mech_types. Selection of the system-specified default set is recommended in the interests of application portability. The actual_mechs return value may be interrogated by the caller to determine the set of mechanisms with which the returned credentials may be used.

2.1.2: GSS_Release_cred call

Input:

o cred_handle CREDENTIAL HANDLE -- if GSS_C_NO_CREDENTIAL
-- is specified, the call will complete successfully, but
-- will have no effect; no credential elements will be
-- released.

Outputs:

o major_status INTEGER,

o minor_status INTEGER

Return major_status codes:

o GSS_S_COMPLETE indicates that the credentials referenced by the input cred_handle were released for purposes of subsequent access by the caller. The effect on other processes which may be authorized shared access to such credentials is a local matter.

o GSS_S_NO_CRED indicates that no release operation was performed, either because the input cred_handle was invalid or because the caller lacks authorization to access the referenced credentials.

o GSS_S_FAILURE indicates that the release operation failed for reasons unspecified at the GSS-API level.

Provides a means for a caller to explicitly request that credentials be released when their use is no longer required. Note that system-specific credential management functions are also likely to exist, for example to assure that credentials shared among processes are properly deleted when all affected processes terminate, even if no explicit release requests are issued by those processes. Given the fact that multiple callers are not precluded from gaining authorized access to the same credentials, invocation of GSS_Release_cred() cannot be assumed to delete a particular set of credentials on a system-wide basis.

2.1.3: GSS_Inquire_cred call

Input:

o cred_handle CREDENTIAL HANDLE -- if GSS_C_NO_CREDENTIAL
-- is specified, default initiator credentials are queried

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o cred_name INTERNAL NAME, -- caller must release with
-- GSS_Release_name()

o lifetime_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

o cred_usage INTEGER, -- 0=INITIATE-AND-ACCEPT, 1=INITIATE-ONLY,
-- 2=ACCEPT-ONLY

o mech_set SET OF OBJECT IDENTIFIER -- caller must release
-- with GSS_Release_oid_set()

Return major_status codes:

o GSS_S_COMPLETE indicates that the credentials referenced by the input cred_handle argument were valid, and that the output cred_name, lifetime_rec, and cred_usage values represent, respectively, the credentials' associated principal name, remaining lifetime, suitable usage modes, and supported mechanism types.

o GSS_S_NO_CRED indicates that no information could be returned about the referenced credentials, either because the input cred_handle was invalid or because the caller lacks authorization to access the referenced credentials.

o GSS_S_DEFECTIVE_CREDENTIAL indicates that the referenced credentials are invalid.

o GSS_S_CREDENTIALS_EXPIRED indicates that the referenced credentials have expired.

o GSS_S_FAILURE indicates that the operation failed for reasons unspecified at the GSS-API level.

The GSS_Inquire_cred() call is defined primarily for the use of those callers which request use of default credential behavior rather than acquiring credentials explicitly with GSS_Acquire_cred(). It enables callers to determine a credential structure's associated principal name, remaining validity period, usability for security context initiation and/or acceptance, and supported mechanisms.

For a multi-mechanism credential, the returned "lifetime" specifier indicates the shortest lifetime of any of the mechanisms' elements in the credential (for either context initiation or acceptance purposes).

GSS_Inquire_cred() should indicate INITIATE-AND-ACCEPT for "cred_usage" if both of the following conditions hold:

(1) there exists in the credential an element which allows context initiation using some mechanism

(2) there exists in the credential an element which allows context acceptance using some mechanism (allowably, but not necessarily, one of the same mechanism(s) qualifying for (1)).

If condition (1) holds but not condition (2), GSS_Inquire_cred() should indicate INITIATE-ONLY for "cred_usage". If condition (2) holds but not condition (1), GSS_Inquire_cred() should indicate ACCEPT-ONLY for "cred_usage".

Callers requiring finer disambiguation among available combinations of lifetimes, usage modes, and mechanisms should call the GSS_Inquire_cred_by_mech() routine, passing that routine one of the mech OIDs returned by GSS_Inquire_cred().

2.1.4: GSS_Add_cred call

Inputs:

o input_cred_handle CREDENTIAL HANDLE -- handle to credential
-- structure created with prior GSS_Acquire_cred() or
-- GSS_Add_cred() call; see text for definition of behavior
-- when GSS_C_NO_CREDENTIAL provided.

o desired_name INTERNAL NAME

o initiator_time_req INTEGER -- in seconds; 0 requests default

o acceptor_time_req INTEGER -- in seconds; 0 requests default

o desired_mech OBJECT IDENTIFIER

o cred_usage INTEGER -- 0=INITIATE-AND-ACCEPT, 1=INITIATE-ONLY,
-- 2=ACCEPT-ONLY

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_cred_handle CREDENTIAL HANDLE, -- NULL to request that
-- credential elements be added "in place" to the credential
-- structure identified by input_cred_handle,
-- non-NULL pointer to request that
-- a new credential structure and handle be created.
-- if credential handle returned, caller must release with
-- GSS_Release_cred()

o actual_mechs SET OF OBJECT IDENTIFIER, -- if returned, caller must
-- release with GSS_Release_oid_set()

o initiator_time_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

o acceptor_time_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

o cred_usage INTEGER, -- 0=INITIATE-AND-ACCEPT, 1=INITIATE-ONLY,
-- 2=ACCEPT-ONLY

o mech_set SET OF OBJECT IDENTIFIER -- full set of mechanisms
-- supported by resulting credential.

Return major_status codes:

o GSS_S_COMPLETE indicates that the credentials referenced by the input_cred_handle argument were valid, and that the resulting credential from GSS_Add_cred() is valid for the durations indicated in initiator_time_rec and acceptor_time_rec, suitable for the usage requested in cred_usage, and for the mechanisms indicated in actual_mechs.

o GSS_S_DUPLICATE_ELEMENT indicates that the input desired_mech specified a mechanism for which the referenced credential already contained a credential element with overlapping cred_usage and validity time specifiers.

o GSS_S_BAD_MECH indicates that the input desired_mech specified a mechanism unsupported by the GSS-API implementation, causing the GSS_Add_cred() operation to fail.

o GSS_S_BAD_NAMETYPE indicates that the provided desired_name is uninterpretable or of a type unsupported by the applicable underlying GSS-API mechanism(s), so the GSS_Add_cred() operation could not be performed for that name.

o GSS_S_BAD_NAME indicates that the provided desired_name is inconsistent in terms of internally-incorporated type specifier information, so the GSS_Add_cred() operation could not be performed for that name.

o GSS_S_NO_CRED indicates that the input_cred_handle referenced invalid or inaccessible credentials. In particular, this status should be returned upon temporary user-fixable conditions preventing successful credential establishment or upon lack of authorization to establish or use credentials representing the requested identity.

o GSS_S_CREDENTIALS_EXPIRED indicates that referenced credential elements have expired, so the GSS_Add_cred() operation could not be performed.

o GSS_S_FAILURE indicates that the operation failed for reasons unspecified at the GSS-API level.

GSS_Add_cred() enables callers to construct credentials iteratively by adding credential elements in successive operations, corresponding to different mechanisms. This offers particular value in multi-mechanism environments, as the major_status and minor_status values returned on each iteration are individually visible and can therefore be interpreted unambiguously on a per-mechanism basis. A 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 extension routines.

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.

If GSS_C_NO_CREDENTIAL is specified as input_cred_handle, a non-NULL output_cred_handle must be supplied. For the case of GSS_C_NO_CREDENTIAL as input_cred_handle, GSS_Add_cred() will create the credential referenced by its output_cred_handle based on default behavior. That is, the call will have the same effect as if the caller had previously called GSS_Acquire_cred(), specifying the same usage and passing GSS_C_NO_NAME as the desired_name parameter (thereby obtaining an explicit credential handle corresponding to default behavior), had passed that credential handle to GSS_Add_cred(), and had finally called GSS_Release_cred() on the credential handle received from GSS_Acquire_cred().

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 resulting from applying GSS_Inquire_context() to an active context, or a name resulting from applying GSS_Inquire_cred() against a credential handle corresponding to default behavior. It is important to recognize that the explicit name which is yielded by resolving a default reference may change over time, e.g., as a result of local

credential element management operations outside GSS-API; once resolved, however, the value of such an explicit name will remain constant.

A caller may provide the value NULL (GSS_C_NO_NAME) for desired_name, which will be 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.

The same input desired_name, or default reference, should be used on all GSS_Acquire_cred() and GSS_Add_cred() calls corresponding to a particular credential.

2.1.5: GSS_Inquire_cred_by_mech call

Inputs:

o cred_handle CREDENTIAL HANDLE -- if GSS_C_NO_CREDENTIAL
-- specified, default initiator credentials are queried

o mech_type OBJECT IDENTIFIER -- specific mechanism for
-- which credentials are being queried

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o cred_name INTERNAL NAME, -- guaranteed to be MN; caller must
-- release with GSS_Release_name()

o lifetime_rec_initiate INTEGER -- in seconds, or reserved value for
-- INDEFINITE

o lifetime_rec_accept INTEGER -- in seconds, or reserved value for
-- INDEFINITE

o cred_usage INTEGER, -- 0=INITIATE-AND-ACCEPT, 1=INITIATE-ONLY,
-- 2=ACCEPT-ONLY

Return major_status codes:

o GSS_S_COMPLETE indicates that the credentials referenced by the input cred_handle argument were valid, that the mechanism indicated by the input mech_type was represented with elements within those

credentials, and that the output cred_name, lifetime_rec_initiate, lifetime_rec_accept, and cred_usage values represent, respectively, the credentials' associated principal name, remaining lifetimes, and suitable usage modes.

o GSS_S_NO_CRED indicates that no information could be returned about the referenced credentials, either because the input cred_handle was invalid or because the caller lacks authorization to access the referenced credentials.

o GSS_S_DEFECTIVE_CREDENTIAL indicates that the referenced credentials are invalid.

o GSS_S_CREDENTIALS_EXPIRED indicates that the referenced credentials have expired.

o GSS_S_BAD_MECH indicates that the referenced credentials do not contain elements for the requested mechanism.

o GSS_S_FAILURE indicates that the operation failed for reasons unspecified at the GSS-API level.

The GSS_Inquire_cred_by_mech() call enables callers in multi-mechanism environments to acquire specific data about available combinations of lifetimes, usage modes, and mechanisms within a credential structure. The lifetime_rec_initiate result indicates the available lifetime for context initiation purposes; the lifetime_rec_accept result indicates the available lifetime for context acceptance purposes.

2.2: Context-level calls

This group of calls is devoted to the establishment and management of security contexts between peers. A context's initiator calls GSS_Init_sec_context(), resulting in generation of a token which the caller passes to the target. At the target, that token is passed to GSS_Accept_sec_context(). Depending on the underlying mech_type and specified options, additional token exchanges may be performed in the course of context establishment; such exchanges are accommodated by GSS_S_CONTINUE_NEEDED status returns from GSS_Init_sec_context() and GSS_Accept_sec_context().

Either party to an established context may invoke GSS_Delete_sec_context() to flush context information when a context is no longer required. GSS_Process_context_token() is used to process received tokens carrying context-level control information. GSS_Context_time() allows a caller to determine the length of time for which an established context will remain valid.

GSS_Inquire_context() returns status information describing context characteristics. GSS_Wrap_size_limit() allows a caller to determine the size of a token which will be generated by a GSS_Wrap() operation. GSS_Export_sec_context() and GSS_Import_sec_context() enable transfer of active contexts between processes on an end system.

