GNU SASL

Simple Authentication and Security Layer for the GNU system
for version 0.2.15, 28 July 2006

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1 Introduction

GNU SASL is an implementation of the Simple Authentication and Security Layer framework and a few common SASL mechanisms. SASL is used by network servers (e.g., IMAP, SMTP) to request authentication from clients, and in clients to authenticate against servers.

GNU SASL consists of a library ('libgsasl'), a command line utility ('gsasl') to access the library from the shell, and a manual. The library includes support for the framework (with authentication functions and application data privacy and integrity functions) and at least partial support for the CRAM-MD5, EXTERNAL, GSSAPI, ANONYMOUS, PLAIN, SECURID, DIGEST-MD5, LOGIN, and NTLM mechanisms.

The library is easily ported because it does not do network communication by itself, but rather leaves it up to the calling application. The library is flexible with regards to the authorization infrastructure used, as it utilize a callback into the application to decide whether a user is authorized or not.

GNU SASL is developed for the GNU/Linux system, but runs on over 20 platforms including most major Unix platforms and Windows, and many kind of devices including iPAQ handhelds and S/390 mainframes.

GNU SASL is written in pure ANSI C89 to be portable to embedded and otherwise limited platforms. The entire library, with full support for ANONYMOUS, EXTERNAL, PLAIN, LOGIN and CRAM-MD5, and the front-end that support client and server mode, and the IMAP and SMTP protocols, fits in under 60kb on an Intel x86 platform, without any modifications to the code. (This figure was accurate as of version 0.0.13.)

The library is licensed under the GNU Lesser General Public License, and the command-line interface, self-tests and examples are licensed under the GNU General Public License.

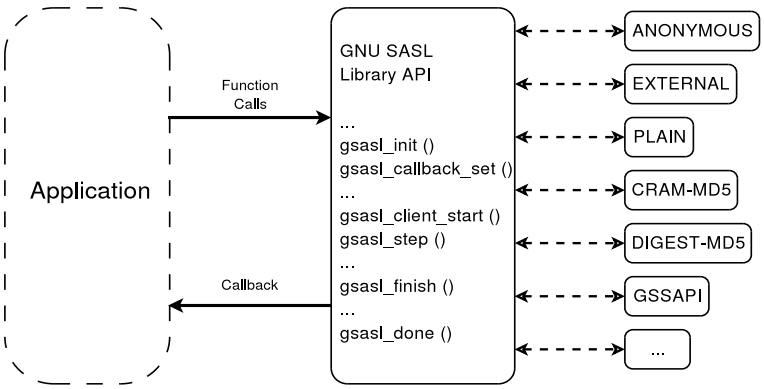


Illustration 1.1: Logical overview showing how applications use authentication mechanisms through an abstract interface.

1.1 Getting Started

This manual documents the GNU SASL Library programming interface. All functions and data types provided by the library are explained.

The reader is assumed to possess basic familiarity with SASL and network programming in C or C++.

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

1.2 Features

GNU SASL might have a couple of advantages over other libraries doing a similar job.

It's Free Software
: Anybody can use, modify, and redistribute it under the terms of the GNU General Public License. The library can even be distributed under the GNU Lesser General Public License.

It's thread-safe
: No global variables are used and multiple library handles and session handles may be used in parallel.

It's internationalized
: It handles non-ASCII username and passwords and user visible strings used in the library (error messages) can be translated into the users' language.

It's portable
: It should work on all Unix like operating systems, including Windows. The library itself should be portable to any C89 system, not even POSIX is required.

Note that the library do not implement any policy to decide whether a certain user is "authenticated" or "authorized" or not. Rather, it uses a callback into the application to answer these questions.

1.3 SASL Overview

This section describes SASL from a protocol point of view.

The Simple Authentication and Security Layer (SASL) is a method for adding authentication support to connection-based protocols. A protocol includes a command for identifying and authenticating a user to a server and for optionally negotiating a security layer for subsequent protocol interactions.

The command has a required argument identifying a SASL mechanism. SASL mechanisms are named by strings, from 1 to 20 characters in length, consisting of upper-case letters, digits, hyphens, and/or underscores.

If a server supports the requested mechanism, it initiates an authentication protocol exchange. This consists of a series of server challenges and client responses that are specific to the requested mechanism. The challenges and responses are defined by the mechanisms as binary tokens of arbitrary length. The protocol's profile then specifies how these binary tokens are then encoded for transfer over the connection.

After receiving the authentication command or any client response, a server may issue a challenge, indicate failure, or indicate completion. The protocol's profile specifies how the server indicates which of the above it is doing.

After receiving a challenge, a client may issue a response or abort the exchange. The protocol's profile specifies how the client indicates which of the above it is doing.

During the authentication protocol exchange, the mechanism performs authentication, transmits an authorization identity (frequently known as a userid) from the client to server, and negotiates the use of a mechanism-specific security layer. If the use of a security layer is agreed upon, then the mechanism must also define or negotiate the maximum cipher-text buffer size that each side is able to receive.

The transmitted authorization identity may be different than the identity in the client's authentication credentials. This permits agents such as proxy servers to authenticate using their own credentials, yet request the access privileges of the identity for which they are proxying. With any mechanism, transmitting an authorization identity of the empty string directs the server to derive an authorization identity from the client's authentication credentials.

If use of a security layer is negotiated, it is applied to all subsequent data sent over the connection. The security layer takes effect immediately following the last response of the authentication exchange for data sent by the client and the completion indication for data sent by the server. Once the security layer is in effect, the protocol stream is processed by the security layer into buffers of cipher-text. Each buffer is transferred over the connection as a stream of octets prepended with a four octet field in network byte order that represents the length of the following buffer. The length of the cipher-text buffer must be no larger than the maximum size that was defined or negotiated by the other side.

1.4 Requirements

The GNU SASL library does not have any required external dependencies, but some optional features are enabled if you have a specific external library.

LibNTLM The NTLM mechanism requires the library LibNTLM, `http://josefsson.org/libntlm/`.

GSS-API The GSS-API mechanism requires a GSS-API library, such as GNU GSS (`http://josefsson.org/gss/`, MIT Kerberos or Heimdal.

LibIDN Processing of non-ASCII username and passwords requires the SASLprep implementation in GNU LibIDN (`http://josefsson.org/libidn/`. This is needed for full conformance with the latest SASL protocol drafts, but is optional in the library for improved portability.

Libgcrypt The GNU SASL library ships with its own cryptographic implementation, but it can use the one in libgcrypt (`http://www.gnupg.org/` instead, if it is available. This is typically useful for desktop machines which have libgcrypt installed.

The command-line interface to GNU SASL requires a POSIX or Windows platform for network connectivity. The command-line tool can make use of GnuTLS (`http://josefsson.org/gnutls/` to support the STARTTLS modes of IMAP and SMTP, but GnuTLS is not required.

Note that the library does not need a POSIX platform or network connectivity.

1.5 Supported Platforms

GNU SASL has at some point in time been tested on the following platforms.

1. Debian GNU/Linux 3.0 (Woody)

   GCC 2.95.4 and GNU Make. This is the main development platform. `alphaev67-unknown-linux-gnu`, `alphaev6-unknown-linux-gnu`, `arm-unknown-linux-gnu`, `hppa-unknown-linux-gnu`, `hppa64-unknown-linux-gnu`, `i686-pc-linux-gnu`, `ia64-unknown-linux-gnu`, `m68k-unknown-linux-gnu`, `mips-unknown-linux-gnu`, `mipsel-unknown-linux-gnu`, `powerpc-unknown-linux-gnu`, `s390-ibm-linux-gnu`, `sparc-unknown-linux-gnu`.
2. Debian GNU/Linux 2.1

   GCC 2.95.1 and GNU Make. `armv4l-unknown-linux-gnu`.
3. Tru64 UNIX

   Tru64 UNIX C compiler and Tru64 Make. `alphaev67-dec-osf5.1`, `alphaev68-dec-osf5.1`.
4. SuSE Linux 7.1

   GCC 2.96 and GNU Make. `alphaev6-unknown-linux-gnu`, `alphaev67-unknown-linux-gnu`.
5. SuSE Linux 7.2a

   GCC 3.0 and GNU Make. `ia64-unknown-linux-gnu`.
6. RedHat Linux 7.2

   GCC 2.96 and GNU Make. `alphaev6-unknown-linux-gnu`, `alphaev67-unknown-linux-gnu`, `ia64-unknown-linux-gnu`.
7. RedHat Linux 8.0

   GCC 3.2 and GNU Make. `i686-pc-linux-gnu`.
8. RedHat Advanced Server 2.1

   GCC 2.96 and GNU Make. `i686-pc-linux-gnu`.
9. Slackware Linux 8.0.01

   GCC 2.95.3 and GNU Make. `i686-pc-linux-gnu`.
10. Mandrake Linux 9.0

    GCC 3.2 and GNU Make. `i686-pc-linux-gnu`.
11. IRIX 6.5

    MIPS C compiler, IRIX Make. `mips-sgi-irix6.5`.
12. AIX 4.3.2

    IBM C for AIX compiler, AIX Make. `rs6000-ibm-aix4.3.2.0`.
13. Microsoft Windows 2000 (Cygwin)

    GCC 3.2, GNU make. `i686-pc-cygwin`.
14. HP-UX 11

    HP-UX C compiler and HP Make. `ia64-hp-hpux11.22`, `hppa2.0w-hp-hpux11.11`.
15. SUN Solaris 2.8

    Sun WorkShop Compiler C 6.0 and SUN Make. `sparc-sun-solaris2.8`.

16. SUN Solaris 2.9

    Sun Forte Developer 7 C compiler and GNU Make. `sparc-sun-solaris2.9`.

17. NetBSD 1.6

    GCC 2.95.3 and GNU Make. `alpha-unknown-netbsd1.6`, `i386-unknown-netbsdelf1.6`.

18. OpenBSD 3.1 and 3.2

    GCC 2.95.3 and GNU Make. `alpha-unknown-openbsd3.1`, `i386-unknown-openbsd3.1`.

19. FreeBSD 4.7

    GCC 2.95.4 and GNU Make. `alpha-unknown-freebsd4.7`, `i386-unknown-freebsd4.7`.

20. Cross compiled to uClinux/uClibc on Motorola Coldfire.

    GCC 3.4 and GNU Make `m68k-uclinux-elf`.

If you port GNU SASL to a new platform, please report it to the author so this list can be updated.

1.6 Getting help

A mailing list where users may help each other exists, and you can reach it by sending e-mail to `help-gsasl@gnu.org`. Archives of the mailing list discussions, and an interface to manage subscriptions, is available through the World Wide Web at `http://lists.gnu.org/mailman/listinfo/help-gsasl`.

1.7 Commercial Support

Commercial support is available for users of GNU SASL. The kind of support that can be purchased may include:

- Implement new features. Such as a new SASL mechanism.
- Port GNU SASL to new platforms. This could include porting to an embedded platforms that may need memory or size optimization.
- Integrating SASL as a security environment in your existing project.
- System design of components related to SASL.

If you are interested, please write to:

```
Simon Josefsson Datakonsult
Hagagatan 24
113 47 Stockholm
Sweden

E-mail: simon@josefsson.org
```

If your company provide support related to GNU SASL and would like to be mentioned here, contact the author (see Section 1.9 [Bug Reports], page 7).

1.8 Downloading and Installing

The package can be downloaded from several places, including:

`http://josefsson.org/gsasl/releases/`

The latest version is stored in a file, e.g., '`gsasl-0.2.15.tar.gz`' where the '`0.2.15`' value is the highest version number in the directory.

The package is then extracted, configured and built like many other packages that use Autoconf. For detailed information on configuring and building it, refer to the '`INSTALL`' file that is part of the distribution archive.

Here is an example terminal session that download, configure, build and install the package. You will need a few basic tools, such as '`sh`', '`make`' and '`cc`'.

```
$ wget -q http://josefsson.org/gsasl/releases/gsasl-0.2.15.tar.gz
$ tar xfz gsasl-0.2.15.tar.gz
$ cd gsasl-0.2.15/
$ ./configure
...
$ make
...
$ make install
...
```

After that gsasl should be properly installed and ready for use.

A few `configure` options may be relevant, summarized in the table.

`--disable-client`
`--disable-server`
: If your target system require a minimal implementation, you may wish to disable the client or the server part of the code. This do not remove symbols from the library, so if you attempt to call an application that uses server functions in a library built with `--disable-server`, the function will return an error code.

`--disable-obsolete`
: This remove backwards compatibility (see Appendix B [Old Functions], page 61). Use if you want to limit the size of the library.

`--disable-anonymous`
`--disable-external`
`--disable-plain`
`--disable-login`
`--disable-securid`
`--disable-ntlm`
`--disable-cram-md5`
`--disable-digest-md5`
`--disable-gssapi`
`--enable-kerberos_v5`
: Disable or enable individual mechanisms (see Chapter 5 [Mechanisms], page 23).

`--without-stringprep`
: Disable internationalized string processing. Note that this will result in a SASL library that is only compatible with RFC 2222.

For the complete list, refer to the output from `configure --help`.

1.9 Bug Reports

If you think you have found a bug in GNU SASL, please investigate it and report it.

- Please make sure that the bug is really in GNU SASL, and preferably also check that it hasn't already been fixed in the latest version.
- You have to send us a test case that makes it possible for us to reproduce the bug.
- You also have to explain what is wrong; if you get a crash, or if the results printed are not good and in that case, in what way. Make sure that the bug report includes all information you would need to fix this kind of bug for someone else.

Please make an effort to produce a self-contained report, with something definite that can be tested or debugged. Vague queries or piecemeal messages are difficult to act on and don't help the development effort.

If your bug report is good, we will do our best to help you to get a corrected version of the software; if the bug report is poor, we won't do anything about it (apart from asking you to send better bug reports).