2.2.1: GSS_Init_sec_context call

Inputs:

o claimant_cred_handle CREDENTIAL HANDLE, -- NULL specifies "use -- default"

o input_context_handle CONTEXT HANDLE, -- 0 -- (GSS_C_NO_CONTEXT) specifies "none assigned yet"

o targ_name INTERNAL NAME,

o mech_type OBJECT IDENTIFIER, -- NULL parameter specifies "use -- default"

o deleg_req_flag BOOLEAN,

o mutual_req_flag BOOLEAN,

o replay_det_req_flag BOOLEAN,

o sequence_req_flag BOOLEAN,

o anon_req_flag BOOLEAN,

o conf_req_flag BOOLEAN,

o integ_req_flag BOOLEAN,

o lifetime_req INTEGER, -- 0 specifies default lifetime

o chan_bindings OCTET STRING,

o input_token OCTET STRING -- NULL or token received from target

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_context_handle CONTEXT HANDLE, -- once returned non-NULL,
-- caller must release with GSS_Delete_sec_context()

o mech_type OBJECT IDENTIFIER, -- actual mechanism always
-- indicated, never NULL; caller should treat as read-only
-- and should not attempt to release

o output_token OCTET STRING, -- NULL or token to pass to context
-- target; caller must release with GSS_Release_buffer()

o deleg_state BOOLEAN,

o mutual_state BOOLEAN,

o replay_det_state BOOLEAN,

o sequence_state BOOLEAN,

o anon_state BOOLEAN,

o trans_state BOOLEAN,

o prot_ready_state BOOLEAN, -- see Section 1.2.7

o conf_avail BOOLEAN,

o integ_avail BOOLEAN,

o lifetime_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

This call may block pending network interactions for those mech_types in which an authentication server or other network entity must be consulted on behalf of a context initiator in order to generate an output_token suitable for presentation to a specified target.

Return major_status codes:

o GSS_S_COMPLETE indicates that context-level information was successfully initialized, and that the returned output_token will provide sufficient information for the target to perform per-message processing on the newly-established context.

o GSS_S_CONTINUE_NEEDED indicates that control information in the returned output_token must be sent to the target, and that a reply must be received and passed as the input_token argument

to a continuation call to GSS_Init_sec_context(), before per-message processing can be performed in conjunction with this context (unless the prot_ready_state value is concurrently returned TRUE).

o GSS_S_DEFECTIVE_TOKEN indicates that consistency checks performed on the input_token failed, preventing further processing from being performed based on that token.

o GSS_S_DEFECTIVE_CREDENTIAL indicates that consistency checks performed on the credential structure referenced by claimant_cred_handle failed, preventing further processing from being performed using that credential structure.

o GSS_S_BAD_SIG (GSS_S_BAD_MIC) indicates that the received input_token contains an incorrect integrity check, so context setup cannot be accomplished.

o GSS_S_NO_CRED indicates that no context was established, either because the input cred_handle was invalid, because the referenced credentials are valid for context acceptor use only, because the caller lacks authorization to access the referenced credentials, or because the resolution of default credentials failed.

o GSS_S_CREDENTIALS_EXPIRED indicates that the credentials provided through the input claimant_cred_handle argument are no longer valid, so context establishment cannot be completed.

o GSS_S_BAD_BINDINGS indicates that a mismatch between the caller-provided chan_bindings and those extracted from the input_token was detected, signifying a security-relevant event and preventing context establishment. (This result will be returned by GSS_Init_sec_context() only for contexts where mutual_state is TRUE.)

o GSS_S_OLD_TOKEN indicates that the input_token is too old to be checked for integrity. This is a fatal error during context establishment.

o GSS_S_DUPLICATE_TOKEN indicates that the input token has a correct integrity check, but is a duplicate of a token already processed. This is a fatal error during context establishment.

o GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided; this major status will be returned only for successor calls following GSS_S_CONTINUE_ NEEDED status returns.

o GSS_S_BAD_NAMETYPE indicates that the provided targ_name is of a type uninterpretable or unsupported by the applicable underlying GSS-API mechanism(s), so context establishment cannot be completed.

o GSS_S_BAD_NAME indicates that the provided targ_name is inconsistent in terms of internally-incorporated type specifier information, so context establishment cannot be accomplished.

o GSS_S_BAD_MECH indicates receipt of a context establishment token or of a caller request specifying a mechanism unsupported by the local system or with the caller's active credentials

o GSS_S_FAILURE indicates that context setup could not be accomplished for reasons unspecified at the GSS-API level, and that no interface-defined recovery action is available.

This routine is used by a context initiator, and ordinarily emits an output_token suitable for use by the target within the selected mech_type's protocol. For the case of a multi-step exchange, this output_token will be one in a series, each generated by a successive call. Using information in the credentials structure referenced by claimant_cred_handle, GSS_Init_sec_context() initializes the data structures required to establish a security context with target targ_name.

The targ_name may be any valid INTERNAL NAME; it need not be an MN. In addition to support for other name types, it is recommended (newly as of GSS-V2, Update 1) that mechanisms be able to accept GSS_C_NO_NAME as an input type for targ_name. While recommended, such support is not required, and it is recognized that not all mechanisms can construct tokens without explicitly naming the context target, even when mutual authentication of the target is not obtained. Callers wishing to make use of this facility and concerned with portability should be aware that support for GSS_C_NO_NAME as input targ_name type is unlikely to be provided within mechanism definitions specified prior to GSS-V2, Update 1.

The claimant_cred_handle must correspond to the same valid credentials structure on the initial call to GSS_Init_sec_context() and on any successor calls resulting from GSS_S_CONTINUE_NEEDED status returns; different protocol sequences modeled by the GSS_S_CONTINUE_NEEDED facility will require access to credentials at different points in the context establishment sequence.

The caller-provided input_context_handle argument is to be 0 (GSS_C_NO_CONTEXT), specifying "not yet assigned", on the first GSS_Init_sec_context() call relating to a given context. If successful (i.e., if accompanied by major_status GSS_S_COMPLETE or

GSS_S_CONTINUE_NEEDED), and only if successful, the initial GSS_Init_sec_context() call returns a non-zero output_context_handle for use in future references to this context. Once a non-zero output_context_handle has been returned, GSS-API callers should call GSS_Delete_sec_context() to release context-related resources if errors occur in later phases of context establishment, or when an established context is no longer required. If GSS_Init_sec_context() is passed the handle of a context which is already fully established, GSS_S_FAILURE status is returned.

When continuation attempts to GSS_Init_sec_context() are needed to perform context establishment, the previously-returned non-zero handle value is entered into the input_context_handle argument and will be echoed in the returned output_context_handle argument. On such continuation attempts (and only on continuation attempts) the input_token value is used, to provide the token returned from the context's target.

The chan_bindings argument is used by the caller to provide information binding the security context to security-related characteristics (e.g., addresses, cryptographic keys) of the underlying communications channel. See Section 1.1.6 of this document for more discussion of this argument's usage.

The input_token argument contains a message received from the target, and is significant only on a call to GSS_Init_sec_context() which follows a previous return indicating GSS_S_CONTINUE_NEEDED major_status.

It is the caller's responsibility to establish a communications path to the target, and to transmit any returned output_token (independent of the accompanying returned major_status value) to the target over that path. The output_token can, however, be transmitted along with the first application-provided input message to be processed by GSS_GetMIC() or GSS_Wrap() in conjunction with a successfully-established context. (Note: when the GSS-V2 prot_ready_state indicator is returned TRUE, it can be possible to transfer a protected message before context establishment is complete: see also Section 1.2.7)

The initiator may request various context-level functions through input flags: the deleg_req_flag requests delegation of access rights, the mutual_req_flag requests mutual authentication, the replay_det_req_flag requests that replay detection features be applied to messages transferred on the established context, and the sequence_req_flag requests that sequencing be enforced. (See Section

1.2.3 for more information on replay detection and sequencing features.) The anon_req_flag requests that the initiator's identity not be transferred within tokens to be sent to the acceptor.

The conf_req_flag and integ_req_flag provide informatory inputs to the GSS-API implementation as to whether, respectively, per-message confidentiality and per-message integrity services will be required on the context. This information is important as an input to negotiating mechanisms. It is important to recognize, however, that the inclusion of these flags (which are newly defined for GSS-V2) introduces a backward incompatibility with callers implemented to GSS-V1, where the flags were not defined. Since no GSS-V1 callers would set these flags, even if per-message services are desired, GSS-V2 mechanism implementations which enable such services selectively based on the flags' values may fail to provide them to contexts established for GSS-V1 callers. It may be appropriate under certain circumstances, therefore, for such mechanism implementations to infer these service request flags to be set if a caller is known to be implemented to GSS-V1.

Not all of the optionally-requestable features will be available in all underlying mech_types. The corresponding return state values deleg_state, mutual_state, replay_det_state, and sequence_state indicate, as a function of mech_type processing capabilities and initiator-provided input flags, the set of features which will be active on the context. The returned trans_state value indicates whether the context is transferable to other processes through use of GSS_Export_sec_context(). These state indicators' values are undefined unless either the routine's major_status indicates GSS_S_COMPLETE, or TRUE prot_ready_state is returned along with GSS_S_CONTINUE_NEEDED major_status; for the latter case, it is possible that additional features, not confirmed or indicated along with TRUE prot_ready_state, will be confirmed and indicated when GSS_S_COMPLETE is subsequently returned.

The returned anon_state and prot_ready_state values are significant for both GSS_S_COMPLETE and GSS_S_CONTINUE_NEEDED major_status returns from GSS_Init_sec_context(). When anon_state is returned TRUE, this indicates that neither the current token nor its predecessors delivers or has delivered the initiator's identity. Callers wishing to perform context establishment only if anonymity support is provided should transfer a returned token from GSS_Init_sec_context() to the peer only if it is accompanied by a TRUE anon_state indicator. When prot_ready_state is returned TRUE in conjunction with GSS_S_CONTINUE_NEEDED major_status, this indicates that per-message protection operations may be applied on the context: see Section 1.2.7 for further discussion of this facility.

Failure to provide the precise set of features requested by the caller does not cause context establishment to fail; it is the caller's prerogative to delete the context if the feature set provided is unsuitable for the caller's use.

The returned mech_type value indicates the specific mechanism employed on the context; it will never indicate the value for "default". A valid mech_type result must be returned along with a GSS_S_COMPLETE status return; GSS-API implementations may (but are not required to) also return mech_type along with predecessor calls indicating GSS_S_CONTINUE_NEEDED status or (if a mechanism is determinable) in conjunction with fatal error cases. For the case of mechanisms which themselves perform negotiation, the returned mech_type result may indicate selection of a mechanism identified by an OID different than that passed in the input mech_type argument, and the returned value may change between successive calls returning GSS_S_CONTINUE_NEEDED and the final call returning GSS_S_COMPLETE.

The conf_avail return value indicates whether the context supports per-message confidentiality services, and so informs the caller whether or not a request for encryption through the conf_req_flag input to GSS_Wrap() can be honored. In similar fashion, the integ_avail return value indicates whether per-message integrity services are available (through either GSS_GetMIC() or GSS_Wrap()) on the established context. These state indicators' values are undefined unless either the routine's major_status indicates GSS_S_COMPLETE, or TRUE prot_ready_state is returned along with GSS_S_CONTINUE_NEEDED major_status.

The lifetime_req input specifies a desired upper bound for the lifetime of the context to be established, with a value of 0 used to request a default lifetime. The lifetime_rec return value indicates the length of time for which the context will be valid, expressed as an offset from the present; depending on mechanism capabilities, credential lifetimes, and local policy, it may not correspond to the value requested in lifetime_req. If no constraints on context lifetime are imposed, this may be indicated by returning a reserved value representing INDEFINITE lifetime_req. The value of lifetime_rec is undefined unless the routine's major_status indicates GSS_S_COMPLETE.

If the mutual_state is TRUE, this fact will be reflected within the output_token. A call to GSS_Accept_sec_context() at the target in conjunction with such a context will return a token, to be processed by a continuation call to GSS_Init_sec_context(), in order to achieve mutual authentication.

2.2.2: GSS_Accept_sec_context call

Inputs:

o acceptor_cred_handle CREDENTIAL HANDLE, -- NULL specifies
-- "use default"

o input_context_handle CONTEXT HANDLE, -- 0
-- (GSS_C_NO_CONTEXT) specifies "not yet assigned"

o chan_bindings OCTET STRING,

o input_token OCTET STRING

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o src_name INTERNAL NAME, -- guaranteed to be MN
-- once returned, caller must release with GSS_Release_name()

o mech_type OBJECT IDENTIFIER, -- caller should treat as
-- read-only; does not need to be released

o output_context_handle CONTEXT HANDLE, -- once returned
-- non-NULL in context establishment sequence, caller
-- must release with GSS_Delete_sec_context()

o deleg_state BOOLEAN,

o mutual_state BOOLEAN,

o replay_det_state BOOLEAN,

o sequence_state BOOLEAN,

o anon_state BOOLEAN,

o trans_state BOOLEAN,

o prot_ready_state BOOLEAN, -- see Section 1.2.7 for discussion

o conf_avail BOOLEAN,

o integ_avail BOOLEAN,

o lifetime_rec INTEGER, -- in seconds, or reserved value for
-- INDEFINITE

o delegated_cred_handle CREDENTIAL HANDLE, -- if returned non-NULL,
-- caller must release with GSS_Release_cred()

o output_token OCTET STRING -- NULL or token to pass to context
-- initiator; if returned non-NULL, caller must release with
-- GSS_Release_buffer()

This call may block pending network interactions for those mech_types in which a directory service or other network entity must be consulted on behalf of a context acceptor in order to validate a received input_token.

Return major_status codes:

o GSS_S_COMPLETE indicates that context-level data structures were successfully initialized, and that per-message processing can now be performed in conjunction with this context.

o GSS_S_CONTINUE_NEEDED indicates that control information in the returned output_token must be sent to the initiator, and that a response must be received and passed as the input_token argument to a continuation call to GSS_Accept_sec_context(), before per-message processing can be performed in conjunction with this context.

o GSS_S_DEFECTIVE_TOKEN indicates that consistency checks performed on the input_token failed, preventing further processing from being performed based on that token.

o GSS_S_DEFECTIVE_CREDENTIAL indicates that consistency checks performed on the credential structure referenced by acceptor_cred_handle failed, preventing further processing from being performed using that credential structure.

o GSS_S_BAD_SIG (GSS_S_BAD_MIC) indicates that the received input_token contains an incorrect integrity check, so context setup cannot be accomplished.

o GSS_S_DUPLICATE_TOKEN indicates that the integrity check on the received input_token was correct, but that the input_token was recognized as a duplicate of an input_token already processed. No new context is established.

- GSS_S_OLD_TOKEN indicates that the integrity check on the received input_token was correct, but that the input_token is too old to be checked for duplication against previously-processed input_tokens. No new context is established.

- GSS_S_NO_CRED indicates that no context was established, either because the input cred_handle was invalid, because the referenced credentials are valid for context initiator use only, because the caller lacks authorization to access the referenced credentials, or because the procedure for default credential resolution failed.

- GSS_S_CREDENTIALS_EXPIRED indicates that the credentials provided through the input acceptor_cred_handle argument are no longer valid, so context establishment cannot be completed.

- GSS_S_BAD_BINDINGS indicates that a mismatch between the caller-provided chan_bindings and those extracted from the input_token was detected, signifying a security-relevant event and preventing context establishment.

- GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided; this major status will be returned only for successor calls following GSS_S_CONTINUE_ NEEDED status returns.

- GSS_S_BAD_MECH indicates receipt of a context establishment token specifying a mechanism unsupported by the local system or with the caller's active credentials.

- GSS_S_FAILURE indicates that context setup could not be accomplished for reasons unspecified at the GSS-API level, and that no interface-defined recovery action is available.

The GSS_Accept_sec_context() routine is used by a context target. Using information in the credentials structure referenced by the input acceptor_cred_handle, it verifies the incoming input_token and (following the successful completion of a context establishment sequence) returns the authenticated src_name and the mech_type used. The returned src_name is guaranteed to be an MN, processed by the mechanism under which the context was established. The acceptor_cred_handle must correspond to the same valid credentials structure on the initial call to GSS_Accept_sec_context() and on any successor calls resulting from GSS_S_CONTINUE_NEEDED status returns; different protocol sequences modeled by the GSS_S_CONTINUE_NEEDED mechanism will require access to credentials at different points in the context establishment sequence.

The caller-provided input_context_handle argument is to be 0 (GSS_C_NO_CONTEXT), specifying "not yet assigned", on the first GSS_Accept_sec_context() call relating to a given context. If successful (i.e., if accompanied by major_status GSS_S_COMPLETE or GSS_S_CONTINUE_NEEDED), and only if successful, the initial GSS_Accept_sec_context() call returns a non-zero output_context_handle for use in future references to this context. Once a non-zero output_context_handle has been returned, GSS-API callers should call GSS_Delete_sec_context() to release context-related resources if errors occur in later phases of context establishment, or when an established context is no longer required. If GSS_Accept_sec_context() is passed the handle of a context which is already fully established, GSS_S_FAILURE status is returned.

The chan_bindings argument is used by the caller to provide information binding the security context to security-related characteristics (e.g., addresses, cryptographic keys) of the underlying communications channel. See Section 1.1.6 of this document for more discussion of this argument's usage.

The returned state results (deleg_state, mutual_state, replay_det_state, sequence_state, anon_state, trans_state, and prot_ready_state) reflect the same information as described for GSS_Init_sec_context(), and their values are significant under the same return state conditions.

The conf_avail return value indicates whether the context supports per-message confidentiality services, and so informs the caller whether or not a request for encryption through the conf_req_flag input to GSS_Wrap() can be honored. In similar fashion, the integ_avail return value indicates whether per-message integrity services are available (through either GSS_GetMIC() or GSS_Wrap()) on the established context. These values are significant under the same return state conditions as described under GSS_Init_sec_context().

The lifetime_rec return value is significant only in conjunction with GSS_S_COMPLETE major_status, and indicates the length of time for which the context will be valid, expressed as an offset from the present.

The returned mech_type value indicates the specific mechanism employed on the context; it will never indicate the value for "default". A valid mech_type result must be returned whenever GSS_S_COMPLETE status is indicated; GSS-API implementations may (but are not required to) also return mech_type along with predecessor calls indicating GSS_S_CONTINUE_NEEDED status or (if a mechanism is determinable) in conjunction with fatal error cases. For the case of

mechanisms which themselves perform negotiation, the returned mech_type result may indicate selection of a mechanism identified by an OID different than that passed in the input mech_type argument, and the returned value may change between successive calls returning GSS_S_CONTINUE_NEEDED and the final call returning GSS_S_COMPLETE.

The delegated_cred_handle result is significant only when deleg_state is TRUE, and provides a means for the target to reference the delegated credentials. The output_token result, when non-NULL, provides a context-level token to be returned to the context initiator to continue a multi-step context establishment sequence. As noted with GSS_Init_sec_context(), any returned token should be transferred to the context's peer (in this case, the context initiator), independent of the value of the accompanying returned major_status.

Note: A target must be able to distinguish a context-level input_token, which is passed to GSS_Accept_sec_context(), from the per-message data elements passed to GSS_VerifyMIC() or GSS_Unwrap(). These data elements may arrive in a single application message, and GSS_Accept_sec_context() must be performed before per-message processing can be performed successfully.

2.2.3: GSS_Delete_sec_context call

Input:

- context_handle CONTEXT HANDLE

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- output_context_token OCTET STRING

Return major_status codes:

- GSS_S_COMPLETE indicates that the context was recognized, and that relevant context-specific information was flushed. If the caller provides a non-null buffer to receive an output_context_token, and the mechanism returns a non-NULL token into that buffer, the returned output_context_token is ready for transfer to the context's peer.
- GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided, so no deletion was performed.

o GSS_S_FAILURE indicates that the context is recognized, but that the GSS_Delete_sec_context() operation could not be performed for reasons unspecified at the GSS-API level.

This call can be made by either peer in a security context, to flush context-specific information. Once a non-zero output_context_handle has been returned by context establishment calls, GSS-API callers should call GSS_Delete_sec_context() to release context-related resources if errors occur in later phases of context establishment, or when an established context is no longer required. This call may block pending network interactions for mech_types in which active notification must be made to a central server when a security context is to be deleted.

If a non-null output_context_token parameter is provided by the caller, an output_context_token may be returned to the caller. If an output_context_token is provided to the caller, it can be passed to the context's peer to inform the peer's GSS-API implementation that the peer's corresponding context information can also be flushed. (Once a context is established, the peers involved are expected to retain cached credential and context-related information until the information's expiration time is reached or until a GSS_Delete_sec_context() call is made.)

The facility for context_token usage to signal context deletion is retained for compatibility with GSS-API Version 1. For current usage, it is recommended that both peers to a context invoke GSS_Delete_sec_context() independently, passing a null output_context_token buffer to indicate that no context_token is required. Implementations of GSS_Delete_sec_context() should delete relevant locally-stored context information.

Attempts to perform per-message processing on a deleted context will result in error returns.

2.2.4: GSS_Process_context_token call

Inputs:

o context_handle CONTEXT HANDLE,

o input_context_token OCTET STRING

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

Return major_status codes:

o GSS_S_COMPLETE indicates that the input_context_token was successfully processed in conjunction with the context referenced by context_handle.

o GSS_S_DEFECTIVE_TOKEN indicates that consistency checks performed on the received context_token failed, preventing further processing from being performed with that token.

o GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided.

o GSS_S_FAILURE indicates that the context is recognized, but that the GSS_Process_context_token() operation could not be performed for reasons unspecified at the GSS-API level.

This call is used to process context_tokens received from a peer once a context has been established, with corresponding impact on context-level state information. One use for this facility is processing of the context_tokens generated by GSS_Delete_sec_context(); GSS_Process_context_token() will not block pending network interactions for that purpose. Another use is to process tokens indicating remote-peer context establishment failures after the point where the local GSS-API implementation has already indicated GSS_S_COMPLETE status.

2.2.5: GSS_Context_time call

Input:

o context_handle CONTEXT HANDLE,

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o lifetime_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE

Return major_status codes:

o GSS_S_COMPLETE indicates that the referenced context is valid, and will remain valid for the amount of time indicated in lifetime_rec.

o GSS_S_CONTEXT_EXPIRED indicates that data items related to the referenced context have expired.

o GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided.

o GSS_S_FAILURE indicates that the requested operation failed for reasons unspecified at the GSS-API level.

This call is used to determine the amount of time for which a currently established context will remain valid.

2.2.6: GSS_Inquire_context call

Input:

o context_handle CONTEXT HANDLE,

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o src_name INTERNAL NAME, -- name of context initiator,
-- guaranteed to be MN;
-- caller must release with GSS_Release_name() if returned

o targ_name INTERNAL NAME, -- name of context target,
-- guaranteed to be MN;
-- caller must release with GSS_Release_name() if returned

o lifetime_rec INTEGER -- in seconds, or reserved value for
-- INDEFINITE or EXPIRED

o mech_type OBJECT IDENTIFIER, -- the mechanism supporting this
-- security context; caller should treat as read-only and not
-- attempt to release

o deleg_state BOOLEAN,

o mutual_state BOOLEAN,

o replay_det_state BOOLEAN,

o sequence_state BOOLEAN,

o anon_state BOOLEAN,

- trans_state BOOLEAN,
- prot_ready_state BOOLEAN,
- conf_avail BOOLEAN,
- integ_avail BOOLEAN,
- locally_initiated BOOLEAN, -- TRUE if initiator, FALSE if acceptor
- open BOOLEAN, -- TRUE if context fully established, FALSE
-- if partly established (in CONTINUE_NEEDED state)

Return major_status codes:

- GSS_S_COMPLETE indicates that the referenced context is valid and that deleg_state, mutual_state, replay_det_state, sequence_state, anon_state, trans_state, prot_ready_state, conf_avail, integ_avail, locally_initiated, and open return values describe the corresponding characteristics of the context. If open is TRUE, lifetime_rec is also returned: if open is TRUE and the context peer's name is known, src_name and targ_name are valid in addition to the values listed above. The mech_type value must be returned for contexts where open is TRUE and may be returned for contexts where open is FALSE.
- GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided. Return values other than major_status and minor_status are undefined.
- GSS_S_FAILURE indicates that the requested operation failed for reasons unspecified at the GSS-API level. Return values other than major_status and minor_status are undefined.

This call is used to extract information describing characteristics of a security context. Note that GSS-API implementations are expected to retain inquirable context data on a context until the context is released by a caller, even after the context has expired, although underlying cryptographic data elements may be deleted after expiration in order to limit their exposure.