If you think something in this manual is unclear, or downright incorrect, or if the language needs to be improved, please also send a note.

Send your bug report to:

'`bug-gsasl@gnu.org`'

1.10 Contributing

If you want to submit a patch for inclusion – from solve a typo you discovered, up to adding support for a new feature – you should submit it as a bug report (see Section 1.9 [Bug Reports], page 7). There are some things that you can do to increase the chances for it to be included in the official package.

Unless your patch is very small (say, under 10 lines) we require that you assign the copyright of your work to the Free Software Foundation. This is to protect the freedom of the project. If you have not already signed papers, we will send you the necessary information when you submit your contribution.

For contributions that doesn't consist of actual programming code, the only guidelines are common sense. Use it.

For code contributions, a number of style guides will help you:

- Coding Style. Follow the GNU Standards document (see ⟨undefined⟩ [top], page ⟨undefined⟩).

  If you normally code using another coding standard, there is no problem, but you should use '`indent`' to reformat the code (see ⟨undefined⟩ [top], page ⟨undefined⟩) before submitting your work.
- Use the unified diff format '`diff -u`'.
- Return errors. No reason whatsoever should abort the execution of the library. Even memory allocation errors, e.g. when malloc return NULL, should work although result in an error code.

- Design with thread safety in mind. Don't use global variables. Don't even write to per-handle global variables unless the documented behaviour of the function you write is to write to the per-handle global variable.
- Avoid using the C math library. It causes problems for embedded implementations, and in most situations it is very easy to avoid using it.
- Document your functions. Use comments before each function headers, that, if properly formatted, are extracted into Texinfo manuals and GTK-DOC web pages.
- Supply a ChangeLog and NEWS entries, where appropriate.

2 Preparation

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

A faster way to find out how to adapt your application for use with GNU SASL may be to look at the examples at the end of this manual (see Chapter 12 [Examples], page 44).

2.1 Header

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

```
#include <gsasl.h>
```

The name space is `gsasl_*` for function names, `Gsasl*` for data types and `GSASL_*` for other symbols. In addition the same name prefixes with one prepended underscore are reserved for internal use and should never be used by an application.

2.2 Initialization

The library must be initialized before it can be used. The library is initialized by calling `gsasl_init` (see Chapter 6 [Global Functions], page 28). The resources allocated by the initialization process can be released if the application no longer has a need to call 'Libgsasl' functions, this is done by calling `gsasl_done`. For example:

```
int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;
...
  rc = gsasl_init (&ctx);
  if (rc != GSASL_OK)
    {
      printf ("SASL initialization failure (%d): %s\n",
              rc, gsasl_strerror (rc));
      return 1;
    }
...
```

In order to make error messages from `gsasl_strerror` be translated (see section "Top" in *GNU Gettext*) the application must set the current locale using `setlocale` before calling `gsasl_init`. For example:

```
int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
```

```
  int rc;
...
  setlocale (LC_ALL, "");
...
  rc = gsasl_init (&ctx);
  if (rc != GSASL_OK)
    {
      printf (gettext ("SASL initialization failure (%d): %s\n"),
              rc, gsasl_strerror (rc));
      return 1;
    }
...
```

In order to take advantage of the secure memory features in Libgcrypt[1], you need to initialize secure memory in your application, and for some platforms even make your application setuid root. See the Libgcrypt documentation for more information. Example code to initialize secure memory in your code:

```
#include <gcrypt.h>
...
int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;
...
  /* Check version of libgcrypt. */
  if (!gcry_check_version (GCRYPT_VERSION))
    die ("version mismatch\n");

  /* Allocate a pool of 16k secure memory.  This also drops priviliges
     on some systems. */
  gcry_control (GCRYCTL_INIT_SECMEM, 16384, 0);

  /* Tell Libgcrypt that initialization has completed. */
  gcry_control (GCRYCTL_INITIALIZATION_FINISHED, 0);
...
  rc = gsasl_init (&ctx);
  if (rc != GSASL_OK)
    {
      printf ("SASL initialization failure (%d): %s\n",
              rc, gsasl_strerror (rc));
      return 1;
    }
...
```

[1] Note that GNU SASL normally use its own internal implementation of the cryptographic functions. Take care to verify that GNU SASL really use Libgcrypt, if this is what you want.

If you do not do this, keying material will not be allocated in secure memory (which for most application is not the biggest secure problem anyway). Note that the GNU SASL Library has not been audited to make sure it only ever stores passwords or keys in secure memory.

2.3 Version Check

It is often desirable to check that the version of the library used is indeed one which fits all requirements. Even with binary compatibility new features may have been introduced but due to problem with the dynamic linker an old version is actually used. So you may want to check that the version is okay right after program startup.

gsasl_check_version

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

req_version: version string to compare with, or NULL.

Check library version.

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

Return value: Check that the the version of the library is at minimum the one given as a string in `req_version` and return the actual version string of the library; return NULL if the condition is not met. If `NULL` is passed to this function no check is done and only the version string is returned.

The normal way to use the function is to put something similar to the following early in your `main`:

```
if (!gsasl_check_version (GSASL_VERSION))
  {
    printf ("gsasl_check_version failed:\n"
            "Header file incompatible with shared library.\n");
    exit(1);
  }
```

2.4 Building the source

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

However, the path to the include file is determined at the time the source is configured. To solve this problem, the library uses the external package `pkg-config` that knows the path to the include file and other configuration options. The options that need to be added to the compiler invocation at compile time are output by the '`--cflags`' option to `pkg-config libgsasl`. The following example shows how it can be used at the command line:

```
gcc -c foo.c `pkg-config libgsasl --cflags`
```

Adding the output of '`pkg-config libgsasl --cflags`' to the compilers command line will ensure that the compiler can find the 'gsasl.h' header file.

A similar problem occurs when linking the program with the library. Again, the compiler has to find the library files. For this to work, the path to the library files has to be added to the library search path (via the '`-L`' option). For this, the option '`--libs`' to `pkg-config libgsasl` can be used. For convenience, this option also outputs all other options that are required to link the program with the 'libgsasl' libarary (for instance, the '`-lidn`' option). The example shows how to link '`foo.o`' with the 'libgsasl' library to a program `foo`.

```
gcc -o foo foo.o `pkg-config libgsasl --libs`
```

Of course you can also combine both examples to a single command by specifying both options to `pkg-config`:

```
gcc -o foo foo.c `pkg-config libgsasl --cflags --libs`
```

2.5 Autoconf tests

If you work on a project that uses Autoconf (see ⟨undefined⟩ [top], page ⟨undefined⟩) to help find installed libraries, the suggestions in the previous section are not the entire story. There are a few methods to detect and incorporate the GNU SASL Library into your Autoconf based package. The preferred approach, is to use Libtool in your project, and use the normal Autoconf header file and library tests.

2.5.1 Autoconf test via 'pkg-config'

If your audience is a typical GNU/Linux desktop, you can often assume they have the '`pkg-config`' tool installed, in which you can use its Autoconf M4 macro to find and set up your package for use with Libgsasl. The following illustrate this scenario.

```
AC_ARG_ENABLE(gsasl,
AC_HELP_STRING([--disable-gsasl], [don't use GNU SASL]),
gsasl=$enableval)
if test "$gsal" != "no" ; then
PKG_CHECK_MODULES(GSASL, libgsasl >= 0.2.15,
[gsasl=yes],
                        [gsasl=no])
if test "$gsasl" != "yes" ; then
sal=no
AC_MSG_WARN([Cannot find GNU SASL, disabling])
else
gsasl=yes
AC_DEFINE(USE_GSASL, 1, [Define to 1 if you want GNU SASL.])
fi
fi
AC_MSG_CHECKING([if GNU SASL should be used])
AC_MSG_RESULT($gsasl)
```

2.5.2 Standalone Autoconf test using Libtool

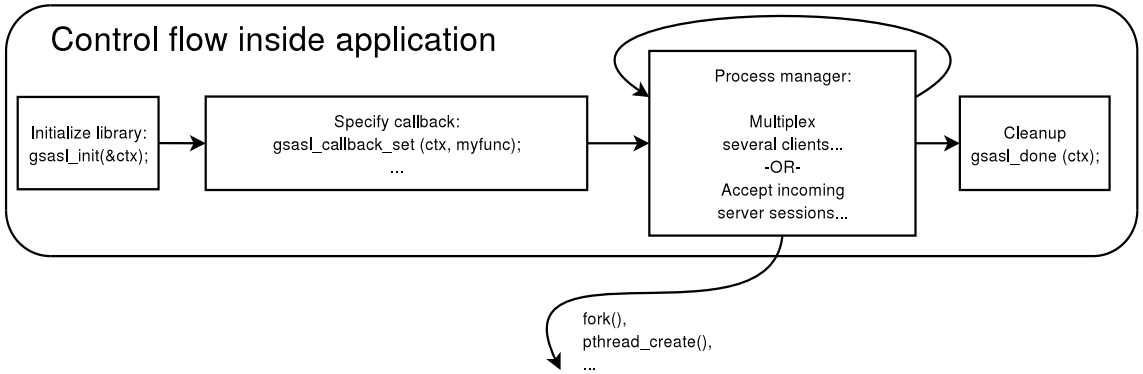
If your package uses Libtool(see ⟨undefined⟩ [top], page ⟨undefined⟩), you can use the normal Autoconf tests to find Libgsasl and rely on the Libtool dependency tracking to include the proper dependency libraries (e.g., Libidn). The following illustrate this scenario.

```
AC_CHECK_HEADER(gsasl.h,
```

```
AC_CHECK_LIB(gsasl, gsasl_check_version,
[gsasl=yes AC_SUBST(GSASL_LIBS, -lgsasl)],
gsasl=no),
gsasl=no)
AC_ARG_ENABLE(gsasl,
AC_HELP_STRING([--disable-gsasl], [don't use GNU SASL]),
gsasl=$enableval)
if test "$gsasl" != "no" ; then
AC_DEFINE(USE_SASL, 1, [Define to 1 if you want GNU SASL.])
else
AC_MSG_WARN([Cannot find GNU SASL, diabling])
fi
AC_MSG_CHECKING([if GNU SASL should be used])
AC_MSG_RESULT($gsasl)
```

3 Using the Library

Your application's use of the library can be roughly modeled into the following steps: initialize the library, optionally specify the callback, perform the authentication, and finally clean up. The following image illustrate this.



The third step may look the most complex, but for a simple client it will actually not involve any code. If your application need to handle several concurrent clients, or if it is a server that need to serve many clients simultaneous, things do get a bit more complicated.

For illustration, we will write a simple client. Writing a server would be similar, the only difference is that, later on, instead of supplying username or passwords, you need to decide whether someone should be allowed to log in or not. The code for what we have discussed so far make up our `main` function in our client (see Section 12.1 [Example 1], page 44):

```
int main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;

  if ((rc = gsasl_init (&ctx)) != GSASL_OK)
    {
      printf ("Cannot initialize libgsasl (%d): %s",
              rc, gsasl_strerror (rc));
      return 1;
    }

  client (ctx);

  gsasl_done (ctx);

  return 0;
}
```

Here, the call to the function `client` correspond to the third step in the image above.

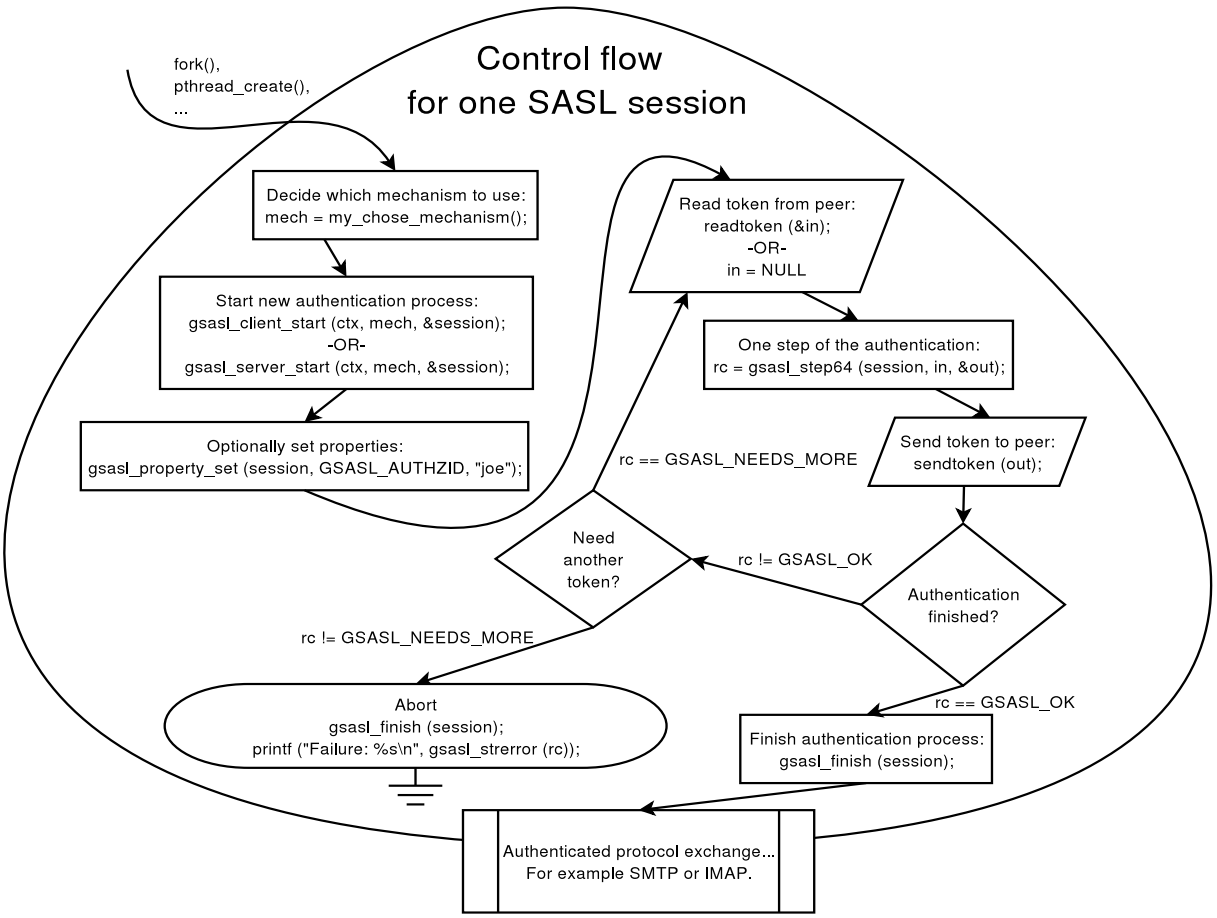
For a more complicated application, that have several clients running simultaneous, instead of simply calling `client`, it may have created new threads for each session, and call `client` within each thread. The library is thread safe.