2.2.7: GSS_Wrap_size_limit call

Inputs:

- context_handle CONTEXT HANDLE,
- conf_req_flag BOOLEAN,

o qop INTEGER,

o output_size INTEGER

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o max_input_size INTEGER

Return major_status codes:

o GSS_S_COMPLETE indicates a successful token size determination: an input message with a length in octets equal to the returned max_input_size value will, when passed to GSS_Wrap() for processing on the context identified by the context_handle parameter with the confidentiality request state as provided in conf_req_flag and with the quality of protection specifier provided in the qop parameter, yield an output token no larger than the value of the provided output_size parameter.

o GSS_S_CONTEXT_EXPIRED indicates that the provided input context_handle is recognized, but that the referenced context has expired. Return values other than major_status and minor_status are undefined.

o GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided. Return values other than major_status and minor_status are undefined.

o GSS_S_BAD_QOP indicates that the provided QOP value is not recognized or supported for the context.

o GSS_S_FAILURE indicates that the requested operation failed for reasons unspecified at the GSS-API level. Return values other than major_status and minor_status are undefined.

This call is used to determine the largest input datum which may be passed to GSS_Wrap() without yielding an output token larger than a caller-specified value.

2.2.8: GSS_Export_sec_context call

Inputs:

o context_handle CONTEXT HANDLE

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o interprocess_token OCTET STRING -- caller must release
-- with GSS_Release_buffer()

Return major_status codes:

o GSS_S_COMPLETE indicates that the referenced context has been successfully exported to a representation in the interprocess_token, and is no longer available for use by the caller.

o GSS_S_UNAVAILABLE indicates that the context export facility is not available for use on the referenced context. (This status should occur only for contexts for which the trans_state value is FALSE.) Return values other than major_status and minor_status are undefined.

o GSS_S_CONTEXT_EXPIRED indicates that the provided input context_handle is recognized, but that the referenced context has expired. Return values other than major_status and minor_status are undefined.

o GSS_S_NO_CONTEXT indicates that no valid context was recognized for the input context_handle provided. Return values other than major_status and minor_status are undefined.

o GSS_S_FAILURE indicates that the requested operation failed for reasons unspecified at the GSS-API level. Return values other than major_status and minor_status are undefined.

This call generates an interprocess token for transfer to another process within an end system, in order to transfer control of a security context to that process. The recipient of the interprocess token will call GSS_Import_sec_context() to accept the transfer. The GSS_Export_sec_context() operation is defined for use only with security contexts which are fully and successfully established (i.e., those for which GSS_Init_sec_context() and GSS_Accept_sec_context() have returned GSS_S_COMPLETE major_status).

A successful GSS_Export_sec_context() operation deactivates the security context for the calling process; for this case, the GSS-API implementation shall deallocate all process-wide resources associated with the security context and shall set the context_handle to GSS_C_NO_CONTEXT. In the event of an error that makes it impossible to complete export of the security context, the GSS-API implementation must not return an interprocess token and should strive to leave the security context referenced by the context_handle untouched. If this is impossible, it is permissible for the implementation to delete the security context, provided that it also sets the context_handle parameter to GSS_C_NO_CONTEXT.

Portable callers must not assume that a given interprocess token can be imported by GSS_Import_sec_context() more than once, thereby creating multiple instantiations of a single context. GSS-API implementations may detect and reject attempted multiple imports, but are not required to do so.

The internal representation contained within the interprocess token is an implementation-defined local matter. Interprocess tokens cannot be assumed to be transferable across different GSS-API implementations.

It is recommended that GSS-API implementations adopt policies suited to their operational environments in order to define the set of processes eligible to import a context, but specific constraints in this area are local matters. Candidate examples include transfers between processes operating on behalf of the same user identity, or processes comprising a common job. However, it may be impossible to enforce such policies in some implementations.

In support of the above goals, implementations may protect the transferred context data by using cryptography to protect data within the interprocess token, or by using interprocess tokens as a means to reference local interprocess communication facilities (protected by other means) rather than storing the context data directly within the tokens.

Transfer of an open context may, for certain mechanisms and implementations, reveal data about the credential which was used to establish the context. Callers should, therefore, be cautious about the trustworthiness of processes to which they transfer contexts. Although the GSS-API implementation may provide its own set of protections over the exported context, the caller is responsible for protecting the interprocess token from disclosure, and for taking care that the context is transferred to an appropriate destination process.

2.2.9: GSS_Import_sec_context call

Inputs:

o interprocess_token OCTET STRING

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o context_handle CONTEXT HANDLE -- if successfully returned,
-- caller must release with GSS_Delete_sec_context()

Return major_status codes:

o GSS_S_COMPLETE indicates that the context represented by the input interprocess_token has been successfully transferred to the caller, and is available for future use via the output context_handle.

o GSS_S_NO_CONTEXT indicates that the context represented by the input interprocess_token was invalid. Return values other than major_status and minor_status are undefined.

o GSS_S_DEFECTIVE_TOKEN indicates that the input interprocess_token was defective. Return values other than major_status and minor_status are undefined.

o GSS_S_UNAVAILABLE indicates that the context import facility is not available for use on the referenced context. Return values other than major_status and minor_status are undefined.

o GSS_S_UNAUTHORIZED indicates that the context represented by the input interprocess_token is unauthorized for transfer to the caller. Return values other than major_status and minor_status are undefined.

o GSS_S_FAILURE indicates that the requested operation failed for reasons unspecified at the GSS-API level. Return values other than major_status and minor_status are undefined.

This call processes an interprocess token generated by GSS_Export_sec_context(), making the transferred context available for use by the caller. After a successful GSS_Import_sec_context() operation, the imported context is available for use by the importing process. In particular, the imported context is usable for all per-message operations and may be deleted or exported by its importer. The inability to receive delegated credentials through

gss_import_sec_context() precludes establishment of new contexts based on information delegated to the importer's end system within the context which is being imported, unless those delegated credentials are obtained through separate routines (e.g., XGSS-API calls) outside the GSS-V2 definition.

For further discussion of the security and authorization issues regarding this call, please see the discussion in Section 2.2.8.

2.3: Per-message calls

This group of calls is used to perform per-message protection processing on an established security context. None of these calls block pending network interactions. These calls may be invoked by a context's initiator or by the context's target. The four members of this group should be considered as two pairs; the output from GSS_GetMIC() is properly input to GSS_VerifyMIC(), and the output from GSS_Wrap() is properly input to GSS_Unwrap().

GSS_GetMIC() and GSS_VerifyMIC() support data origin authentication and data integrity services. When GSS_GetMIC() is invoked on an input message, it yields a per-message token containing data items which allow underlying mechanisms to provide the specified security services. The original message, along with the generated per-message token, is passed to the remote peer; these two data elements are processed by GSS_VerifyMIC(), which validates the message in conjunction with the separate token.

GSS_Wrap() and GSS_Unwrap() support caller-requested confidentiality in addition to the data origin authentication and data integrity services offered by GSS_GetMIC() and GSS_VerifyMIC(). GSS_Wrap() outputs a single data element, encapsulating optionally enciphered user data as well as associated token data items. The data element output from GSS_Wrap() is passed to the remote peer and processed by GSS_Unwrap() at that system. GSS_Unwrap() combines decipherment (as required) with validation of data items related to authentication and integrity.

Although zero-length tokens are never returned by GSS calls for transfer to a context's peer, a zero-length object may be passed by a caller into GSS_Wrap(), in which case the corresponding peer calling GSS_Unwrap() on the transferred token will receive a zero-length object as output from GSS_Unwrap(). Similarly, GSS_GetMIC() can be called on an empty object, yielding a MIC which GSS_VerifyMIC() will successfully verify against the active security context in conjunction with a zero-length object.

2.3.1: GSS_GetMIC call

Note: This call is functionally equivalent to the GSS_Sign call as defined in previous versions of this specification. In the interests of backward compatibility, it is recommended that implementations support this function under both names for the present; future references to this function as GSS_Sign are deprecated.

Inputs:

- context_handle CONTEXT HANDLE,
- qop_req INTEGER, -- 0 specifies default QOP
- message OCTET STRING

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- per_msg_token OCTET STRING -- caller must release -- with GSS_Release_buffer()

Return major_status codes:

- GSS_S_COMPLETE indicates that an integrity check, suitable for an established security context, was successfully applied and that the message and corresponding per_msg_token are ready for transmission.
- GSS_S_CONTEXT_EXPIRED indicates that context-related data items have expired, so that the requested operation cannot be performed.
- GSS_S_NO_CONTEXT indicates that no context was recognized for the input context_handle provided.
- GSS_S_BAD_QOP indicates that the provided QOP value is not recognized or supported for the context.
- GSS_S_FAILURE indicates that the context is recognized, but that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Using the security context referenced by context_handle, apply an integrity check to the input message (along with timestamps and/or other data included in support of mech_type-specific mechanisms) and (if GSS_S_COMPLETE status is indicated) return the result in

per_msg_token. The qop_req parameter, interpretation of which is discussed in Section 1.2.4, allows quality-of-protection control. The caller passes the message and the per_msg_token to the target.

The GSS_GetMIC() function completes before the message and per_msg_token is sent to the peer; successful application of GSS_GetMIC() does not guarantee that a corresponding GSS_VerifyMIC() has been (or can necessarily be) performed successfully when the message arrives at the destination.

Mechanisms which do not support per-message protection services should return GSS_S_FAILURE if this routine is called.

2.3.2: GSS_VerifyMIC call

Note: This call is functionally equivalent to the GSS_Verify call as defined in previous versions of this specification. In the interests of backward compatibility, it is recommended that implementations support this function under both names for the present; future references to this function as GSS_Verify are deprecated.

Inputs:

- context_handle CONTEXT HANDLE,
- message OCTET STRING,
- per_msg_token OCTET STRING

Outputs:

- qop_state INTEGER,
- major_status INTEGER,
- minor_status INTEGER,

Return major_status codes:

- GSS_S_COMPLETE indicates that the message was successfully verified.
- GSS_S_DEFECTIVE_TOKEN indicates that consistency checks performed on the received per_msg_token failed, preventing further processing from being performed with that token.
- GSS_S_BAD_SIG (GSS_S_BAD_MIC) indicates that the received per_msg_token contains an incorrect integrity check for the message.

o GSS_S_DUPLICATE_TOKEN, GSS_S_OLD_TOKEN, GSS_S_UNSEQ_TOKEN, and GSS_S_GAP_TOKEN values appear in conjunction with the optional per-message replay detection features described in Section 1.2.3; their semantics are described in that section.

o GSS_S_CONTEXT_EXPIRED indicates that context-related data items have expired, so that the requested operation cannot be performed.

o GSS_S_NO_CONTEXT indicates that no context was recognized for the input context_handle provided.

o GSS_S_FAILURE indicates that the context is recognized, but that the GSS_VerifyMIC() operation could not be performed for reasons unspecified at the GSS-API level.

Using the security context referenced by context_handle, verify that the input per_msg_token contains an appropriate integrity check for the input message, and apply any active replay detection or sequencing features. Returns an indication of the quality-of-protection applied to the processed message in the qop_state result.

Mechanisms which do not support per-message protection services should return GSS_S_FAILURE if this routine is called.

2.3.3: GSS_Wrap call

Note: This call is functionally equivalent to the GSS_Seal call as defined in previous versions of this specification. In the interests of backward compatibility, it is recommended that implementations support this function under both names for the present; future references to this function as GSS_Seal are deprecated.

Inputs:

o context_handle CONTEXT HANDLE,

o conf_req_flag BOOLEAN,

o qop_req INTEGER, -- 0 specifies default QOP

o input_message OCTET STRING

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o conf_state BOOLEAN,

o output_message OCTET STRING -- caller must release with
-- GSS_Release_buffer()

Return major_status codes:

o GSS_S_COMPLETE indicates that the input_message was successfully processed and that the output_message is ready for transmission.

o GSS_S_CONTEXT_EXPIRED indicates that context-related data items have expired, so that the requested operation cannot be performed.

o GSS_S_NO_CONTEXT indicates that no context was recognized for the input context_handle provided.

o GSS_S_BAD_QOP indicates that the provided QOP value is not recognized or supported for the context.

o GSS_S_FAILURE indicates that the context is recognized, but that the GSS_Wrap() operation could not be performed for reasons unspecified at the GSS-API level.