An actual authentication session is more complicated than what we have seen so far. The steps that make up it are: decide which mechanism to use, start the session, optionally specify the callback, optionally set any properties, perform the authentication loop, and clean up. Naturally, your application will start to talk its own protocol (e.g., SMTP or IMAP) after these steps have concluded.

The authentication loop is based on sending tokens (typically short messages encoded in base 64) back and forth between the client and server. It continue until authentication succeeds or there is an error. The format of the data to transfer, the number of iterations in the loop, and other details are specified by each mechanism. The goal of the library is to isolate your application from the details of all different mechanisms.

Note that the library do not send data to the server itself, but return it in an buffer. You must send it to the server yourself, according to an application protocol profile. For example, the SASL application protocol profile for SMTP is described in RFC 2554.

The following image illustrate the steps we have been talking about.



We will now show the implementation of the `client` function used before.

```
void client (Gsasl *ctx)
{
  Gsasl_session *session;
```

```
  const char *mech = "PLAIN";
  int rc;

  /* Create new authentication session. */
  if ((rc = gsasl_client_start (ctx, mech, &session)) != GSASL_OK)
    {
      printf ("Cannot initialize client (%d): %s\n",
              rc, gsasl_strerror (rc));
      return;
    }

  /* Set username and password in session handle.  This info will be
     lost when this session is deallocated below.  */
  gsasl_property_set (session, GSASL_AUTHID, "jas");
  gsasl_property_set (session, GSASL_PASSWORD, "secret");

  /* Do it. */
  client_authenticate (ctx, session);

  /* Cleanup. */
  gsasl_finish (session);
}
```

This function is responsible for deciding which mechanism to use. In this case, the 'PLAIN' mechanism is hard coded, but you will see later how this can be made more flexible. The function create a new session, store the username and password in the session handle, then call another function `client_authenticate` to handle the authentication loop, and end by cleaning up. Let's continue with the implementation of `client_authenticate`.

```
void client_authenticate (Gsasl * ctx, Gsasl_session * session)
{
  char buf[BUFSIZ] = "";
  char *p;
  int rc;

  /* This loop mimic a protocol where the server get to send data
     first. */

  do
    {
      printf ("Input base64 encoded data from server:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      if (buf[strlen (buf) - 1] == '\n')
        buf[strlen (buf) - 1] = '\0';

      rc = gsasl_step64 (session, buf, &p);

      if (rc == GSASL_NEEDS_MORE || rc == GSASL_OK)
```

```
          {
            printf ("Output:\n%s\n", p);
            free (p);
          }
      }
    while (rc == GSASL_NEEDS_MORE);

    printf ("\n");

    if (rc != GSASL_OK)
      {
        printf ("Authentication error (%d): %s\n",
                rc, gsasl_strerror (rc));
        return;
      }

    /* The client is done.  Here you would typically check if the
       server let the client in.  If not, you could try again. */

    printf ("If server accepted us, we're done.\n");
  }
```

This last function need to be discussed in some detail. First, you should be aware that there are two versions of this function, that differ in a subtle way. The version above (see Section 12.2 [Example 2], page 46) is used for application profiles where the server send data first. For some mechanisms, this may waste a roundtrip, because the server need input from the client to proceed. Therefor, today the recommended approach is to permit client to send data first (see Section 12.1 [Example 1], page 44). Which version you should use depend on which application protocol you are implementing.

Further, you should realize that it is bad programming style to use a fixed size buffer. On GNU systems, you may use the `getline` functions instead of `fgets`. However, in practice, there are few mechanisms that use very large tokens. In typical configurations, the mechanism with the largest tokens (GSSAPI) can use at least 500 bytes. A fixed buffer size of 8192 bytes may thus be sufficient for now. But don't say I didn't warn you, when a future mechanism doesn't work in your application, because of a fixed size buffer.

The `gsasl_step64` (and of course also `gasl_step`) return two non-error return codes. `GSASL_OK` is used for success, indicating that the library consider the authentication finished. That may include a successful server authentication, depending on the mechanism. You must not let the client continue to the application protocol part unless you receive `GSASL_OK` from these functions. In particular, don't be fooled into believing authentication were successful if the server reply "OK" but these function has failed with an error. The server may have been hacked, and could be tricking you into sending confidential data, without having successfully authenticated the server.

The non-error return code `GSASL_NEEDS_MORE` is used to signal to your application that you should send the output token to the peer, and wait for a new token, and do another iteration. If the server conclude the authentication process, with no data, you should call `gsasl_step64` (or `gsasl_step`) specifying a zero-length token.

If the functions (`gsasl_step` and `gsasl_step64`) return any non-error code, the content of the output buffer is undefined. Otherwise, it is the callers responsibility to deallocate the buffer, by calling `free`. Note that in some situations, where the buffer is empty, `NULL` is returned as the buffer value. You should treat this as an empty buffer.

3.1 Choosing a mechanism

Our earlier code was hard coded to use a specific mechanism. This is rarely a good idea. Instead, it is recommended to select the best mechanism available from the list of mechanism supported by the server. Note that without TLS or similar, the list may have been maliciously altered, by an attacker. This means that you should abort if you cannot find any mechanism that exceeds your minimum security level. There is a function `gsasl_client_suggest_mechanism` (see Chapter 6 [Global Functions], page 28) that will try to pick the "best" available mechanism from a list of mechanisms. Our simple interactive example client (see Section 12.3 [Example 3], page 49) include the following function to decide which mechanism to use. Note that the code doesn't blindly use what is returned from `gsasl_client_suggest_mechanism`, but rather let some logic (in this case the user, through an interactive query) decide which mechanism is acceptable.

```
const char *client_mechanism (Gsasl *ctx)
{
  static char mech[GSASL_MAX_MECHANISM_SIZE + 1] = "";
  char mechlist[BUFSIZ] = "";
  const char *suggestion;

  printf ("Enter list of mechanism that server support, separate by SPC:\n");
  fgets (mechlist, sizeof (mechlist) - 1, stdin);

  suggestion = gsasl_client_suggest_mechanism (ctx, mechlist);
  if (suggestion)
    printf ("Library suggest use of ‘%s’.\n", suggestion);

  printf ("Enter mechanism to use:\n");
  fgets (mech, sizeof (mech) - 1, stdin);
  mech[strlen (mech) - 1] = '\0';

  return mech;
}
```

When running this example code, it might look like in the following output.

```
Enter list of mechanism that server support, separate by SPC:
CRAM-MD5 DIGEST-MD5 GSSAPI FOO BAR
Library suggest use of ‘GSSAPI’.
Enter mechanism to use:
CRAM-MD5
Input base64 encoded data from server:
Zm5vcmQ=
Output:
amFzIDkyY2U1NWE5MTM2ZTY4NzEyMTUyZTFjYmFmNjVkZjgx
```

```
If server accepted us, we're done.
```

3.2 Using a callback

Our earlier code specified the username and password before the authentication loop, as in:

```
gsasl_property_set (ctx, GSASL_AUTHID, "jas");
gsasl_property_set (ctx, GSASL_PASSWORD, "secret");
```

This may work for simple mechanisms, that only ever need an username and a password. But some mechanism require more information, such as an authorization identity, a special PIN or passcode, a realm, a hostname, a service name, or an anonymous identifier. Querying the user for all that information, without knowing exactly which of it is really needed will result in a poor user interface. The user should not have to input private information, if it isn't required.

The approach is a bad idea for another reason. What if the server abort the authentication process? Then your application have already queried the user for a username and password. It would be better if you only asked the user for this information, annoying to input, when it is known to be needed.

A better approach to this problem is to use a callback. Then the mechanism may query your application whenever it need some information, like the username and password. It will only do this at the precise step in the authentication when the information is actually needed. Further, if the user abort, e.g., a password prompt, the mechanism is directly informed of this (because it invoked the callback), and could recover somehow.

Our final example (see Section 12.4 [Example 4], page 52) specify a callback function, inside `main` as below.

```
/* Set the callback handler for the library. */
gsasl_callback_set (ctx, callback);
```

The function itself is implemented as follows.

```
int callback (Gsasl * ctx, Gsasl_session * sctx, Gsasl_property prop)
{
  char buf[BUFSIZ] = "";
  int rc = GSASL_NO_CALLBACK;

  /* Get user info from user. */

  printf ("Callback invoked, for property %d.\n", prop);

  switch (prop)
    {
    case GSASL_PASSCODE:
      printf ("Enter passcode:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      buf[strlen (buf) - 1] = '\0';

      gsasl_property_set (sctx, GSASL_PASSCODE, buf);
```

```
        rc = GSASL_OK;
        break;

      case GSASL_AUTHID:
        printf ("Enter username:\n");
        fgets (buf, sizeof (buf) - 1, stdin);
        buf[strlen (buf) - 1] = '\0';

        gsasl_property_set (sctx, GSASL_AUTHID, buf);
        rc = GSASL_OK;
        break;

      default:
        printf ("Unknown property!  Don't worry.\n");
        break;
      }

    return rc;
  }
```

Again, it is bad style to use a fixed size buffer. Mmm'kay.

Which properties you should handle is up to you. If you don't know how to respond to a certain property, simply return `GSASL_NO_CALLBACK`. The basic properties to support are authentication identity (`GSASL_AUTHID`), authorization identity (`GSASL_AUTHZID`), and password (`GSASL_PASSWORD`). See See Chapter 4 [Properties], page 21, for the list of all properties, and what your callback should (ideally) do for them, and which properties each mechanism require in order to work.

4 Properties

Properties with associated data:

- `GSASL_AUTHID`

  The authentication identity.

- `GSASL_AUTHZID`

  The authorization identity.

- `GSASL_PASSWORD`

  The password of the authentication identity.

- `GSASL_ANONYMOUS_TOKEN`

  The anonymous token. This is typically the email address of the user.

- `GSASL_SERVICE`

  The registered GSSAPI service name of the application service, e.g. "imap". While the names are registered for GSSAPI, other mechanisms such as DIGEST-MD5 may also use this.

- `GSASL_HOSTNAME`

  Should be the local host name of the machine.

- `GSASL_GSSAPI_DISPLAY_NAME`

  Contain the GSSAPI "display name", set by the server GSSAPI mechanism. Typically you retrieve this property in your callback, when invoked for `GSASL_VALIDATE_GSSAPI`.

- `GSASL_REALM`

  The name of the authentication domain. This is used by several mechanisms, including DIGEST-MD5, GSS-API, KERBEROS_V5 and NTLM.

- `GSASL_PASSCODE`

  The SecurID passcode.

- `GSASL_PIN`

  The SecurID personal identification number (PIN).

- `GSASL_SUGGESTED_PIN`

  A SecurID personal identification number (PIN) suggested by the server.

Abstract properties, used to trigger the callback, typically used in servers to validate client credentials:

- `GSASL_VALIDATE_SIMPLE`

  You may retrieve GSASL_AUTHID, GSASL_AUTHZID and GSASL_PASSWORD and use them to make an authentication and authorization decision.

- `GSASL_VALIDATE_EXTERNAL`

  Used by EXTERNAL mechanism on the server side to validate the client. The GSASL_AUTHID will contain the authorization identity of the client.

- `GSASL_VALIDATE_ANONYMOUS`

  Used by ANONYMOUS mechanism on the server side to validate the client. The GSASL_ANONYMOUS_TOKEN will contain token that identity the client.

- `GSASL_VALIDATE_GSSAPI`

  Used by the GSSAPI mechanism on the server side, to validate the client. You may retrieve the authorization identity from GSASL_AUTHZID and the GSS-API display name from GSASL_GSSAPI_DISPLAY_NAME.

- `GSASL_VALIDATE_SECURID`

  Used by SECURID mechanism on the server side to validate client. The GSASL_AUTHID, GSASL_AUTHZID, GSASL_PASSCODE, and GSASL_PIN will be set. It can return GSASL_SECURID_SERVER_NEED_ADDITIONAL_PASSCODE to ask the client to supply another passcode, and GSASL_SECURID_SERVER_NEED_NEW_PIN to require the client to supply a new PIN code.

5 Mechanisms

Different SASL mechanisms have different requirements on the application using it. To handle these differences the library can use a callback function into your application in several different ways. Some mechanisms, such as '`PLAIN`', are simple to explain and use. The client callback query the user for a username and password. The server callback hand the username and password into any local policy deciding authentication system (such as '`/etc/passwd`' via PAM).

Mechanism such as '`CRAM-MD5`' and '`DIGEST-MD5`' uses hashed passwords. The client callback behaviour is the same as for PLAIN. However, the server do not receive the plain text password over the network but rather a hash of it. Existing policy deciding systems like PAM cannot handle this, so the server callback for these mechanisms are more complicated.

Further, mechanisms like GSSAPI (Kerberos 5) assume a specific authentication system. In theory this means that the SASL library would not need to interact with the application, but rather call this specific authentication system directly. However, some callbacks are supported anyway, to modify the behaviour of how the specific authentication system is used (i.e., to handle "super-user" login as some other user).