Performs the data origin authentication and data integrity functions of GSS_GetMIC(). If the input conf_req_flag is TRUE, requests that confidentiality be applied to the input_message. Confidentiality may not be supported in all mech_types or by all implementations; the returned conf_state flag indicates whether confidentiality was provided for the input_message. The qop_req parameter, interpretation of which is discussed in Section 1.2.4, allows quality-of-protection control.

When GSS_S_COMPLETE status is returned, the GSS_Wrap() call yields a single output_message data element containing (optionally enciphered) user data as well as control information.

Mechanisms which do not support per-message protection services should return GSS_S_FAILURE if this routine is called.

2.3.4: GSS_Unwrap call

Note: This call is functionally equivalent to the GSS_Unseal call as defined in previous versions of this specification. In the interests of backward compatibility, it is recommended that implementations support this function under both names for the present; future references to this function as GSS_Unseal are deprecated.

Inputs:

o context_handle CONTEXT HANDLE,

o input_message OCTET STRING

Outputs:

o conf_state BOOLEAN,

o qop_state INTEGER,

o major_status INTEGER,

o minor_status INTEGER,

o output_message OCTET STRING -- caller must release with
-- GSS_Release_buffer()

Return major_status codes:

o GSS_S_COMPLETE indicates that the input_message was successfully processed and that the resulting output_message is available.

o GSS_S_DEFECTIVE_TOKEN indicates that consistency checks performed on the per_msg_token extracted from the input_message failed, preventing further processing from being performed.

o GSS_S_BAD_SIG (GSS_S_BAD_MIC) indicates that an incorrect integrity check was detected for the message.

o GSS_S_DUPLICATE_TOKEN, GSS_S_OLD_TOKEN, GSS_S_UNSEQ_TOKEN, and GSS_S_GAP_TOKEN values appear in conjunction with the optional per-message replay detection features described in Section 1.2.3; their semantics are described in that section.

o GSS_S_CONTEXT_EXPIRED indicates that context-related data items have expired, so that the requested operation cannot be performed.

o GSS_S_NO_CONTEXT indicates that no context was recognized for the input context_handle provided.

o GSS_S_FAILURE indicates that the context is recognized, but that the GSS_Unwrap() operation could not be performed for reasons unspecified at the GSS-API level.

Processes a data element generated (and optionally enciphered) by GSS_Wrap(), provided as input_message. The returned conf_state value indicates whether confidentiality was applied to the input_message. If conf_state is TRUE, GSS_Unwrap() has deciphered the input_message. Returns an indication of the quality-of-protection applied to the processed message in the qop_state result. GSS_Unwrap() performs the data integrity and data origin authentication checking functions of GSS_VerifyMIC() on the plaintext data. Plaintext data is returned in output_message.

Mechanisms which do not support per-message protection services should return GSS_S_FAILURE if this routine is called.

2.4: Support calls

This group of calls provides support functions useful to GSS-API callers, independent of the state of established contexts. Their characterization with regard to blocking or non-blocking status in terms of network interactions is unspecified.

2.4.1: GSS_Display_status call

Inputs:

o status_value INTEGER, -- GSS-API major_status or minor_status
-- return value

o status_type INTEGER, -- 1 if major_status, 2 if minor_status

o mech_type OBJECT IDENTIFIER -- mech_type to be used for
-- minor_status translation

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o status_string_set SET OF OCTET STRING -- required calls for
-- release by caller are specific to language bindings

Return major_status codes:

o GSS_S_COMPLETE indicates that a valid printable status representation (possibly representing more than one status event encoded within the status_value) is available in the returned status_string_set.

o GSS_S_BAD_MECH indicates that translation in accordance with an unsupported mech_type was requested, so translation could not be performed.

o GSS_S_BAD_STATUS indicates that the input status_value was invalid, or that the input status_type carried a value other than 1 or 2, so translation could not be performed.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Provides a means for callers to translate GSS-API-returned major and minor status codes into printable string representations. Note: some language bindings may employ an iterative approach in order to emit successive status components; this approach is acceptable but not required for conformance with the current specification.

Although not contemplated in [RFC-2078], it has been observed that some existing GSS-API implementations return GSS_S_CONTINUE_NEEDED status when iterating through successive messages returned from GSS_Display_status(). This behavior is deprecated; GSS_S_CONTINUE_NEEDED should be returned only by GSS_Init_sec_context() and GSS_Accept_sec_context(). For maximal portability, however, it is recommended that defensive callers be able to accept and ignore GSS_S_CONTINUE_NEEDED status if indicated by GSS_Display_status() or any other call other than GSS_Init_sec_context() or GSS_Accept_sec_context().

2.4.2: GSS_Indicate_mechs call

Input:

o (none)

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o mech_set SET OF OBJECT IDENTIFIER -- caller must release
-- with GSS_Release_oid_set()

Return major_status codes:

o GSS_S_COMPLETE indicates that a set of available mechanisms has been returned in mech_set.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to determine the set of mechanism types available on the local system. This call is intended for support of specialized callers who need to request non-default mech_type sets from GSS-API calls which accept input mechanism type specifiers.

2.4.3: GSS_Compare_name call

Inputs:

o name1 INTERNAL NAME,

o name2 INTERNAL NAME

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o name_equal BOOLEAN

Return major_status codes:

o GSS_S_COMPLETE indicates that name1 and name2 were comparable, and that the name_equal result indicates whether name1 and name2 represent the same entity.

o GSS_S_BAD_NAMETYPE indicates that the two input names' types are different and incomparable, so that the comparison operation could not be completed.

o GSS_S_BAD_NAME indicates that one or both of the input names was ill-formed in terms of its internal type specifier, so the comparison operation could not be completed.

o GSS_S_FAILURE indicates that the call's operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to compare two internal name representations to determine whether they refer to the same entity. If either name presented to GSS_Compare_name() denotes an anonymous principal, GSS_Compare_name() shall indicate FALSE. It is not required that either or both inputs name1 and name2 be MNs; for some

implementations and cases, GSS_S_BAD_NAMETYPE may be returned, indicating name incomparability, for the case where neither input name is an MN.

2.4.4: GSS_Display_name call

Inputs:

o name INTERNAL NAME

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o name_string OCTET STRING, -- caller must release
-- with GSS_Release_buffer()

o name_type OBJECT IDENTIFIER -- caller should treat
-- as read-only; does not need to be released

Return major_status codes:

o GSS_S_COMPLETE indicates that a valid printable name representation is available in the returned name_string.

o GSS_S_BAD_NAME indicates that the contents of the provided name were inconsistent with the internally-indicated name type, so no printable representation could be generated.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to translate an internal name representation into a printable form with associated namespace type descriptor. The syntax of the printable form is a local matter.

If the input name represents an anonymous identity, a reserved value (GSS_C_NT_ANONYMOUS) shall be returned for name_type.

The GSS_C_NO_OID name type is to be returned only when the corresponding internal name was created through import with GSS_C_NO_OID. It is acceptable for mechanisms to normalize names imported with GSS_C_NO_OID into other supported types and, therefore, to display them with types other than GSS_C_NO_OID.

2.4.5: GSS_Import_name call

Inputs:

o input_name_string OCTET STRING,

o input_name_type OBJECT IDENTIFIER

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_name INTERNAL NAME -- caller must release with
-- GSS_Release_name()

Return major_status codes:

o GSS_S_COMPLETE indicates that a valid name representation is output in output_name and described by the type value in output_name_type.

o GSS_S_BAD_NAMETYPE indicates that the input_name_type is unsupported by the applicable underlying GSS-API mechanism(s), so the import operation could not be completed.

o GSS_S_BAD_NAME indicates that the provided input_name_string is ill-formed in terms of the input_name_type, so the import operation could not be completed.

o GSS_S_BAD_MECH indicates that the input presented for import was an exported name object and that its enclosed mechanism type was not recognized or was unsupported by the GSS-API implementation.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to provide a name representation as a contiguous octet string, designate the type of namespace in conjunction with which it should be parsed, and convert that representation to an internal form suitable for input to other GSS-API routines. The syntax of the input_name_string is defined in conjunction with its associated name type; depending on the input_name_type, the associated input_name_string may or may not be a printable string. If the input_name_type's value is GSS_C_NO_OID, a mechanism-specific default printable syntax (which shall be specified in the corresponding GSS-V2 mechanism specification) is assumed for the input_name_string;

other input_name_type values as registered by GSS-API implementations can be used to indicate specific non-default name syntaxes. Note: The input_name_type argument serves to describe and qualify the interpretation of the associated input_name_string; it does not specify the data type of the returned output_name.

If a mechanism claims support for a particular name type, its GSS_Import_name() operation shall be able to accept all possible values conformant to the external name syntax as defined for that name type. These imported values may correspond to:

(1) locally registered entities (for which credentials may be acquired),

(2) non-local entities (for which local credentials cannot be acquired, but which may be referenced as targets of initiated security contexts or initiators of accepted security contexts), or to

(3) neither of the above.

Determination of whether a particular name belongs to class (1), (2), or (3) as described above is not guaranteed to be performed by the GSS_Import_name() function.

The internal name generated by a GSS_Import_name() operation may be a single-mechanism MN, and is likely to be an MN within a single-mechanism implementation, but portable callers must not depend on this property (and must not, therefore, assume that the output from GSS_Import_name() can be passed directly to GSS_Export_name() without first being processed through GSS_Canonicalize_name()).

2.4.6: GSS_Release_name call

Inputs:

- name INTERNAL NAME

Outputs:

- major_status INTEGER,
- minor_status INTEGER

Return major_status codes:

- GSS_S_COMPLETE indicates that the storage associated with the input name was successfully released.

o GSS_S_BAD_NAME indicates that the input name argument did not contain a valid name.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to release the storage associated with an internal name representation. This call's specific behavior depends on the language and programming environment within which a GSS-API implementation operates, and is therefore detailed within applicable bindings specifications; in particular, implementation and invocation of this call may be superfluous (and may be omitted) within bindings where memory management is automatic.

2.4.7: GSS_Release_buffer call

Inputs:

o buffer OCTET STRING

Outputs:

o major_status INTEGER,

o minor_status INTEGER

Return major_status codes:

o GSS_S_COMPLETE indicates that the storage associated with the input buffer was successfully released.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to release the storage associated with an OCTET STRING buffer allocated by another GSS-API call. This call's specific behavior depends on the language and programming environment within which a GSS-API implementation operates, and is therefore detailed within applicable bindings specifications; in particular, implementation and invocation of this call may be superfluous (and may be omitted) within bindings where memory management is automatic.

2.4.8: GSS_Release_OID_set call

Inputs:

o buffer SET OF OBJECT IDENTIFIER

Outputs:

o major_status INTEGER,

o minor_status INTEGER

Return major_status codes:

o GSS_S_COMPLETE indicates that the storage associated with the input object identifier set was successfully released.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to release the storage associated with an object identifier set object allocated by another GSS-API call. This call's specific behavior depends on the language and programming environment within which a GSS-API implementation operates, and is therefore detailed within applicable bindings specifications; in particular, implementation and invocation of this call may be superfluous (and may be omitted) within bindings where memory management is automatic.

2.4.9: GSS_Create_empty_OID_set call

Inputs:

o (none)

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o oid_set SET OF OBJECT IDENTIFIER -- caller must release
-- with GSS_Release_oid_set()

Return major_status codes:

o GSS_S_COMPLETE indicates successful completion

o GSS_S_FAILURE indicates that the operation failed

Creates 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().

2.4.10: GSS_Add_OID_set_member call

Inputs:

- member_oid OBJECT IDENTIFIER,
- oid_set SET OF OBJECT IDENTIFIER

Outputs:

- major_status INTEGER,
- minor_status INTEGER,

Return major_status codes:

- GSS_S_COMPLETE indicates successful completion
- GSS_S_FAILURE indicates that the operation failed

Adds 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().