Some mechanisms, like '`EXTERNAL`' and '`ANONYMOUS`' are entirely dependent on callbacks.

5.1 The EXTERNAL mechanism

The EXTERNAL mechanism is used to authenticate a user to a server based on out-of-band authentication. EXTERNAL is typically used over TLS authenticated channels. Note that in the server, you need to make sure that TLS actually authenticated the client successfully. It is normally not sufficient that TLS is used, since they also support anonymous modes.

In the client, this mechanism is always enabled, and will send the `GSASL_AUTHZID` property as the authorization name to the server, if the property is set. If the property is not set, the empty authorization name is sent. You need not implement a callback.

In the server, this mechanism will invoke the `GSASL_VALIDATE_EXTERNAL` callback to decide whether the client is authenticated and authorized to log in. Your callback can retrieve the `GSASL_AUTHZID` property to inspect the requested authorization name from the client.

5.2 The ANONYMOUS mechanism

The ANONYMOUS mechanism is used to "authenticate" clients to anonymous services; or rather, just indicate that the client wishes to use the service anonymously. The client sends a token, usually her email address, which serve the purpose of some trace information suitable for log files. The token is not permitted to be empty.

In the client, this mechanism is always enabled, and will send the `GSASL_ANONYMOUS_TOKEN` property as the trace information to the server.

In the server, this mechanism will invoke the `GSASL_VALIDATE_ANONYMOUS` callback to decide whether the client should be permitted to log in. Your callback can retrieve the `GSASL_ANONYMOUS_TOKEN` property to, for example, save it in a log file. The token is normally not used to decide whether the client should be permitted to log in or not.

5.3 The PLAIN mechanism

The PLAIN mechanism uses username and password to authenticate users. Two user names are relevant. The first, the authentication identity, indicate the credential holder, i.e., whom the provided password belongs to. The second, the authorization identity, is typically empty, to indicate that the user requests to log on to the server as herself. However, if the authorization identity is not empty, the server should decide whether the authenticated user may log on as the authorization identity. Normally, only "super-user" accounts such as '`admin`' or similar should be allowed this.

In the client, this mechanism is always enabled, and require the `GSASL_AUTHID` and `GSASL_PASSWORD` properties. If set, `GSASL_AUTHZID` will also be used.

In the server, the mechanism is always enabled. Two approaches to authenticate and authorize the client is provided.

In the first approach, the server side of the mechanism will invoke the `GSASL_VALIDATE_SIMPLE` callback property to decide whether the client should be accepted or not. The callback may inspect the `GSASL_AUTHID`, `GSASL_AUTHID`, and `GSASL_PASSWORD` properties. These properties values will be normalized.

If the first approach fails (because, e.g., your callback return '`GSASL_NO_CALLBACK`' to signal that it does not implement `GSASL_VALIDATE_SIMPLE`) the mechanism will continue to query the application for a password, via the `GSASL_PASSWORD` property. Your callback may use the `GSASL_AUTHID` and `GSASL_AUTHZID` properties to select the proper password. The password is then normalized and compared to the client credential.

Which approach to use? If your database store hashed passwords, you have no option, but must use the first approach. If passwords in your user database are stored in prepared (SASLprep) form, the first approach will be faster. If you do not have prepared passwords available, you can use the second approach to make sure the password is prepared properly before comparison.

5.4 The LOGIN mechanism

The LOGIN mechanism is a non-standard mechanism, and is similar to the PLAIN mechanism except that LOGIN lack the support for authorization identities. Always use PLAIN instead of LOGIN in new applications.

The callback behaviour is the same as for PLAIN, except that `GSASL_AUTHZID` is not used nor required, and that the server do not normalize the password using SASLprep.

See Section A.2 [Use of SASLprep in LOGIN], page 60, for a proposed clarification of the interpretation of a hypothetical LOGIN specification.

5.5 The CRAM-MD5 mechanism

The CRAM-MD5 is a widely used, but officially deprecated (apparently in favor of DIGEST-MD5), challenge-response mechanism that transfer hashed passwords instead of clear text passwords. For insecure channels (e.g., when TLS is not used), it is safer than PLAIN. The CRAM-MD5 mechanism do not support authorization identities; making the relationship between CRAM-MD5 and DIGEST-MD5 similar to the relationship between LOGIN and PLAIN.

The disadvantage with hashed passwords is that the server cannot use normal authentication infrastructures such as PAM, because the server must have access to the correct password in order to validate an authentication attempt.

In the client, this mechanism is always enabled, and require the `GSASL_AUTHID` and `GSASL_PASSWORD` properties.

In the server, the mechanism will invoke the `GSASL_PASSWORD` callback, which may use the `GSASL_AUTHID` property to determine which users' password should be used. The `GSASL_AUTHID` will be in normalized form. The server will then normalize the returned password, and compare the client response with the computed correct response, and accept the user accordingly.

See Section A.1 [Use of SASLprep in CRAM-MD5], page 60, for a clarification on the interpretation of the CRAM-MD5 specification that this implementation rely on.

5.6 The DIGEST-MD5 mechanism

The DIGEST-MD5 mechanism is based on repeated hashing using MD5, which after the MD5 break may be argued to be weaker than HMAC-MD5, but supports more features. For example, authorization identities and data integrity and privacy protection are supported. Like CRAM-MD5, only a hashed password is transfered. Consequently, DIGEST-MD5 need access to the correct password (although it may be hashed, another improvement compared to CRAM-MD5) to verify the client response. Alas, this make it impossible to use, e.g., PAM on the server side.

In the client, this mechanism is always enabled, and require the `GSASL_AUTHID`, `GSASL_PASSWORD`, `GSASL_SERVICE`, and `GSASL_HOSTNAME` properties. If set, `GSASL_AUTHZID` and `GSASL_REALM` will also be used.

In the server, the mechanism will invoke the `GSASL_PASSWORD` callback, which may use the `GSASL_AUTHID`, `GSASL_AUTHZID` and `GSASL_REALM` properties to determine which users' password should be used. The server will then compare the client response with a computed correct response, and accept the user accordingly.

Currently only the authentication quality of service is implemented. In other words, payload integrity or privacy protection are not supported. Consequently, there are no properties for the maximum buffer size, quality of protection, and cipher fields.

5.7 The NTLM mechanism

The NTLM is a non-standard mechanism. Do not use it in new applications, and do not expect it to be secure. Currently only the client side is supported.

In the client, this mechanism is always enabled, and require the `GSASL_AUTHID` and `GSASL_PASSWORD` properties. It will set the '`domain`' field in the NTLM request to the value of `GSASL_REALM`. Some servers reportedly need non-empty but arbitrary values in that field.

5.8 The SECURID mechanism

The SECURID mechanism uses authentication and authorization identity together with a passcode from a hardware token to authenticate users.

In the client, this mechanism is always enabled, and require the GSASL_AUTHID and GSASL_PASSCODE properties. If set, GSASL_AUTHZID will also be used. If the server requests it, the GSASL_PIN property is also required, and its callback may inspect the GSASL_SUGGESTED_PIN property to discover a server-provided PIN to use.

In the server, this mechanism will invoke the GSASL_VALIDATE_SECURID callback. The callback may inspect the GSASL_AUTHID, GSASL_AUTHZID, and GSASL_PASSCODE properties. The callback can return GSASL_SECURID_SERVER_NEED_ADDITIONAL_PASSCODE to ask for another additional passcode from the client. The callback can return GSASL_SECURID_SERVER_NEED_NEW_PIN to ask for a new PIN code from the client, in which case it may also set the GSASL_SUGGESTED_PIN property to indicate a recommended new PIN. If the callbacks has invoked again, after having returned GSASL_SECURID_SERVER_NEED_NEW_PIN, it may also inspect the GSASL_PIN property, in addition to the other properties, to find out the client selected PIN code.

5.9 The GSSAPI mechanism

GSS-API is a framework, similar to SASL, for authentication. The GSSAPI mechanism only support the Kerberos 5 GSS-API mechanism, though. (A new SASL mechanism to support non-Kerberos 5 GSS-API mechanisms may be supported in the future.)

In the client, the mechanism is enabled only if the user has acquired credentials (i.e., a ticket granting ticket), and require the GSASL_AUTHID, GSASL_SERVICE, and GSASL_HOSTNAME properties.

In the server, the mechanism require the GSASL_SERVICE, and GSASL_HOSTNAME properties, and will invoke the GSASL_VALIDATE_GSSAPI callback in order to validate the user. The callback may inspect the GSASL_AUTHZID and GSASL_GSSAPI_DISPLAY_NAME properties to decide whether to authorize the user. Note that authentication is performed by the GSS-API library.

XXX: explain more about quality of service, maximum buffer size, etc.

5.10 The KERBEROS_V5 mechanism

The KERBEROS_V5 is an experimental mechanism, the protocol specification is available on the GNU SASL homepage. It can operate in three modes, non-infrastructure mode, infrastructure mode and proxied infrastructure mode. Currently only non-infrastructure mode is supported.

In the non-infrastructure mode, it works as a superset of most features provided by PLAIN, CRAM-MD5, DIGEST-MD5 and GSSAPI while at the same time building on what is believed to be proven technology (the RFC 1510 network security system). In the non-infrastructure mode, the client must specify (via callbacks) the name of the user, and optionally the server name and realm. The server must be able to retrieve passwords given the name of the user.

In the infrastructure mode (proxied or otherwise), it allows clients and servers to authenticate via SASL in an RFC 1510 environment, using a trusted third party, a "Key Distribution Central". In the normal mode, clients aquire tickets out of band and then invokes a one roundtrip AP-REQ and AP-REP exchange. In the proxied mode, which can be used by clients without IP addresses or without connectivity to the KDC (e.g., when

the KDC is IPv4 and the client is IPV6-only), the client uses the server to proxy ticket requests and finishes with the AP-REQ/AP-REP exchange. In infrastructure mode (proxied or otherwise), the client nor server need to implement any callbacks (this will likely change later, to allow a server to authorize users, similar to the GSSAPI callback).

XXX: update when implementation has matured

6 Global Functions

gsasl_init

`int gsasl_init (`*Gsasl ** `ctx`*`)` [Function]

ctx: pointer to libgsasl handle.

This functions initializes libgsasl. The handle pointed to by ctx is valid for use with other libgsasl functions iff this function is successful. It also register all builtin SASL mechanisms, using `gsasl_register()`.

Return value: GSASL_OK iff successful, otherwise GSASL_MALLOC_ERROR.

gsasl_done

`void gsasl_done (`*Gsasl * `ctx`*`)` [Function]

ctx: libgsasl handle.

This function destroys a libgsasl handle. The handle must not be used with other libgsasl functions after this call.

gsasl_client_mechlist

`int gsasl_client_mechlist (`*Gsasl * `ctx`, char ** `out`*`)` [Function]

ctx: libgsasl handle.

out: newly allocated output character array.

Return a newly allocated string containing SASL names, separated by space, of mechanisms supported by the libgsasl client. `out` is allocated by this function, and it is the responsibility of caller to deallocate it.

Return value: Returns GSASL_OK if successful, or error code.

gsasl_server_mechlist

`int gsasl_server_mechlist (`*Gsasl * `ctx`, char ** `out`*`)` [Function]

ctx: libgsasl handle.

out: newly allocated output character array.

Return a newly allocated string containing SASL names, separated by space, of mechanisms supported by the libgsasl server. `out` is allocated by this function, and it is the responsibility of caller to deallocate it.

Return value: Returns GSASL_OK if successful, or error code.

gsasl_client_support_p

`int gsasl_client_support_p (`*Gsasl * `ctx`, const char * `name`*`)` [Function]

ctx: libgsasl handle.

name: name of SASL mechanism.

Decide whether there is client-side support for a specified mechanism.

Return value: Returns 1 if the libgsasl client supports the named mechanism, otherwise 0.

gsasl_server_support_p

`int gsasl_server_support_p (Gsasl * ctx, const char * name)` [Function]

ctx: libgsasl handle.

name: name of SASL mechanism.

Decide whether there is server-side support for a specified mechanism.

Return value: Returns 1 if the libgsasl server supports the named mechanism, otherwise 0.

gsasl_client_suggest_mechanism

`const char * gsasl_client_suggest_mechanism (Gsasl * ctx, const char * mechlist)` [Function]

ctx: libgsasl handle.

mechlist: input character array with SASL mechanism names, separated by invalid characters (e.g. SPC).

Given a list of mechanisms, suggest which to use.

Return value: Returns name of "best" SASL mechanism supported by the libgsasl client which is present in the input string.

gsasl_register

`int gsasl_register (Gsasl * ctx, const Gsasl_mechanism * mech)` [Function]

ctx: pointer to libgsasl handle.

mech: plugin structure with information about plugin.

This function initialize given mechanism, and if successful, add it to the list of plugins that is used by the library.

Return value: GSASL_OK iff successful, otherwise GSASL_MALLOC_ERROR.

Since: 0.2.0

7 Callback Functions

The callback is used by mechanisms to retrieve information, such as username and password, from the application. In a server, the callback is used to decide whether a user is permitted to log in or not. You tell the library of your callback function by calling `gsasl_callback_set`.

Since your callback may need to access to data from other parts of your application, there are hooks to store and retrieve application specific pointers. This avoid the use of global variables in your application, which wouldn't be thread safe. You store a pointer to some information (opaque from the point of view of the library) by calling `gsasl_callback_hook_set` and can later retrieve this data in your callback by calling `gsasl_callback_hook_get`.

gsasl_callback_set

`void gsasl_callback_set (`*Gsasl * `ctx`, Gsasl_callback_function `cb`*`)` [Function]

ctx: handle received from `gsasl_init()`.

cb: pointer to function implemented by application.

Store the pointer to the application provided callback in the library handle. The callback will be used, via `gsasl_callback()`, by mechanisms to discover various parameters (such as username and passwords). The callback function will be called with a Gsasl_property value indicating the requested behaviour. For example, for GSASL_ANONYMOUS_TOKEN, the function is expected to invoke gsasl_property_set(CTX, GSASL_ANONYMOUS_TOKEN, "token") where "token" is the anonymous token the application wishes the SASL mechanism to use. See the manual for the meaning of all parameters.

Since: 0.2.0

gsasl_callback

`int gsasl_callback (`*Gsasl * `ctx`, Gsasl_session * `sctx`, Gsasl_property `prop`*`)` [Function]

ctx: handle received from `gsasl_init()`, may be NULL to derive it from `sctx`.

sctx: session handle.

prop: enumerated value of Gsasl_property type.

Invoke the application callback. The `prop` value indicate what the callback is expected to do. For example, for GSASL_ANONYMOUS_TOKEN, the function is expected to invoke gsasl_property_set(SCTX, GSASL_ANONYMOUS_TOKEN, "token") where "token" is the anonymous token the application wishes the SASL mechanism to use. See the manual for the meaning of all parameters.

Note that if no callback has been set by the application, but the obsolete callback interface has been used, this function will translate the old callback interface into the new. This interface should be sufficient to invoke all callbacks, both new and old.

Return value: Returns whatever the application callback return, or GSASL_NO_CALLBACK if no application was known.

Since: 0.2.0

gsasl_callback_hook_set

`void gsasl_callback_hook_set (Gsasl * ctx, void * hook)` [Function]

ctx: libgsasl handle.

hook: opaque pointer to application specific data.

Store application specific data in the libgsasl handle.

The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_callback_hook_get()`. This is normally used by the application to maintain a global state between the main program and callbacks.

Since: 0.2.0

gsasl_callback_hook_get

`void * gsasl_callback_hook_get (Gsasl * ctx)` [Function]

ctx: libgsasl handle.

Retrieve application specific data from libgsasl handle.

The application data is set using `gsasl_callback_hook_set()`. This is normally used by the application to maintain a global state between the main program and callbacks.

Return value: Returns the application specific data, or NULL.

Since: 0.2.0

gsasl_session_hook_set

`void gsasl_session_hook_set (Gsasl_session * sctx, void * hook)` [Function]

sctx: libgsasl session handle.

hook: opaque pointer to application specific data.

Store application specific data in the libgsasl session handle.

The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_session_hook_get()`. This is normally used by the application to maintain a per-session state between the main program and callbacks.

Since: 0.2.14

gsasl_session_hook_get

`void * gsasl_session_hook_get (Gsasl_session * sctx)` [Function]

sctx: libgsasl session handle.

Retrieve application specific data from libgsasl session handle.

The application data is set using `gsasl_callback_hook_set()`. This is normally used by the application to maintain a per-session state between the main program and callbacks.

Return value: Returns the application specific data, or NULL.

Since: 0.2.14

8 Property Functions

gsasl_property_set

`void gsasl_property_set (`*Gsasl_session * `sctx`, Gsasl_property `prop`, const char * `data`*`)` [Function]

sctx: session handle.

prop: enumerated value of Gsasl_property type, indicating the type of data in `data`.

data: zero terminated character string to store.

Make a copy of `data` and store it in the session handle for the indicated property `prop`.

You can immediately deallocate `data` after calling this function, without affecting the data stored in the session handle.

Since: 0.2.0

gsasl_property_set_raw

`void gsasl_property_set_raw (`*Gsasl_session * `sctx`, Gsasl_property `prop`, const char * `data`, size_t `len`*`)` [Function]

sctx: session handle.

prop: enumerated value of Gsasl_property type, indicating the type of data in `data`.

data: character string to store.

len: length of character string to store.

Make a copy of `len` sized `data` and store a zero terminated version of it in the session handle for the indicated property `prop`.

You can immediately deallocate `data` after calling this function, without affecting the data stored in the session handle.

Except for the length indicator, this function is identical to gsasl_property_set.

Since: 0.2.0

gsasl_property_fast

`const char * gsasl_property_fast (`*Gsasl_session * `sctx`, Gsasl_property `prop`*`)` [Function]

sctx: session handle.

prop: enumerated value of Gsasl_property type, indicating the type of data in `data`.

Retrieve the data stored in the session handle for given property `prop`.

The pointer is to live data, and must not be deallocated or modified in any way.

This function will not invoke the application callback.

Return value: Return property value, if known, or `NULL` if no value known.

Since: 0.2.0

gsasl_property_get

`const char * gsasl_property_get (`*Gsasl_session * `sctx`,* [Function]
Gsasl_property `prop`)

sctx: session handle.

prop: enumerated value of Gsasl_property type, indicating the type of data in `data`.

Retrieve the data stored in the session handle for given property `prop`, possibly invoking the application callback to get the value.

The pointer is to live data, and must not be deallocated or modified in any way.

This function will invoke the application callback, using `gsasl_callback()`, when a property value is not known.

If no value is known, and no callback is specified or if the callback fail to return data, and if any obsolete callback functions has been set by the application, this function will try to call these obsolete callbacks, and store the returned data as the corresponding property. This behaviour of this function will be removed when the obsolete callback interfaces are removed.

Return value: Return data for property, or NULL if no value known.

Since: 0.2.0

9 Session Functions

gsasl_client_start

`int gsasl_client_start (`*Gsasl * `ctx`, const char * `mech`, Gsasl_session ** `sctx`*`)` [Function]

ctx: libgsasl handle.

mech: name of SASL mechanism.

sctx: pointer to client handle.

This functions initiates a client SASL authentication. This function must be called before any other gsasl_client_*() function is called.

Return value: Returns GSASL_OK if successful, or error code.

gsasl_server_start

`int gsasl_server_start (`*Gsasl * `ctx`, const char * `mech`, Gsasl_session ** `sctx`*`)` [Function]

ctx: libgsasl handle.

mech: name of SASL mechanism.

sctx: pointer to server handle.

This functions initiates a server SASL authentication. This function must be called before any other gsasl_server_*() function is called.

Return value: Returns GSASL_OK if successful, or error code.

gsasl_step

`int gsasl_step (`*Gsasl_session * `sctx`, const char * `input`, size_t `input_len`, char ** `output`, size_t * `output_len`*`)` [Function]

sctx: libgsasl session handle.

input: input byte array.

input_len: size of input byte array.

output: newly allocated output byte array.

output_len: pointer to output variable with size of output byte array.

Perform one step of SASL authentication. This reads data from the other end (from `input` and `input_len`), processes it (potentially invoking callbacks to the application), and writes data to server (into newly allocated variable `output` and `output_len` that indicate the length of `output`).

The contents of the `output` buffer is unspecified if this functions returns anything other than `GSASL_OK` or `GSASL_NEEDS_MORE`. If this function return `GSASL_OK` or `GSASL_NEEDS_MORE`, however, the `output` buffer is allocated by this function, and it is the responsibility of caller to deallocate it by calling free (`output`).

Return value: Returns `GSASL_OK` if authenticated terminated successfully, `GSASL_NEEDS_MORE` if more data is needed, or error code.

gsasl_step64

`int gsasl_step64 (`*Gsasl_session * `**`sctx`*, *const char * `**`b64input`*, *char ** `**`b64output`*`)` [Function]

sctx: libgsasl client handle.

b64input: input base64 encoded byte array.

b64output: newly allocated output base64 encoded byte array.

This is a simple wrapper around `gsasl_step()` that base64 decodes the input and base64 encodes the output.

The contents of the `b64output` buffer is unspecified if this functions returns anything other than `GSASL_OK` or `GSASL_NEEDS_MORE`. If this function return `GSASL_OK` or `GSASL_NEEDS_MORE`, however, the `b64output` buffer is allocated by this function, and it is the responsibility of caller to deallocate it by calling free (`b64output`).

Return value: Returns `GSASL_OK` if authenticated terminated successfully, `GSASL_NEEDS_MORE` if more data is needed, or error code.

gsasl_finish

`void gsasl_finish (`*Gsasl_session * `**`sctx`*`)` [Function]

sctx: libgsasl session handle.

Destroy a libgsasl client or server handle. The handle must not be used with other libgsasl functions after this call.

gsasl_encode

`int gsasl_encode (`*Gsasl_session * `**`sctx`*, *const char * `**`input`*, *size_t `**`input_len`*, *char ** `**`output`*, *size_t * `**`output_len`*`)` [Function]

sctx: libgsasl session handle.

input: input byte array.

input_len: size of input byte array.

output: newly allocated output byte array.

output_len: size of output byte array.

Encode data according to negotiated SASL mechanism. This might mean that data is integrity or privacy protected.

The `output` buffer is allocated by this function, and it is the responsibility of caller to deallocate it by calling free(`output`).

Return value: Returns GSASL_OK if encoding was successful, otherwise an error code.

gsasl_decode

`int gsasl_decode (`*Gsasl_session * `**`sctx`*, *const char * `**`input`*, *size_t `**`input_len`*, *char ** `**`output`*, *size_t * `**`output_len`*`)` [Function]

sctx: libgsasl session handle.

input: input byte array.

input_len: size of input byte array.

output: newly allocated output byte array.

output_len: size of output byte array.

Decode data according to negotiated SASL mechanism. This might mean that data is integrity or privacy protected.

The `output` buffer is allocated by this function, and it is the responsibility of caller to deallocate it by calling free(`output`).

Return value: Returns GSASL_OK if encoding was successful, otherwise an error code.

10 Utilities

gsasl_saslprep

`int gsasl_saslprep` (*const char * `in`, Gsasl_saslprep_flags `flags`, char ** `out`, int * `stringpreprc`*) [Function]

in: a UTF-8 encoded string.

flags: any SASLprep flag, e.g., `GSASL_ALLOW_UNASSIGNED`.

out: on exit, contains newly allocated output string.

stringpreprc: if non-NULL, will hold precise stringprep return code.

Prepare string using SASLprep. On success, the `out` variable must be deallocated by the caller.

Return value: Returns `GSASL_OK` on success, or `GSASL_SASLPREP_ERROR` on error.

Since: 0.2.3

gsasl_base64_to

`int gsasl_base64_to` (*const char * `in`, size_t `inlen`, char ** `out`, size_t * `outlen`*) [Function]

in: input byte array

inlen: size of input byte array

out: pointer to newly allocated output byte array

outlen: pointer to size of newly allocated output byte array

Encode data as base64. The string is zero terminated, and OUTLEN holds the length excluding the terminating zero. The OUT buffer must be deallocated by the caller.

Return value: Returns `GSASL_OK` on success, or `GSASL_MALLOC_ERROR` if input was too large or memory allocation fail.

Since: 0.2.2

gsasl_base64_from

`int gsasl_base64_from` (*const char * `in`, size_t `inlen`, char ** `out`, size_t * `outlen`*) [Function]

in: input byte array

inlen: size of input byte array

out: pointer to newly allocated output byte array

outlen: pointer to size of newly allocated output byte array

Decode Base64 data. The OUT buffer must be deallocated by the caller.

Return value: Returns `GSASL_OK` on success, `GSASL_BASE64_ERROR` if input was invalid, and `GSASL_MALLOC_ERROR` on memory allocation errors.

Since: 0.2.2

gsasl_simple_getpass

`int gsasl_simple_getpass (const char * filename, const char * username, char ** key)` [Function]

filename: filename of file containing passwords.

username: username string.

key: newly allocated output character array.

Retrieve password for user from specified file. The buffer `key` contain the password if this function is successful. The caller is responsible for deallocating it.

The file should be on the UoW "MD5 Based Authentication" format, which means it is in text format with comments denoted by # first on the line, with user entries looking as "usernameTABpassword". This function removes CR and LF at the end of lines before processing. TAB, CR, and LF denote ASCII values 9, 13, and 10, respectively.

Return value: Return GSASL_OK if output buffer contains the password, GSASL_AUTHENTICATION_ERROR if the user could not be found, or other error code.

gsasl_nonce

`int gsasl_nonce (char * data, size_t datalen)` [Function]

data: output array to be filled with unpredictable random data.

datalen: size of output array.

Store unpredictable data of given size in the provided buffer.

Return value: Returns `GSASL_OK` iff successful.

gsasl_random

`int gsasl_random (char * data, size_t datalen)` [Function]

data: output array to be filled with strong random data.

datalen: size of output array.

Store cryptographically strong random data of given size in the provided buffer.

Return value: Returns `GSASL_OK` iff successful.

gsasl_md5

`int gsasl_md5 (const char * in, size_t inlen, char * out[16])` [Function]

in: input character array of data to hash.

inlen: length of input character array of data to hash.

Compute hash of data using MD5. The `out` buffer must be deallocated by the caller.

Return value: Returns `GSASL_OK` iff successful.

gsasl_hmac_md5

`int gsasl_hmac_md5` (*const char * key*, *size_t keylen*, *const char * in*, *size_t inlen*, *char * outhash*[*16*]) [Function]

key: input character array with key to use.

keylen: length of input character array with key to use.

in: input character array of data to hash.

inlen: length of input character array of data to hash.

Compute keyed checksum of data using HMAC-MD5. The `outhash` buffer must be deallocated by the caller.

Return value: Returns `GSASL_OK` iff successful.

11 Error Handling

Most functions in the GNU SASL Library are returning an error if they fail. For this reason, the application should always catch the error condition and take appropriate measures, for example by releasing the resources and passing the error up to the caller, or by displaying a descriptive message to the user and cancelling the operation.

Some error values do not indicate a system error or an error in the operation, but the result of an operation that failed properly.

11.1 Error values

Errors are returned as an `int`. Except for the OK case an application should always use the constants instead of their numeric value. Applications are encouraged to use the constants even for OK as it improves readability. Possible values are:

`GSASL_OK` This value indicates success. The value of this error is guaranteed to always be `0` so you may use it in boolean constructs.