2.4.11: GSS_Test_OID_set_member call

Inputs:

- member OBJECT IDENTIFIER,
- set SET OF OBJECT IDENTIFIER

Outputs:

- major_status INTEGER,
- minor_status INTEGER,
- present BOOLEAN

Return major_status codes:

- GSS_S_COMPLETE indicates successful completion
- GSS_S_FAILURE indicates that the operation failed

Interrogates 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().

2.4.12: GSS_Inquire_names_for_mech call

Input:

o input_mech_type OBJECT IDENTIFIER, -- mechanism type

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o name_type_set SET OF OBJECT IDENTIFIER -- caller must release -- with GSS_Release_oid_set()

Return major_status codes:

o GSS_S_COMPLETE indicates that the output name_type_set contains a list of name types which are supported by the locally available mechanism identified by input_mech_type.

o GSS_S_BAD_MECH indicates that the mechanism identified by input_mech_type was unsupported within the local implementation, causing the query to fail.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

Allows callers to determine the set of name types which are supportable by a specific locally-available mechanism.

2.4.13: GSS_Inquire_mechs_for_name call

Inputs:

o input_name INTERNAL NAME,

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o mech_types SET OF OBJECT IDENTIFIER -- caller must release
-- with GSS_Release_oid_set()

Return major_status codes:

o GSS_S_COMPLETE indicates that a set of object identifiers, corresponding to the set of mechanisms suitable for processing the input_name, is available in mech_types.

o GSS_S_BAD_NAME indicates that the input_name was ill-formed and could not be processed.

o GSS_S_BAD_NAMETYPE indicates that the input_name parameter contained an invalid name type or a name type unsupported by the GSS-API implementation.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

This routine returns the mechanism set with which the input_name may be processed.

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 result may indicate that a particular mechanism will understand a particular name when in fact it would refuse to accept that name as input to GSS_Canonicalize_name(), GSS_Init_sec_context(), GSS_Acquire_cred(), or GSS_Add_cred(), due to some property of the particular name rather than a property of the name type. Thus, this routine should be used only as a pre-filter for a call to a subsequent mechanism-specific routine.

2.4.14: GSS_Canonicalize_name call

Inputs:

o input_name INTERNAL NAME,

o mech_type OBJECT IDENTIFIER -- must be explicit mechanism,
-- not "default" specifier or identifier of negotiating mechanism

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_name INTERNAL NAME -- caller must release with
-- GSS_Release_name()

Return major_status codes:

o GSS_S_COMPLETE indicates that a mechanism-specific reduction of the input_name, as processed by the mechanism identified by mech_type, is available in output_name.

o GSS_S_BAD_MECH indicates that the identified mechanism is unsupported for this operation; this may correspond either to a mechanism wholly unsupported by the local GSS-API implementation or to a negotiating mechanism with which the canonicalization operation cannot be performed.

o GSS_S_BAD_NAMETYPE indicates that the input name does not contain an element with suitable type for processing by the identified mechanism.

o GSS_S_BAD_NAME indicates that the input name contains an element with suitable type for processing by the identified mechanism, but that this element could not be processed successfully.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

This routine reduces a GSS-API internal name input_name, which may in general contain elements corresponding to multiple mechanisms, to a mechanism-specific Mechanism Name (MN) output_name by applying the translations corresponding to the mechanism identified by mech_type. The contents of input_name are unaffected by the GSS_Canonicalize_name() operation. References to output_name will remain valid until output_name is released, independent of whether or not input_name is subsequently released.

2.4.15: GSS_Export_name call

Inputs:

o input_name INTERNAL NAME, -- required to be MN

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o output_name OCTET STRING -- caller must release
-- with GSS_Release_buffer()

Return major_status codes:

o GSS_S_COMPLETE indicates that a flat representation of the input name is available in output_name.

o GSS_S_NAME_NOT_MN indicates that the input name contained elements corresponding to multiple mechanisms, so cannot be exported into a single-mechanism flat form.

o GSS_S_BAD_NAME indicates that the input name was an MN, but could not be processed.

o GSS_S_BAD_NAMETYPE indicates that the input name was an MN, but that its type is unsupported by the GSS-API implementation.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

This routine creates a flat name representation, suitable for bytewise comparison or for input to GSS_Import_name() in conjunction with the reserved GSS-API Exported Name Object OID, from a internal-form Mechanism Name (MN) as emitted, e.g., by GSS_Canonicalize_name() or GSS_Accept_sec_context().

The emitted GSS-API Exported Name Object is self-describing; no associated parameter-level OID need be emitted by this call. This flat representation consists of a mechanism-independent wrapper layer, defined in Section 3.2 of this document, enclosing a mechanism-defined name representation.

In all cases, the flat name output by GSS_Export_name() to correspond to a particular input MN must be invariant over time within a particular installation.

The GSS_S_NAME_NOT_MN status code is provided to enable implementations to reject input names which are not MNs. It is not, however, required for purposes of conformance to this specification that all non-MN input names must necessarily be rejected.

2.4.16: GSS_Duplicate_name call

Inputs:

o src_name INTERNAL NAME

Outputs:

o major_status INTEGER,

o minor_status INTEGER,

o dest_name INTERNAL NAME -- caller must release
-- with GSS_Release_name()

Return major_status codes:

o GSS_S_COMPLETE indicates that dest_name references an internal name object containing the same name as passed to src_name.

o GSS_S_BAD_NAME indicates that the input name was invalid.

o GSS_S_FAILURE indicates that the requested operation could not be performed for reasons unspecified at the GSS-API level.

This routine takes input internal name src_name, and returns another reference (dest_name) to that name which can be used even if src_name is later freed. (Note: This may be implemented by copying or through use of reference counts.)

3: Data Structure Definitions for GSS-V2 Usage

Subsections of this section define, for interoperability and portability purposes, certain data structures for use with GSS-V2.

3.1: Mechanism-Independent Token Format

This section specifies a mechanism-independent level of encapsulating representation for the initial token of a GSS-API context establishment sequence, incorporating an identifier of the mechanism type to be used on that context and enabling tokens to be interpreted unambiguously at GSS-API peers. Use of this format is required for initial context establishment tokens of Internet standards-track GSS-API mechanisms; use in non-initial tokens is optional.

The encoding format for the token tag is derived from ASN.1 and DER (per illustrative ASN.1 syntax included later within this subsection), but its concrete representation is defined directly in terms of octets rather than at the ASN.1 level in order to facilitate interoperable implementation without use of general ASN.1 processing code. The token tag consists of the following elements, in order:

1. 0x60 -- Tag for [APPLICATION 0] SEQUENCE; indicates that
-- constructed form, definite length encoding follows.

2. Token length octets, specifying length of subsequent data (i.e., the summed lengths of elements 3-5 in this list, and of the mechanism-defined token object following the tag). This element comprises a variable number of octets:

   2a. If the indicated value is less than 128, it shall be represented in a single octet with bit 8 (high order) set to "0" and the remaining bits representing the value.

   2b. If the indicated value is 128 or more, it shall be represented in two or more octets, with bit 8 of the first octet set to "1" and the remaining bits of the first octet specifying the number of additional octets. The subsequent octets carry the value, 8 bits per octet, most significant digit first. The minimum number of octets shall be used to encode the length (i.e., no octets representing leading zeros shall be included within the length encoding).

3. 0x06 -- Tag for OBJECT IDENTIFIER

4. Object identifier length -- length (number of octets) of
-- the encoded object identifier contained in element 5,
-- encoded per rules as described in 2a. and 2b. above.

5. Object identifier octets -- variable number of octets,
-- encoded per ASN.1 BER rules:

   5a. The first octet contains the sum of two values: (1) the top-level object identifier component, multiplied by 40 (decimal), and (2) the second-level object identifier component. This special case is the only point within an object identifier encoding where a single octet represents contents of more than one component.

   5b. Subsequent octets, if required, encode successively-lower components in the represented object identifier. A component's encoding may span multiple octets, encoding 7 bits per octet (most significant bits first) and with bit 8 set to "1" on all but the final octet in the component's encoding. The minimum number of octets shall be used to encode each component (i.e., no octets representing leading zeros shall be included within a component's encoding).

(Note: In many implementations, elements 3-5 may be stored and referenced as a contiguous string constant.)

The token tag is immediately followed by a mechanism-defined token object. Note that no independent size specifier intervenes following the object identifier value to indicate the size of the mechanism-defined token object. While ASN.1 usage within mechanism-defined tokens is permitted, there is no requirement that the mechanism-specific innerContextToken, innerMsgToken, and sealedUserData data elements must employ ASN.1 BER/DER encoding conventions.

The following ASN.1 syntax is included for descriptive purposes only, to illustrate structural relationships among token and tag objects. For interoperability purposes, token and tag encoding shall be performed using the concrete encoding procedures described earlier in this subsection.

```
GSS-API DEFINITIONS ::=

BEGIN

MechType ::= OBJECT IDENTIFIER
-- data structure definitions
-- callers must be able to distinguish among
-- InitialContextToken, SubsequentContextToken,
-- PerMsgToken, and SealedMessage data elements
-- based on the usage in which they occur

InitialContextToken ::=
-- option indication (delegation, etc.) indicated within
-- mechanism-specific token
[APPLICATION 0] IMPLICIT SEQUENCE {
        thisMech MechType,
        innerContextToken ANY DEFINED BY thisMech
           -- contents mechanism-specific
           -- ASN.1 structure not required
        }

SubsequentContextToken ::= innerContextToken ANY
-- interpretation based on predecessor InitialContextToken
-- ASN.1 structure not required

PerMsgToken ::=
-- as emitted by GSS_GetMIC and processed by GSS_VerifyMIC
-- ASN.1 structure not required
        innerMsgToken ANY

SealedMessage ::=
-- as emitted by GSS_Wrap and processed by GSS_Unwrap
-- includes internal, mechanism-defined indicator
-- of whether or not encrypted
```

```
      -- ASN.1 structure not required
              sealedUserData ANY

      END
```

3.2: Mechanism-Independent Exported Name Object Format

This section specifies a mechanism-independent level of encapsulating representation for names exported via the GSS_Export_name() call, including an object identifier representing the exporting mechanism. The format of names encapsulated via this representation shall be defined within individual mechanism drafts. The Object Identifier value to indicate names of this type is defined in Section 4.7 of this document.

No name type OID is included in this mechanism-independent level of format definition, since (depending on individual mechanism specifications) the enclosed name may be implicitly typed or may be explicitly typed using a means other than OID encoding.

The bytes within MECH_OID_LEN and NAME_LEN elements are represented most significant byte first (equivalently, in IP network byte order).

Length	Name	Description
2	TOK_ID	Token Identifier For exported name objects, this must be hex 04 01.
2	MECH_OID_LEN	Length of the Mechanism OID
MECH_OID_LEN	MECH_OID	Mechanism OID, in DER
4	NAME_LEN	Length of name
NAME_LEN	NAME	Exported name; format defined in applicable mechanism draft.

A concrete example of the contents of an exported name object, derived from the Kerberos Version 5 mechanism, is as follows:

```
04 01 00 0B 06 09 2A 86 48 86 F7 12 01 02 02 hx xx xx xl pp qq ... zz
```

```
04 01        mandatory token identifier

00 0B        2-byte length of the immediately following DER-encoded
             ASN.1 value of type OID, most significant octet first
```

```
   06 09 2A 86 48 86 F7 12 01 02 02    DER-encoded ASN.1 value
                                       of type OID; Kerberos V5
                                       mechanism OID indicates
                                       Kerberos V5 exported name

          in Detail:      06                   Identifier octet (6=OID)
                          09                         Length octet(s)
                          2A 86 48 86 F7 12 01 02 02   Content octet(s)

   hx xx xx xl   4-byte length of the immediately following exported
                 name blob, most significant octet first

   pp qq ... zz  exported name blob of specified length,
                 bits and bytes specified in the
                 (Kerberos 5) GSS-API v2 mechanism spec
```

4: Name Type Definitions

This section includes definitions for name types and associated syntaxes which are defined in a mechanism-independent fashion at the GSS-API level rather than being defined in individual mechanism specifications.