`GSASL_NEEDS_MORE`
SASL mechanism needs more data

`GSASL_UNKNOWN_MECHANISM`
Unknown SASL mechanism

`GSASL_MECHANISM_CALLED_TOO_MANY_TIMES`
SASL mechanism called too many times

`GSASL_MALLOC_ERROR`
Memory allocation error in SASL library

`GSASL_BASE64_ERROR`
Base 64 coding error in SASL library

`GSASL_CRYPTO_ERROR`
Low-level crypto error in SASL library

`GSASL_GSSAPI_RELEASE_BUFFER_ERROR`
GSSAPI library could not deallocate memory in gss_release_buffer() in SASL library. This is a serious internal error.

`GSASL_GSSAPI_IMPORT_NAME_ERROR`
GSSAPI library could not understand a peer name in gss_import_name() in SASL library. This may be due to incorrect user supplied data.

`GSASL_GSSAPI_INIT_SEC_CONTEXT_ERROR`
GSSAPI error in client while negotiating security context in gss_init_sec_context() in SASL library. This is most likely due insufficient credentials or malicious interactions.

`GSASL_GSSAPI_ACCEPT_SEC_CONTEXT_ERROR`
GSSAPI error in server while negotiating security context in gss_init_sec_context() in SASL library. This is most likely due insufficient credentials or malicious interactions.

`GSASL_GSSAPI_UNWRAP_ERROR`
: GSSAPI error while decrypting or decoding data in gss_unwrap() in SASL library. This is most likely due to data corruption.

`GSASL_GSSAPI_WRAP_ERROR`
: GSSAPI error while encrypting or encoding data in gss_wrap() in SASL library.

`GSASL_GSSAPI_ACQUIRE_CRED_ERROR`
: GSSAPI error acquiring credentials in gss_acquire_cred() in SASL library. This is most likely due to not having the proper Kerberos key available in /etc/krb5.keytab on the server.

`GSASL_GSSAPI_DISPLAY_NAME_ERROR`
: GSSAPI error creating a display name denoting the client in gss_display_name() in SASL library. This is probably because the client supplied bad data.

`GSASL_GSSAPI_UNSUPPORTED_PROTECTION_ERROR`
: Other entity requested integrity or confidentiality protection in GSSAPI mechanism but this is currently not implemented.

`GSASL_MECHANISM_PARSE_ERROR`
: SASL mechanism could not parse input

`GSASL_AUTHENTICATION_ERROR`
: Error authenticating user

`GSASL_INTEGRITY_ERROR`
: Integrity error in application payload

`GSASL_NO_CLIENT_CODE`
: Client-side functionality not available in library (application error)

`GSASL_NO_SERVER_CODE`
: Server-side functionality not available in library (application error)

`GSASL_NO_CALLBACK`
: No callback specified by caller (application error).

`GSASL_NO_ANONYMOUS_TOKEN`
: Authentication failed because the anonymous token was not provided.

`GSASL_NO_AUTHID`
: Authentication failed because the authentication identity was not provided.

`GSASL_NO_AUTHZID`
: Authentication failed because the authorization identity was not provided.

`GSASL_NO_PASSWORD`
: Authentication failed because the password was not provided.

`GSASL_NO_PASSCODE`
: Authentication failed because the passcode was not provided.

`GSASL_NO_PIN`
: Authentication failed because the pin code was not provided.

`GSASL_NO_SERVICE`
: Authentication failed because the service name was not provided.

`GSASL_NO_HOSTNAME`
: Authentication failed because the host name was not provided.

`GSASL_SASLPREP_ERROR`
: Could not prepare internationalized (non-ASCII) string.

`GSASL_TOO_SMALL_BUFFER`
: SASL function needs larger buffer (internal error)

`GSASL_FOPEN_ERROR`
: Could not open file in SASL library

`GSASL_FCLOSE_ERROR`
: Could not close file in SASL library

`GSASL_CANNOT_GET_CTX`
: Cannot get internal library handle (library error)

`GSASL_NEED_CLIENT_ANONYMOUS_CALLBACK`
: SASL mechanism needs gsasl_client_callback_anonymous() callback (application error)

`GSASL_NEED_CLIENT_PASSWORD_CALLBACK`
: SASL mechanism needs gsasl_client_callback_password() callback (application error)

`GSASL_NEED_CLIENT_PASSCODE_CALLBACK`
: SASL mechanism needs gsasl_client_callback_passcode() callback (application error)

`GSASL_NEED_CLIENT_PIN_CALLBACK`
: SASL mechanism needs gsasl_client_callback_pin() callback (application error)

`GSASL_NEED_CLIENT_AUTHORIZATION_ID_CALLBACK`
: SASL mechanism needs gsasl_client_callback_authorization_id() callback (application error)

`GSASL_NEED_CLIENT_AUTHENTICATION_ID_CALLBACK`
: SASL mechanism needs gsasl_client_callback_authentication_id() callback (application error)

`GSASL_NEED_CLIENT_SERVICE_CALLBACK`
: SASL mechanism needs gsasl_client_callback_service() callback (application error)

`GSASL_NEED_SERVER_VALIDATE_CALLBACK`
: SASL mechanism needs gsasl_server_callback_validate() callback (application error)

`GSASL_NEED_SERVER_CRAM_MD5_CALLBACK`
: SASL mechanism needs gsasl_server_callback_cram_md5() callback (application error)

`GSASL_NEED_SERVER_DIGEST_MD5_CALLBACK`
: SASL mechanism needs gsasl_server_callback_digest_md5() callback (application error)

`GSASL_NEED_SERVER_ANONYMOUS_CALLBACK`
: SASL mechanism needs gsasl_server_callback_anonymous() callback (application error)

`GSASL_NEED_SERVER_EXTERNAL_CALLBACK`
: SASL mechanism needs gsasl_server_callback_external() callback (application error)

`GSASL_NEED_SERVER_REALM_CALLBACK`
: SASL mechanism needs gsasl_server_callback_realm() callback (application error)

`GSASL_NEED_SERVER_SECURID_CALLBACK`
: SASL mechanism needs gsasl_server_callback_securid() callback (application error)

`GSASL_NEED_SERVER_SERVICE_CALLBACK`
: SASL mechanism needs gsasl_server_callback_service() callback (application error)

`GSASL_NEED_SERVER_GSSAPI_CALLBACK`
: SASL mechanism needs gsasl_server_callback_gssapi() callback (application error)

`GSASL_NEED_SERVER_RETRIEVE_CALLBACK`
: SASL mechanism needs gsasl_server_callback_retrieve() callback (application error)

`GSASL_UNICODE_NORMALIZATION_ERROR`
: Failed to perform Unicode Normalization on string.

`GSASL_NO_MORE_REALMS`
: No more realms available (non-fatal)

`GSASL_INVALID_HANDLE`
: The provided library handle was invalid (application error)

11.2 Error strings

gsasl_strerror

`const char * gsasl_strerror (`*int* `err``)` [Function]

err: libgsasl error code

Convert return code to human readable string.

Return value: Returns a pointer to a statically allocated string containing a description of the error with the error value `err`. This string can be used to output a diagnostic message to the user.

12 Examples

This chapter contains example code which illustrate how the GNU SASL Library can be used when writing your own application.

12.1 Example 1

```
/* client.c --- Example SASL client.
 * Copyright (C) 2004, 2005  Simon Josefsson
 *
 * This file is part of GNU SASL.
 *
 * GNU SASL is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
 * GNU SASL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with GNU SASL; if not, write to the Free Software
 * Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.
 *
 */

#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <gsasl.h>

static void
client_authenticate (Gsasl * ctx, Gsasl_session * session)
{
  char buf[BUFSIZ] = "";
  char *p;
  int rc;

  /* This loop mimic a protocol where the client send data first. */

  do
    {
      /* Generate client output. */
```

```
      rc = gsasl_step64 (session, buf, &p);

      if (rc == GSASL_NEEDS_MORE || rc == GSASL_OK)
        {
          /* If sucessful, print it. */
          printf ("Output:\n%s\n", p);
          free (p);
        }

      if (rc == GSASL_NEEDS_MORE)
        {
          /* If the client need more data from server, get it here. */
          printf ("Input base64 encoded data from server:\n");
          fgets (buf, sizeof (buf) - 1, stdin);
          if (buf[strlen (buf) - 1] == '\n')
            buf[strlen (buf) - 1] = '\0';
        }
    }
  while (rc == GSASL_NEEDS_MORE);

  printf ("\n");

  if (rc != GSASL_OK)
    {
      printf ("Authentication error (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* The client is done.  Here you would typically check if the server
     let the client in.  If not, you could try again. */

  printf ("If server accepted us, we're done.\n");
}

static void
client (Gsasl * ctx)
{
  Gsasl_session *session;
  const char *mech = "PLAIN";
  int rc;

  /* Create new authentication session. */
  if ((rc = gsasl_client_start (ctx, mech, &session)) != GSASL_OK)
    {
      printf ("Cannot initialize client (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }
```

```
  /* Set username and password in session handle.  This info will be
     lost when this session is deallocated below.  */
  gsasl_property_set (session, GSASL_AUTHID, "jas");
  gsasl_property_set (session, GSASL_PASSWORD, "secret");

  /* Do it. */
  client_authenticate (ctx, session);

  /* Cleanup. */
  gsasl_finish (session);
}

int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;

  /* Initialize library. */
  if ((rc = gsasl_init (&ctx)) != GSASL_OK)
    {
      printf ("Cannot initialize libgsasl (%d): %s", rc, gsasl_strerror (rc));
      return 1;
    }

  /* Do it. */
  client (ctx);

  /* Cleanup. */
  gsasl_done (ctx);

  return 0;
}
```

12.2 Example 2

```
/* client-serverfirst.c --- Example SASL client, where server send data first.
 * Copyright (C) 2004, 2005  Simon Josefsson
 *
 * This file is part of GNU SASL.
 *
 * GNU SASL is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
```

```
 * GNU SASL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with GNU SASL; if not, write to the Free Software
 * Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.
 *
 */

#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <gsasl.h>

static void
client_authenticate (Gsasl * ctx, Gsasl_session * session)
{
  char buf[BUFSIZ] = "";
  char *p;
  int rc;

  /* This loop mimic a protocol where the server get to send data first. */

  do
    {
      printf ("Input base64 encoded data from server:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      if (buf[strlen (buf) - 1] == '\n')
        buf[strlen (buf) - 1] = '\0';

      rc = gsasl_step64 (session, buf, &p);

      if (rc == GSASL_NEEDS_MORE || rc == GSASL_OK)
        {
          printf ("Output:\n%s\n", p);
          free (p);
        }
    }
  while (rc == GSASL_NEEDS_MORE);

  printf ("\n");

  if (rc != GSASL_OK)
```

```
    {
      printf ("Authentication error (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* The client is done.  Here you would typically check if the server
     let the client in.  If not, you could try again. */

  printf ("If server accepted us, we're done.\n");
}

static void
client (Gsasl * ctx)
{
  Gsasl_session *session;
  const char *mech = "CRAM-MD5";
  int rc;

  /* Create new authentication session. */
  if ((rc = gsasl_client_start (ctx, mech, &session)) != GSASL_OK)
    {
      printf ("Cannot initialize client (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* Set username and password in session handle.  This info will be
     lost when this session is deallocated below.  */
  gsasl_property_set (session, GSASL_AUTHID, "jas");
  gsasl_property_set (session, GSASL_PASSWORD, "secret");

  /* Do it. */
  client_authenticate (ctx, session);

  /* Cleanup. */
  gsasl_finish (session);
}

int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;

  /* Initialize library. */
  if ((rc = gsasl_init (&ctx)) != GSASL_OK)
    {
      printf ("Cannot initialize libgsasl (%d): %s", rc, gsasl_strerror (rc));
```

```
      return 1;
    }

  /* Do it. */
  client (ctx);

  /* Cleanup. */
  gsasl_done (ctx);

  return 0;
}
```

12.3 Example 3

```
/* client-mech.c --- Example SASL client, with a choice of mechanism to use.
 * Copyright (C) 2004, 2005  Simon Josefsson
 *
 * This file is part of GNU SASL.
 *
 * GNU SASL is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
 * GNU SASL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with GNU SASL; if not, write to the Free Software
 * Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.
 *
 */

#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <gsasl.h>

static void
client_authenticate (Gsasl * ctx, Gsasl_session * session)
{
  char buf[BUFSIZ] = "";
  char *p;
```

```
  int rc;

  /* This loop mimic a protocol where the server get to send data first. */

  do
    {
      printf ("Input base64 encoded data from server:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      if (buf[strlen (buf) - 1] == '\n')
        buf[strlen (buf) - 1] = '\0';

      rc = gsasl_step64 (session, buf, &p);

      if (rc == GSASL_NEEDS_MORE || rc == GSASL_OK)
        {
          printf ("Output:\n%s\n", p);
          free (p);
        }
    }
  while (rc == GSASL_NEEDS_MORE);

  printf ("\n");

  if (rc != GSASL_OK)
    {
      printf ("Authentication error (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* The client is done.  Here you would typically check if the server
     let the client in.  If not, you could try again. */

  printf ("If server accepted us, we're done.\n");
}

static const char *
client_mechanism (Gsasl * ctx)
{
  static char mech[GSASL_MAX_MECHANISM_SIZE + 1] = "";
  char mechlist[BUFSIZ] = "";
  const char *suggestion;

  printf ("Enter list of mechanism that server support, separate by SPC:\n");
  fgets (mechlist, sizeof (mechlist) - 1, stdin);

  suggestion = gsasl_client_suggest_mechanism (ctx, mechlist);
  if (suggestion)
```

```
      printf ("Library suggest use of `%s'.\n", suggestion);

  printf ("Enter mechanism to use:\n");
  fgets (mech, sizeof (mech) - 1, stdin);
  mech[strlen (mech) - 1] = '\0';

  return mech;
}

static void
client (Gsasl * ctx)
{
  Gsasl_session *session;
  const char *mech;
  int rc;

  /* Find out which mechanism to use. */
  mech = client_mechanism (ctx);

  /* Create new authentication session. */
  if ((rc = gsasl_client_start (ctx, mech, &session)) != GSASL_OK)
    {
      printf ("Cannot initialize client (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* Set username and password in session handle.  This info will be
     lost when this session is deallocated below.  */
  gsasl_property_set (session, GSASL_AUTHID, "jas");
  gsasl_property_set (session, GSASL_PASSWORD, "secret");

  /* Do it. */
  client_authenticate (ctx, session);

  /* Cleanup. */
  gsasl_finish (session);
}

int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;

  /* Initialize library. */
  if ((rc = gsasl_init (&ctx)) != GSASL_OK)
    {
```

```
      printf ("Cannot initialize libgsasl (%d): %s", rc, gsasl_strerror (rc));
      return 1;
    }

  /* Do it. */
  client (ctx);

  /* Cleanup. */
  gsasl_done (ctx);

  return 0;
}
```

12.4 Example 4

```
/* client-callback.c --- Example SASL client, with callback for user info.
 * Copyright (C) 2004, 2005  Simon Josefsson
 *
 * This file is part of GNU SASL.
 *
 * GNU SASL is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
 * GNU SASL is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with GNU SASL; if not, write to the Free Software
 * Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.
 *
 */

#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <gsasl.h>

static void
client_authenticate (Gsasl * ctx, Gsasl_session * session)
{
  char buf[BUFSIZ] = "";
```

```
  char *p;
  int rc;

  /* This loop mimic a protocol where the server get to send data first. */

  do
    {
      printf ("Input base64 encoded data from server:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      if (buf[strlen (buf) - 1] == '\n')
        buf[strlen (buf) - 1] = '\0';

      rc = gsasl_step64 (session, buf, &p);

      if (rc == GSASL_NEEDS_MORE || rc == GSASL_OK)
        {
          printf ("Output:\n%s\n", p);
          free (p);
        }
    }
  while (rc == GSASL_NEEDS_MORE);

  printf ("\n");

  if (rc != GSASL_OK)
    {
      printf ("Authentication error (%d): %s\n", rc, gsasl_strerror (rc));
      return;
    }

  /* The client is done.  Here you would typically check if the server
     let the client in.  If not, you could try again. */

  printf ("If server accepted us, we're done.\n");
}

static void
client (Gsasl * ctx)
{
  Gsasl_session *session;
  const char *mech = "SECURID";
  int rc;

  /* Create new authentication session. */
  if ((rc = gsasl_client_start (ctx, mech, &session)) != GSASL_OK)
    {
      printf ("Cannot initialize client (%d): %s\n", rc, gsasl_strerror (rc));
```

```
      return;
    }

  /* Do it. */
  client_authenticate (ctx, session);

  /* Cleanup. */
  gsasl_finish (session);
}

static int
callback (Gsasl * ctx, Gsasl_session * sctx, Gsasl_property prop)
{
  char buf[BUFSIZ] = "";
  int rc = GSASL_NO_CALLBACK;

  /* Get user info from user. */

  printf ("Callback invoked, for property %d.\n", prop);

  switch (prop)
    {
    case GSASL_PASSCODE:
      printf ("Enter passcode:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      buf[strlen (buf) - 1] = '\0';

      gsasl_property_set (sctx, GSASL_PASSCODE, buf);
      rc = GSASL_OK;
      break;

    case GSASL_AUTHID:
      printf ("Enter username:\n");
      fgets (buf, sizeof (buf) - 1, stdin);
      buf[strlen (buf) - 1] = '\0';

      gsasl_property_set (sctx, GSASL_AUTHID, buf);
      rc = GSASL_OK;
      break;

    default:
      printf ("Unknown property!  Don't worry.\n");
      break;
    }

  return rc;
}
```

```
int
main (int argc, char *argv[])
{
  Gsasl *ctx = NULL;
  int rc;

  /* Initialize library. */
  if ((rc = gsasl_init (&ctx)) != GSASL_OK)
    {
      printf ("Cannot initialize libgsasl (%d): %s", rc, gsasl_strerror (rc));
      return 1;
    }

  /* Set the callback handler for the library. */
  gsasl_callback_set (ctx, callback);

  /* Do it. */
  client (ctx);

  /* Cleanup. */
  gsasl_done (ctx);

  return 0;
}
```

13 Acknowledgements

The makefiles, manuals, etc borrowed much from Libgcrypt written by Werner Koch.

Cryptographic functions for some SASL mechanisms uses Libgcrypt by Werner Koch et al. The NTLM mechanism uses Libntlm by Grant Edwards et al, using code from Samba written by Andrew Tridgell, and now maintained by Simon Josefsson. The KERBEROS_V5 mechanism uses Shishi by Simon Josefsson. The GSSAPI mechanism uses a GSS-API implementation, such as GSSLib by Simon Josefsson.

Gnulib is used to simplify portability.

This manual borrows text from the SASL specification.

14 Invoking gsasl

Name

GNU SASL (gsasl) – Command line interface to libgsasl.

Description

`gsasl` is the main program of GNU SASL.

This section only lists the commands and options available.

Mandatory or optional arguments to long options are also mandatory or optional for any corresponding short options.

Commands

`gsasl` recognizes these commands:

```
-c, --client               Act as client (the default).
    --client-mechanisms    Write name of supported client mechanisms
                           separated by space to stdout.
-s, --server               Act as server.
    --server-mechanisms    Write name of supported server mechanisms
                           separated by space to stdout.
```

Network Options

Normally the SASL negotiation is performed on the terminal, with reading from stdin and writing to stdout. It is also possible to perform the negotiation with a server over a TCP network connection.

```
--connect=HOSTNAME[:SERVICE]
                           Connect to TCP server and negotiate on stream
                           instead of stdin/stdout. SERVICE is the protocol
                           service, or an integer denoting the port, and
                           defaults to 143 (imap) if not specified. Also sets
                           the --hostname default.
```

Miscellaneous Options:

These parameters affect overall behaviour.

```
-d, --application-data     After authentication, read data from stdin and run
                           it through the mechanism's security layer and
                           print it base64 encoded to stdout. The default is
                           to terminate after authentication.
    --imap                 Use a IMAP-like logon procedure (client only).
                           Also sets the --service default to "imap".
-m, --mechanism=STRING     Mechanism to use.
    --no-client-first      Disallow client to send data first (client only).
```

SASL Mechanism Options

These options modify the behaviour of the callbacks (see Chapter 7 [Callback Functions], page 30) in the library. The default is the query the user on the terminal.

```
-n, --anonymous-token=STRING    Token for anonymous authentication, usually
                                mail address (ANONYMOUS only).
-a, --authentication-id=STRING  Identity of credential owner.
-z, --authorization-id=STRING   Identity to request service for.
    --disable-cleartext-validate
                           Disable cleartext validate hook, forcing server to
                           prompt for password.
    --enable-cram-md5-validate  Validate CRAM-MD5 challenge and response
                                interactively.
    --hostname=STRING      Set the name of the server with the requested
                           service.
-p, --password=STRING      Password for authentication (insecure for
                           non-testing purposes).
    --passcode=NUMBER      Passcode for authentication (SECURID only).
    --quality-of-protection=<auth | auth-int | auth-conf>
                           How application payload will be protected.  "auth"
                           means no protection, "auth-int" means integrity
                           protection, "auth-conf" means integrity and
                           confidentialiy protection.  Currently only used by
                           DIGEST-MD5, where the default is "auth-conf".
-r, --realm=STRING         Realm. Defaults to hostname.
    --service=STRING       Set the requested service name (should be a
                           registered GSSAPI host based service name).
    --service-name=STRING  Set the generic server name in case of a
                           replicated server (DIGEST-MD5 only).
-x, --maxbuf=NUMBER        Indicate maximum buffer size (DIGEST-MD5 only).
```

STARTTLS options

```
--starttls                Force use of STARTTLS.  The default is to use
                            STARTTLS when available.  (default=off)
--no-starttls             Unconditionally disable STARTTLS.
                            (default=off)
--x509-ca-file=FILE       File containing one or more X.509 Certificate
                            Authorities certificates in PEM format, used
                            to verify the certificate received from the
                            server.  If not specified, no verification of
                            the remote server certificate will be done.
--x509-cert-file=FILE     File containing client X.509 certificate in PEM
                            format.  Used together with --x509-key-file
                            to specify the certificate/key pair.
--x509-key-file=FILE      Private key for the client X.509 certificate in
                            PEM format.  Used together with
                            --x509-key-file to specify the
                            certificate/key pair.
```

Other Options

These are some standard parameters.

```
-q, --quiet, --silent     Don't produce any diagnostic output.
-v, --verbose             Produce verbose output.

-?, --help                Give this help list
    --usage               Give a short usage message
-V, --version             Print program version
```

Appendix A Protocol Clarifications

This appendix contain clarification to various SASL specification that we felt were necessary to include, if for nothing else it may serve as a guide for other implementors that worry about the same issues.

A.1 Use of SASLprep in CRAM-MD5

The specification, as of '`draft-ietf-sasl-crammd5-04.txt`', is silent on whether a SASL server implementation applying SASLprep on a password received from an external, non-SASL specific database (i.e., the passwords are not stored in SASLprep form in the database), should set or clear the AllowUnassigned bit. The motivation for the AU-bit in StringPrep/SASLprep is for stored vs query strings. It could be argued that in this situation the server can treat the external password either as a stored string (from a database) or as a query (the server uses the string as a query into the fixed HMAC-MD5 hash).

The specification is also unclear on whether clients should set or clear the AllowUnassigned flag.

In the server, GNU SASL apply SASLprep to the password with the AllowUnassigned bit cleared.

A.2 Use of SASLprep in LOGIN

The non-standard mechanism LOGIN presumably does not support non-ASCII. We suggest that the client should send unprepared UTF-8 and that the server apply SASLprep with the AllowUnassigned bit cleared on the received username and password.

Appendix B Old Functions

As GNU SASL is still under heavy development, some API functions have been found to be less useful. Those old API functions will be supported during a transition period. Refer to the NEWS file to find out since when a function has been deprecated.

gsasl_client_listmech

`int gsasl_client_listmech (`*Gsasl * `ctx`, char * `out`, size_t * `outlen`*`)` [Function]

ctx: libgsasl handle.

out: output character array.

outlen: input maximum size of output character array, on output contains actual length of output array.

Write SASL names, separated by space, of mechanisms supported by the libgsasl client to the output array. To find out how large the output array must be, call this function with out=NULL.

Return value: Returns GSASL_OK if successful, or error code.

Deprecated: Use `gsasl_client_mechlist()` instead.

gsasl_server_listmech

`int gsasl_server_listmech (`*Gsasl * `ctx`, char * `out`, size_t * `outlen`*`)` [Function]

ctx: libgsasl handle.

out: output character array.

outlen: input maximum size of output character array, on output contains actual length of output array.

Write SASL names, separated by space, of mechanisms supported by the libgsasl server to the output array. To find out how large the output array must be, call this function with out=NULL.

Return value: Returns GSASL_OK if successful, or error code.

Deprecated: Use `gsasl_server_mechlist()` instead.

gsasl_client_step

`int gsasl_client_step (`*Gsasl_session * `sctx`, const char * `input`, size_t `input_len`, char * `output`, size_t * `output_len`*`)` [Function]

sctx: libgsasl client handle.

input: input byte array.

input_len: size of input byte array.

output: output byte array.

output_len: size of output byte array.

Perform one step of SASL authentication in client. This reads data from server (specified with input and input_len), processes it (potentially invoking callbacks to the application), and writes data to server (into variables output and output_len).

The contents of the output buffer is unspecified if this functions returns anything other than GSASL_NEEDS_MORE.

Return value: Returns GSASL_OK if authenticated terminated successfully, GSASL_NEEDS_MORE if more data is needed, or error code.

Deprecated: Use `gsasl_step()` instead.

gsasl_server_step

`int gsasl_server_step (`*Gsasl_session * **`sctx`***, *const char * **`input`***, *size_t **`input_len`***, *char * **`output`***, *size_t * **`output_len`***`)` [Function]

sctx: libgsasl server handle.

input: input byte array.

input_len: size of input byte array.

output: output byte array.

output_len: size of output byte array.

Perform one step of SASL authentication in server. This reads data from client (specified with input and input_len), processes it (potentially invoking callbacks to the application), and writes data to client (into variables output and output_len).

The contents of the output buffer is unspecified if this functions returns anything other than GSASL_NEEDS_MORE.

Return value: Returns GSASL_OK if authenticated terminated successfully, GSASL_NEEDS_MORE if more data is needed, or error code.

Deprecated: Use `gsasl_step()` instead.

gsasl_client_step_base64

`int gsasl_client_step_base64 (`*Gsasl_session * **`sctx`***, *const char * **`b64input`***, *char * **`b64output`***, *size_t **`b64output_len`***`)` [Function]

sctx: libgsasl client handle.

b64input: input base64 encoded byte array.

b64output: output base64 encoded byte array.

b64output_len: size of output base64 encoded byte array.

This is a simple wrapper around `gsasl_client_step()` that base64 decodes the input and base64 encodes the output.

Return value: See `gsasl_client_step()`.

Deprecated: Use `gsasl_step64()` instead.

gsasl_server_step_base64

`int gsasl_server_step_base64 (`*Gsasl_session * `**`sctx`**, *const char * `**`b64input`**, *char * `**`b64output`**, *size_t `**`b64output_len`**`)` [Function]

sctx: libgsasl server handle.

b64input: input base64 encoded byte array.

b64output: output base64 encoded byte array.

b64output_len: size of output base64 encoded byte array.