4.1: Host-Based Service Name Form

This name form shall be represented by the Object Identifier:

{iso(1) member-body(2) United States(840) mit(113554) infosys(1) "gssapi(2) generic(1) service_name(4)}.

The recommended symbolic name for this type is "GSS_C_NT_HOSTBASED_SERVICE".

For reasons of compatibility with existing implementations, it is recommended that this OID be used rather than the alternate value as included in [RFC-2078]:

{1(iso), 3(org), 6(dod), 1(internet), 5(security), 6(nametypes), 2(gss-host-based-services)}

While it is not recommended that this alternate value be emitted on output by GSS implementations, it is recommended that it be accepted on input as equivalent to the recommended value.

This name type is used to represent services associated with host computers. Support for this name form is recommended to mechanism designers in the interests of portability, but is not mandated by this specification. This name form is constructed using two elements, "service" and "hostname", as follows:

service@hostname

When a reference to a name of this type is resolved, the "hostname" may (as an example implementation strategy) be canonicalized by attempting a DNS lookup and using the fully-qualified domain name which is returned, or by using the "hostname" as provided if the DNS lookup fails. The canonicalization operation also maps the host's name into lower-case characters.

The "hostname" element may be omitted. If no "@" separator is included, the entire name is interpreted as the service specifier, with the "hostname" defaulted to the canonicalized name of the local host.

Documents specifying means for GSS integration into a particular protocol should state either:

(a) that a specific IANA-registered name associated with that protocol shall be used for the "service" element (this admits, if needed, the possibility that a single name can be registered and shared among a related set of protocols), or

(b) that the generic name "host" shall be used for the "service" element, or

(c) that, for that protocol, fallback in specified order (a, then b) or (b, then a) shall be applied.

IANA registration of specific names per (a) should be handled in accordance with the "Specification Required" assignment policy, defined by BCP 26, RFC 2434 as follows: "Values and their meaning must be documented in an RFC or other available reference, in sufficient detail so that interoperability between independent implementations is possible."

4.2: User Name Form

This name form shall be represented by the Object Identifier {iso(1) member-body(2) United States(840) mit(113554) infosys(1) gssapi(2) generic(1) user_name(1)}. The recommended mechanism-independent symbolic name for this type is "GSS_C_NT_USER_NAME". (Note: the same

name form and OID is defined within the Kerberos V5 GSS-API mechanism, but the symbolic name recommended there begins with a "GSS_KRB5_NT_" prefix.)

This name type is used to indicate a named user on a local system. Its syntax and interpretation may be OS-specific. This name form is constructed as:

username

4.3: Machine UID Form

This name form shall be represented by the Object Identifier {iso(1) member-body(2) United States(840) mit(113554) infosys(1) gssapi(2) generic(1) machine_uid_name(2)}. The recommended mechanism-independent symbolic name for this type is "GSS_C_NT_MACHINE_UID_NAME". (Note: the same name form and OID is defined within the Kerberos V5 GSS-API mechanism, but the symbolic name recommended there begins with a "GSS_KRB5_NT_" prefix.)

This name type is used to indicate a numeric user identifier corresponding to a user on a local system. Its interpretation is OS-specific. The gss_buffer_desc representing a name of this type should contain a locally-significant user ID, represented in host byte order. The GSS_Import_name() operation resolves this uid into a username, which is then treated as the User Name Form.

4.4: String UID Form

This name form shall be represented by the Object Identifier {iso(1) member-body(2) United States(840) mit(113554) infosys(1) gssapi(2) generic(1) string_uid_name(3)}. The recommended symbolic name for this type is "GSS_C_NT_STRING_UID_NAME". (Note: the same name form and OID is defined within the Kerberos V5 GSS-API mechanism, but the symbolic name recommended there begins with a "GSS_KRB5_NT_" prefix.)

This name type is used to indicate a string of digits representing the numeric user identifier of a user on a local system. Its interpretation is OS-specific. This name type is similar to the Machine UID Form, except that the buffer contains a string representing the user ID.

4.5: Anonymous Nametype

The following Object Identifier value is provided as a means to identify anonymous names, and can be compared against in order to determine, in a mechanism-independent fashion, whether a name refers to an anonymous principal:

{1(iso), 3(org), 6(dod), 1(internet), 5(security), 6(nametypes), 3(gss-anonymous-name)}

The recommended symbolic name corresponding to this definition is GSS_C_NT_ANONYMOUS.

4.6: GSS_C_NO_OID

The recommended symbolic name GSS_C_NO_OID corresponds to a null input value instead of an actual object identifier. Where specified, it indicates interpretation of an associated name based on a mechanism-specific default printable syntax.

4.7: Exported Name Object

Name objects of the Mechanism-Independent Exported Name Object type, as defined in Section 3.2 of this document, will be identified with the following Object Identifier:

{1(iso), 3(org), 6(dod), 1(internet), 5(security), 6(nametypes), 4(gss-api-exported-name)}

The recommended symbolic name corresponding to this definition is GSS_C_NT_EXPORT_NAME.

4.8: GSS_C_NO_NAME

The recommended symbolic name GSS_C_NO_NAME indicates that no name is being passed within a particular value of a parameter used for the purpose of transferring names. Note: GSS_C_NO_NAME is not an actual name type, and is not represented by an OID; its acceptability in lieu of an actual name is confined to specific calls (GSS_Acquire_cred(), GSS_Add_cred(), and GSS_Init_sec_context()) with usages as identified within this specification.

5: Mechanism-Specific Example Scenarios

This section provides illustrative overviews of the use of various candidate mechanism types to support the GSS-API. These discussions are intended primarily for readers familiar with specific security technologies, demonstrating how GSS-API functions can be used and implemented by candidate underlying mechanisms. They should not be regarded as constrictive to implementations or as defining the only means through which GSS-API functions can be realized with a particular underlying technology, and do not demonstrate all GSS-API features with each technology.

5.1: Kerberos V5, single-TGT

OS-specific login functions yield a TGT to the local realm Kerberos server; TGT is placed in a credentials structure for the client. Client calls GSS_Acquire_cred() to acquire a cred_handle in order to reference the credentials for use in establishing security contexts.

Client calls GSS_Init_sec_context(). If the requested service is located in a different realm, GSS_Init_sec_context() gets the necessary TGT/key pairs needed to traverse the path from local to target realm; these data are placed in the owner's TGT cache. After any needed remote realm resolution, GSS_Init_sec_context() yields a service ticket to the requested service with a corresponding session key; these data are stored in conjunction with the context. GSS-API code sends KRB_TGS_REQ request(s) and receives KRB_TGS_REP response(s) (in the successful case) or KRB_ERROR.

Assuming success, GSS_Init_sec_context() builds a Kerberos-formatted KRB_AP_REQ message, and returns it in output_token. The client sends the output_token to the service.

The service passes the received token as the input_token argument to GSS_Accept_sec_context(), which verifies the authenticator, provides the service with the client's authenticated name, and returns an output_context_handle.

Both parties now hold the session key associated with the service ticket, and can use this key in subsequent GSS_GetMIC(), GSS_VerifyMIC(), GSS_Wrap(), and GSS_Unwrap() operations.

5.2: Kerberos V5, double-TGT

TGT acquisition as above.

Note: To avoid unnecessary frequent invocations of error paths when implementing the GSS-API atop Kerberos V5, it seems appropriate to represent "single-TGT K-V5" and "double-TGT K-V5" with separate mech_types, and this discussion makes that assumption.

Based on the (specified or defaulted) mech_type, GSS_Init_sec_context() determines that the double-TGT protocol should be employed for the specified target. GSS_Init_sec_context() returns GSS_S_CONTINUE_NEEDED major_status, and its returned output_token contains a request to the service for the service's TGT. (If a service TGT with suitably long remaining lifetime already exists in a cache, it may be usable, obviating the need for this step.) The client passes the output_token to the service. Note: this scenario illustrates a different use for the GSS_S_CONTINUE_NEEDED

status return facility than for support of mutual authentication; note that both uses can coexist as successive operations within a single context establishment operation.

The service passes the received token as the input_token argument to GSS_Accept_sec_context(), which recognizes it as a request for TGT. (Note that current Kerberos V5 defines no intra-protocol mechanism to represent such a request.) GSS_Accept_sec_context() returns GSS_S_CONTINUE_NEEDED major_status and provides the service's TGT in its output_token. The service sends the output_token to the client.

The client passes the received token as the input_token argument to a continuation of GSS_Init_sec_context(). GSS_Init_sec_context() caches the received service TGT and uses it as part of a service ticket request to the Kerberos authentication server, storing the returned service ticket and session key in conjunction with the context. GSS_Init_sec_context() builds a Kerberos-formatted authenticator, and returns it in output_token along with GSS_S_COMPLETE return major_status. The client sends the output_token to the service.

Service passes the received token as the input_token argument to a continuation call to GSS_Accept_sec_context(). GSS_Accept_sec_context() verifies the authenticator, provides the service with the client's authenticated name, and returns major_status GSS_S_COMPLETE.

GSS_GetMIC(), GSS_VerifyMIC(), GSS_Wrap(), and GSS_Unwrap() as above.

5.3: X.509 Authentication Framework

This example illustrates use of the GSS-API in conjunction with public-key mechanisms, consistent with the X.509 Directory Authentication Framework.

The GSS_Acquire_cred() call establishes a credentials structure, making the client's private key accessible for use on behalf of the client.

The client calls GSS_Init_sec_context(), which interrogates the Directory to acquire (and validate) a chain of public-key certificates, thereby collecting the public key of the service. The certificate validation operation determines that suitable integrity checks were applied by trusted authorities and that those certificates have not expired. GSS_Init_sec_context() generates a secret key for use in per-message protection operations on the context, and enciphers that secret key under the service's public key.

The enciphered secret key, along with an authenticator quantity signed with the client's private key, is included in the output_token from GSS_Init_sec_context(). The output_token also carries a certification path, consisting of a certificate chain leading from the service to the client; a variant approach would defer this path resolution to be performed by the service instead of being asserted by the client. The client application sends the output_token to the service.

The service passes the received token as the input_token argument to GSS_Accept_sec_context(). GSS_Accept_sec_context() validates the certification path, and as a result determines a certified binding between the client's distinguished name and the client's public key. Given that public key, GSS_Accept_sec_context() can process the input_token's authenticator quantity and verify that the client's private key was used to sign the input_token. At this point, the client is authenticated to the service. The service uses its private key to decipher the enciphered secret key provided to it for per-message protection operations on the context.

The client calls GSS_GetMIC() or GSS_Wrap() on a data message, which causes per-message authentication, integrity, and (optional) confidentiality facilities to be applied to that message. The service uses the context's shared secret key to perform corresponding GSS_VerifyMIC() and GSS_Unwrap() calls.

6: Security Considerations

This document specifies a service interface for security facilities and services; as such, security considerations are considered 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.

7: Related Activities

In order to implement the GSS-API atop existing, emerging, and future security mechanisms:

- object identifiers must be assigned to candidate GSS-API mechanisms and the name types which they support
- concrete data element formats and processing procedures must be defined for candidate mechanisms

Calling applications must implement formatting conventions which will enable them to distinguish GSS-API tokens from other data carried in their application protocols.

Concrete language bindings are required for the programming environments in which the GSS-API is to be employed, as [RFC-1509] defines for the C programming language and GSS-V1. C Language bindings for GSS-V2 are defined in [RFC-2744].

8: Referenced Documents

[ISO-7498-2] International Standard ISO 7498-2-1988(E), Security Architecture.

[ISOIEC-8824] ISO/IEC 8824, "Specification of Abstract Syntax Notation One (ASN.1)".

[ISOIEC-8825] ISO/IEC 8825, "Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)".)

[RFC-1507]: Kaufman, C., "DASS: Distributed Authentication Security Service", RFC 1507, September 1993.

[RFC-1508]: Linn, J., "Generic Security Service Application Program Interface", RFC 1508, September 1993.

[RFC-1509]: Wray, J., "Generic Security Service API: C-bindings", RFC 1509, September 1993.

[RFC-1964]: Linn, J., "The Kerberos Version 5 GSS-API Mechanism", RFC 1964, June 1996.

[RFC-2025]: Adams, C., "The Simple Public-Key GSS-API Mechanism (SPKM)", RFC 2025, October 1996.

[RFC-2078]: Linn, J., "Generic Security Service Application Program Interface, Version 2", RFC 2078, January 1997.

[RFC-2203]: Eisler, M., Chiu, A. and L. Ling, "RPCSEC_GSS Protocol Specification", RFC 2203, September 1997.

[RFC-2744]: Wray, J., "Generic Security Service API Version 2 : C-bindings", RFC 2744, January 2000.

APPENDIX A

MECHANISM DESIGN CONSTRAINTS

The following constraints on GSS-API mechanism designs are adopted in response to observed caller protocol requirements, and adherence thereto is anticipated in subsequent descriptions of GSS-API mechanisms to be documented in standards-track Internet specifications.

It is strongly recommended that mechanisms offering per-message protection services also offer at least one of the replay detection and sequencing services, as mechanisms offering neither of the latter will fail to satisfy recognized requirements of certain candidate caller protocols.

APPENDIX B

COMPATIBILITY WITH GSS-V1

It is the intent of this document to define an interface and procedures which preserve compatibility between GSS-V1 [RFC-1508] callers and GSS-V2 providers. All calls defined in GSS-V1 are preserved, and it has been a goal that GSS-V1 callers should be able to operate atop GSS-V2 provider implementations. Certain detailed changes, summarized in this section, have been made in order to resolve omissions identified in GSS-V1.

The following GSS-V1 constructs, while supported within GSS-V2, are deprecated:

Names for per-message processing routines: GSS_Seal() deprecated in favor of GSS_Wrap(); GSS_Sign() deprecated in favor of GSS_GetMIC(); GSS_Unseal() deprecated in favor of GSS_Unwrap(); GSS_Verify() deprecated in favor of GSS_VerifyMIC().

GSS_Delete_sec_context() facility for context_token usage, allowing mechanisms to signal context deletion, is retained for compatibility with GSS-V1. For current usage, it is recommended that both peers to a context invoke GSS_Delete_sec_context() independently, passing a null output_context_token buffer to indicate that no context_token is required. Implementations of GSS_Delete_sec_context() should delete relevant locally-stored context information.

This GSS-V2 specification adds the following calls which are not present in GSS-V1:

Credential management calls: GSS_Add_cred(), GSS_Inquire_cred_by_mech().

Context-level calls: GSS_Inquire_context(), GSS_Wrap_size_limit(), GSS_Export_sec_context(), GSS_Import_sec_context().

Per-message calls: No new calls. Existing calls have been renamed.

Support calls: GSS_Create_empty_OID_set(), GSS_Add_OID_set_member(), GSS_Test_OID_set_member(), GSS_Inquire_names_for_mech(), GSS_Inquire_mechs_for_name(), GSS_Canonicalize_name(), GSS_Export_name(), GSS_Duplicate_name().

This GSS-V2 specification introduces three new facilities applicable to security contexts, indicated using the following context state values which are not present in GSS-V1:

anon_state, set TRUE to indicate that a context's initiator is anonymous from the viewpoint of the target; Section 1.2.5 of this specification provides a summary description of the GSS-V2 anonymity support facility, support and use of which is optional.

prot_ready_state, set TRUE to indicate that a context may be used for per-message protection before final completion of context establishment; Section 1.2.7 of this specification provides a summary description of the GSS-V2 facility enabling mechanisms to selectively permit per-message protection during context establishment, support and use of which is optional.

trans_state, set TRUE to indicate that a context is transferable to another process using the GSS-V2 GSS_Export_sec_context() facility.

These state values are represented (at the C bindings level) in positions within a bit vector which are unused in GSS-V1, and may be safely ignored by GSS-V1 callers.

New conf_req_flag and integ_req_flag inputs are defined for GSS_Init_sec_context(), primarily to provide information to negotiating mechanisms. This introduces a compatibility issue with GSS-V1 callers, discussed in section 2.2.1 of this specification.

Relative to GSS-V1, GSS-V2 provides additional guidance to GSS-API implementors in the following areas: implementation robustness, credential management, behavior in multi-mechanism configurations, naming support, and inclusion of optional sequencing services. The token tagging facility as defined in GSS-V2, Section 3.1, is now described directly in terms of octets to facilitate interoperable implementation without general ASN.1 processing code; the corresponding ASN.1 syntax, included for descriptive purposes, is unchanged from that in GSS-V1. For use in conjunction with added naming support facilities, a new Exported Name Object construct is added. Additional name types are introduced in Section 4.

This GSS-V2 specification adds the following major_status values which are not defined in GSS-V1:

GSS_S_BAD_QOP	unsupported QOP value
GSS_S_UNAUTHORIZED	operation unauthorized
GSS_S_UNAVAILABLE	operation unavailable
GSS_S_DUPLICATE_ELEMENT	duplicate credential element requested
GSS_S_NAME_NOT_MN	name contains multi-mechanism elements
GSS_S_GAP_TOKEN	skipped predecessor token(s) detected

Of these added status codes, only two values are defined to be returnable by calls existing in GSS-V1: GSS_S_BAD_QOP (returnable by GSS_GetMIC() and GSS_Wrap()), and GSS_S_GAP_TOKEN (returnable by GSS_VerifyMIC() and GSS_Unwrap()).

Additionally, GSS-V2 descriptions of certain calls present in GSS-V1 have been updated to allow return of additional major_status values from the set as defined in GSS-V1: GSS_Inquire_cred() has GSS_S_DEFECTIVE_CREDENTIAL and GSS_S_CREDENTIALS_EXPIRED defined as returnable, GSS_Init_sec_context() has GSS_S_OLD_TOKEN, GSS_S_DUPLICATE_TOKEN, and GSS_S_BAD_MECH defined as returnable, and GSS_Accept_sec_context() has GSS_S_BAD_MECH defined as returnable.

APPENDIX C

CHANGES RELATIVE TO RFC-2078

This document incorporates a number of changes relative to RFC-2078, made primarily in response to implementation experience, for purposes of alignment with the GSS-V2 C language bindings document, and to add informative clarification. This section summarizes technical changes incorporated.

General:

Clarified usage of object release routines, and incorporated statement that some may be omitted within certain operating environments.

Removed GSS_Release_OID, GSS_OID_to_str(), and GSS_Str_to_OID() routines.

Clarified circumstances under which zero-length tokens may validly exist as inputs and outputs to/from GSS-API calls.

Added GSS_S_BAD_MIC status code as alias for GSS_S_BAD_SIG.

For GSS_Display_status(), deferred to language bindings the choice of whether to return multiple status values in parallel or via iteration, and added commentary deprecating return of GSS_S_CONTINUE_NEEDED.

Adapted and incorporated clarifying material on optional service support, delegation, and interprocess context transfer from C bindings document.

Added and updated references to related documents, and to current status of cited Kerberos mechanism OID.

Added general statement about GSS-API calls having no side effects visible at the GSS-API level.

Context-related (including per-message protection issues):

Clarified GSS_Delete_sec_context() usage for partially-established contexts.

Added clarification on GSS_Export_sec_context() and GSS_Import_sec_context() behavior and context usage following an export-import sequence.

Added informatory conf_req_flag, integ_req_flag inputs to GSS_Init_sec_context(). (Note: this facility introduces a backward incompatibility with GSS-V1 callers, discussed in Section 2.2.1; this implication was recognized and accepted in working group discussion.)

Stated that GSS_S_FAILURE is to be returned if GSS_Init_sec_context() or GSS_Accept_sec_context() is passed the handle of a context which is already fully established.

Re GSS_Inquire_sec_context(), stated that src_name and targ_name are not returned until GSS_S_COMPLETE status is reached; removed use of GSS_S_CONTEXT_EXPIRED status code (replacing with EXPIRED lifetime return value); stated requirement to retain inquirable data until context released by caller; added result value indicating whether or not context is fully open.

Added discussion of interoperability conditions for mechanisms permitting optional support of QOPs. Removed reference to structured QOP elements in GSS_Verify_MIC().

Added discussion of use of GSS_S_DUPLICATE_TOKEN status to indicate reflected per-message tokens.

Clarified use of informational sequencing codes from per-message protection calls in conjunction with GSS_S_COMPLETE and GSS_S_FAILURE major_status returns, adjusting status code descriptions accordingly.

Added specific statements about impact of GSS_GetMIC() and GSS_Wrap() failures on context state information, and generalized existing statements about impact of processing failures on received per-message tokens.

For GSS_Init_sec_context() and GSS_Accept_sec_context(), permitted returned mech_type to be valid before GSS_S_COMPLETE, recognizing that the value may change on successive continuation calls in the negotiated mechanism case.

Deleted GSS_S_CONTEXT_EXPIRED status from GSS_Import_sec_context().

Added conf_req_flag input to GSS_Wrap_size_limit().

Stated requirement for mechanisms' support of per-message protection services to be usable concurrently in both directions on a context.

Credential-related:

For GSS_Acquire_cred() and GSS_Add_cred(), aligned with C bindings statement of likely non-support for INITIATE or BOTH credentials if input name is neither empty nor a name resulting from applying GSS_Inquire_cred() against the default credential. Further, stated that an explicit name returned by GSS_Inquire_context() should also be accepted. Added commentary about potentially time-variant results of default resolution and attendant implications. Aligned with C bindings re behavior when

GSS_C_NO_NAME provided for desired_name. In GSS_Acquire_cred(), stated that NULL, rather than empty OID set, should be used for desired_mechs in order to request default mechanism set.

Added GSS_S_CREDENTIALS_EXPIRED as returnable major_status for GSS_Acquire_cred(), GSS_Add_cred(), also specifying GSS_S_NO_CRED as appropriate return for temporary, user-fixable credential unavailability. GSS_Acquire_cred() and GSS_Add_cred() are also to return GSS_S_NO_CRED if an authorization failure is encountered upon credential acquisition.

Removed GSS_S_CREDENTIALS_EXPIRED status return from per-message protection, GSS_Context_time(), and GSS_Inquire_context() calls.

For GSS_Add_cred(), aligned with C bindings' description of behavior when addition of elements to the default credential is requested.

Upgraded recommended default credential resolution algorithm to status of requirement for initiator credentials.

For GSS_Release_cred(), GSS_Inquire_cred(), and GSS_Inquire_cred_by_mech(), clarified behavior for input GSS_C_NO_CREDENTIAL.

Name-related:

Aligned GSS_Inquire_mechs_for_name() description with C bindings.

Removed GSS_S_BAD_NAMETYPE status return from GSS_Duplicate_name(), GSS_Display_name(); constrained its applicability for GSS_Compare_name().

Aligned with C bindings statement re GSS_Import_name() behavior with GSS_C_NO_OID input name type, and stated that GSS-V2 mechanism specifications are to define processing procedures applicable to their mechanisms. Also clarified GSS_C_NO_OID usage with GSS_Display_name().

Downgraded reference to name canonicalization via DNS lookup to an example.

For GSS_Canonicalize_name(), stated that neither negotiated mechanisms nor the default mechanism are supported input mech_types for this operation, and specified GSS_S_BAD_MECH status to be returned in this case. Clarified that the GSS_Canonicalize_name() operation is non-destructive to its input name.

Clarified semantics of GSS_C_NT_USER_NAME name type.

Added descriptions of additional name types. Also added discussion of GSS_C_NO_NAME and its constrained usage with specific GSS calls.

Adapted and incorporated C bindings discussion about name comparisons with exported name objects.

Added recommendation to mechanism designers for support of host-based service name type, deferring any requirement statement to individual mechanism specifications. Added discussion of host-based service's service name element and proposed approach for IANA registration policy therefor.

Clarified byte ordering within exported name object. Stated that GSS_S_BAD_MECH is to be returned if, in the course of attempted import of an exported name object, the name object's enclosed mechanism type is unrecognized or unsupported.

Stated that mechanisms may optionally accept GSS_C_NO_NAME as an input target name to GSS_Init_sec_context(), with comment that such support is unlikely within mechanisms predating GSS-V2, Update 1.

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