This is a simple wrapper around `gsasl_server_step()` that base64 decodes the input and base64 encodes the output.

Return value: See `gsasl_server_step()`.

Deprecated: Use `gsasl_step64()` instead.

gsasl_client_finish

`void gsasl_client_finish (`*Gsasl_session * `**`sctx`**`)` [Function]

sctx: libgsasl client handle.

Destroy a libgsasl client handle. The handle must not be used with other libgsasl functions after this call.

Deprecated: Use `gsasl_finish()` instead.

gsasl_server_finish

`void gsasl_server_finish (`*Gsasl_session * `**`sctx`**`)` [Function]

sctx: libgsasl server handle.

Destroy a libgsasl server handle. The handle must not be used with other libgsasl functions after this call.

Deprecated: Use `gsasl_finish()` instead.

gsasl_client_ctx_get

`Gsasl * gsasl_client_ctx_get (`*Gsasl_session * `**`sctx`**`)` [Function]

sctx: libgsasl client handle

Return value: Returns the libgsasl handle given a libgsasl client handle.

Deprecated: This function is not useful with the new 0.2.0 API.

gsasl_client_application_data_set

`void gsasl_client_application_data_set (`*Gsasl_session * `**`sctx`**, *void * `**`application_data`**`)` [Function]

sctx: libgsasl client handle.

application_data: opaque pointer to application specific data.

Store application specific data in the libgsasl client handle. The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_client_application_data_get()`. It is normally used by the application to maintain state between the main program and the callback.

Deprecated: Use `gsasl_callback_hook_set()` or `gsasl_session_hook_set()` instead.

gsasl_client_application_data_get

`void * gsasl_client_application_data_get (`*Gsasl_session * sctx*`)` [Function]

sctx: libgsasl client handle.

Retrieve application specific data from libgsasl client handle. The application data is set using `gsasl_client_application_data_set()`. It is normally used by the application to maintain state between the main program and the callback.

Return value: Returns the application specific data, or NULL.

Deprecated: Use `gsasl_callback_hook_get()` or `gsasl_session_hook_get()` instead.

gsasl_server_ctx_get

`Gsasl * gsasl_server_ctx_get (`*Gsasl_session * sctx*`)` [Function]

sctx: libgsasl server handle

Return value: Returns the libgsasl handle given a libgsasl server handle.

Deprecated: This function is not useful with the new 0.2.0 API.

gsasl_server_application_data_set

`void gsasl_server_application_data_set (`*Gsasl_session * sctx, void * application_data*`)` [Function]

sctx: libgsasl server handle.

application_data: opaque pointer to application specific data.

Store application specific data in the libgsasl server handle. The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_server_application_data_get()`. It is normally used by the application to maintain state between the main program and the callback.

Deprecated: Use `gsasl_callback_hook_set()` or `gsasl_session_hook_set()` instead.

gsasl_server_application_data_get

`void * gsasl_server_application_data_get (`*Gsasl_session * sctx*`)` [Function]

sctx: libgsasl server handle.

Retrieve application specific data from libgsasl server handle. The application data is set using `gsasl_server_application_data_set()`. It is normally used by the application to maintain state between the main program and the callback.

Return value: Returns the application specific data, or NULL.

Deprecated: Use `gsasl_callback_hook_get()` or `gsasl_session_hook_get()` instead.

gsasl_randomize

`int gsasl_randomize (`*int* **`strong`**, *char ** **`data`**, *size_t* **`datalen`**`)` [Function]

strong: 0 iff operation should not block, non-0 for very strong randomness.

data: output array to be filled with random data.

datalen: size of output array.

Store cryptographically random data of given size in the provided buffer.

Return value: Returns `GSASL_OK` iff successful.

Deprecated: Use `gsasl_random()` or `gsasl_nonce()` instead.

gsasl_ctx_get

`Gsasl * gsasl_ctx_get (`*Gsasl_session ** **`sctx`**`)` [Function]

sctx: libgsasl session handle

Return value: Returns the libgsasl handle given a libgsasl session handle.

Deprecated: This function is not useful with the new 0.2.0 API.

gsasl_encode_inline

`int gsasl_encode_inline (`*Gsasl_session ** **`sctx`**, *const char ** **`input`**, *size_t* **`input_len`**, *char ** **`output`**, *size_t ** **`output_len`**`)` [Function]

sctx: libgsasl session handle.

input: input byte array.

input_len: size of input byte array.

output: output byte array.

output_len: size of output byte array.

Encode data according to negotiated SASL mechanism. This might mean that data is integrity or privacy protected.

Return value: Returns GSASL_OK if encoding was successful, otherwise an error code.

Deprecated: Use `gsasl_encode()` instead.

Since: 0.2.0

gsasl_decode_inline

`int gsasl_decode_inline (`*Gsasl_session ** **`sctx`**, *const char ** **`input`**, *size_t* **`input_len`**, *char ** **`output`**, *size_t ** **`output_len`**`)` [Function]

sctx: libgsasl session handle.

input: input byte array.

input_len: size of input byte array.

output: output byte array.

output_len: size of output byte array.

Decode data according to negotiated SASL mechanism. This might mean that data is integrity or privacy protected.

Return value: Returns GSASL_OK if encoding was successful, otherwise an error code.

Deprecated: Use `gsasl_decode()` instead.

Since: 0.2.0

gsasl_application_data_set

`void gsasl_application_data_set (`*Gsasl * `ctx`, void * `appdata`*`)` [Function]

ctx: libgsasl handle.

appdata: opaque pointer to application specific data.

Store application specific data in the libgsasl handle. The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_application_data_get()`. It is normally used by the application to maintain state between the main program and the callback.

Deprecated: Use `gsasl_callback_hook_set()` instead.

gsasl_application_data_get

`void * gsasl_application_data_get (`*Gsasl * `ctx`*`)` [Function]

ctx: libgsasl handle.

Retrieve application specific data from libgsasl handle. The application data is set using `gsasl_application_data_set()`. It is normally used by the application to maintain state between the main program and the callback.

Return value: Returns the application specific data, or NULL.

Deprecated: Use `gsasl_callback_hook_get()` instead.

gsasl_appinfo_set

`void gsasl_appinfo_set (`*Gsasl_session * `sctx`, void * `appdata`*`)` [Function]

sctx: libgsasl session handle.

appdata: opaque pointer to application specific data.

Store application specific data in the libgsasl session handle. The application data can be later (for instance, inside a callback) be retrieved by calling `gsasl_appinfo_get()`. It is normally used by the application to maintain state between the main program and the callback.

Deprecated: Use `gsasl_callback_hook_set()` instead.

gsasl_appinfo_get

`void * gsasl_appinfo_get (`*Gsasl_session * `sctx`*`)` [Function]

sctx: libgsasl session handle.

Retrieve application specific data from libgsasl session handle. The application data is set using `gsasl_appinfo_set()`. It is normally used by the application to maintain state between the main program and the callback.

Return value: Returns the application specific data, or NULL.

Deprecated: Use `gsasl_callback_hook_get()` instead.

gsasl_server_suggest_mechanism

`const char * gsasl_server_suggest_mechanism (`*Gsasl * `ctx`*, *const char * `mechlist`*`)` [Function]

ctx: libgsasl handle.

mechlist: input character array with SASL mechanism names, separated by invalid characters (e.g. SPC).

Return value: Returns name of "best" SASL mechanism supported by the libgsasl server which is present in the input string.

Deprecated: This function was never useful, since it is the client that chose which mechanism to use.

gsasl_client_callback_authentication_id_set

`void gsasl_client_callback_authentication_id_set (`*Gsasl * `ctx`*, *Gsasl_client_callback_authentication_id `cb`*`)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the authentication identity. The function can be later retrieved using `gsasl_client_callback_authentication_id_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_authentication_id_get

`Gsasl_client_callback_authentication_id gsasl_client_callback_authentication_id_get (`*Gsasl * `ctx`*`)` [Function]

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_authentication_id_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_authorization_id_set

`void gsasl_client_callback_authorization_id_set (`*Gsasl * `ctx`*, *Gsasl_client_callback_authorization_id `cb`*`)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the authorization identity. The function can be later retrieved using `gsasl_client_callback_authorization_id_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_authorization_id_get

`Gsasl_client_callback_authorization_id` [Function]
`gsasl_client_callback_authorization_id_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_authorization_id_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_password_set

`void gsasl_client_callback_password_set (`*Gsasl * `ctx`*, [Function]
Gsasl_client_callback_password `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the password. The function can be later retrieved using `gsasl_client_callback_password_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_password_get

`Gsasl_client_callback_password` [Function]
`gsasl_client_callback_password_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_password_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_passcode_set

`void gsasl_client_callback_passcode_set (`*Gsasl * `ctx`*, [Function]
Gsasl_client_callback_passcode `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the passcode. The function can be later retrieved using `gsasl_client_callback_passcode_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_passcode_get

`Gsasl_client_callback_passcode` [Function]
`gsasl_client_callback_passcode_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_passcode_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_pin_set

`void gsasl_client_callback_pin_set (`*Gsasl * `ctx`*, [Function]
Gsasl_client_callback_pin `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to chose a new pin, possibly suggested by the server, for the SECURID mechanism. This is not normally invoked, but only when the server requests it. The function can be later retrieved using `gsasl_client_callback_pin_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_pin_get

`Gsasl_client_callback_pin gsasl_client_callback_pin_get` [Function]
`(`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_pin_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_service_set

`void gsasl_client_callback_service_set (`*Gsasl * `ctx`*, [Function]
Gsasl_client_callback_service `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the name of the service. The service buffer should be a registered GSSAPI host-based service name, hostname the name of the server. Servicename is used by DIGEST-MD5 and should be the name of generic server in case of a replicated service. The function can be later retrieved using `gsasl_client_callback_service_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_service_get

`Gsasl_client_callback_service` [Function]
`gsasl_client_callback_service_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_service_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_anonymous_set

`void gsasl_client_callback_anonymous_set (`*Gsasl * `ctx`*, [Function]
Gsasl_client_callback_anonymous `cb`*`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to set the anonymous token, which usually is the users email address. The function can be later retrieved using `gsasl_client_callback_anonymous_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_anonymous_get

`Gsasl_client_callback_anonymous` [Function]
`gsasl_client_callback_anonymous_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_anonymous_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_qop_set

`void gsasl_client_callback_qop_set (`*Gsasl * ctx*, [Function]
Gsasl_client_callback_qop cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to determine the qop to use after looking at what the server offered. The function can be later retrieved using `gsasl_client_callback_qop_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_qop_get

`Gsasl_client_callback_qop gsasl_client_callback_qop_get` [Function]
`(`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_qop_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_maxbuf_set

`void gsasl_client_callback_maxbuf_set (`*Gsasl * ctx*, [Function]
Gsasl_client_callback_maxbuf cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to inform the server of the largest buffer the client is able to receive when using the DIGEST-MD5 "auth-int" or "auth-conf" Quality of Protection (qop). If this directive is missing, the default value 65536 will be assumed. The function can be later retrieved using `gsasl_client_callback_maxbuf_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_maxbuf_get

`Gsasl_client_callback_maxbuf` [Function]
`gsasl_client_callback_maxbuf_get (`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_maxbuf_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_realm_set

`void gsasl_client_callback_realm_set (`*Gsasl * ctx*, [Function]
Gsasl_client_callback_realm cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the client to know which realm it belongs to. The realm is used by the server to determine which username and password to use. The function can be later retrieved using `gsasl_client_callback_realm_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_client_callback_realm_get

`Gsasl_client_callback_realm` [Function]
`gsasl_client_callback_realm_get (`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_client_callback_realm_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_validate_set

`void gsasl_server_callback_validate_set (`*Gsasl * ctx*, [Function]
Gsasl_server_callback_validate cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for deciding if user is authenticated using authentication identity, authorization identity and password. The function can be later retrieved using `gsasl_server_callback_validate_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_validate_get

`Gsasl_server_callback_validate` [Function]
`gsasl_server_callback_validate_get (`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_validate_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_retrieve_set

`void gsasl_server_callback_retrieve_set (`*Gsasl * `ctx`*, *Gsasl_server_callback_retrieve `cb`*`)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for deciding if user is authenticated using authentication identity, authorization identity and password. The function can be later retrieved using `gsasl_server_callback_retrieve_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_retrieve_get

`Gsasl_server_callback_retrieve gsasl_server_callback_retrieve_get (`*Gsasl * `ctx`*`)` [Function]

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_retrieve_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_cram_md5_set

`void gsasl_server_callback_cram_md5_set (`*Gsasl * `ctx`*, *Gsasl_server_callback_cram_md5 `cb`*`)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for deciding if user is authenticated using CRAM-MD5 challenge and response. The function can be later retrieved using `gsasl_server_callback_cram_md5_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_cram_md5_get

`Gsasl_server_callback_cram_md5` [Function]
`gsasl_server_callback_cram_md5_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_cram_md5_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_digest_md5_set

`void gsasl_server_callback_digest_md5_set (`*Gsasl * `ctx`*, [Function]
Gsasl_server_callback_digest_md5 `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for retrieving the secret hash of the username, realm and password for use in the DIGEST-MD5 mechanism. The function can be later retrieved using `gsasl_server_callback_digest_md5_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_digest_md5_get

`Gsasl_server_callback_digest_md5` [Function]
`gsasl_server_callback_digest_md5_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Return the callback earlier set by calling `gsasl_server_callback_digest_md5_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_external_set

`void gsasl_server_callback_external_set (`*Gsasl * `ctx`*, [Function]
Gsasl_server_callback_external `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for deciding if user is authenticated out of band. The function can be later retrieved using `gsasl_server_callback_external_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_external_get

`Gsasl_server_callback_external` [Function]
`gsasl_server_callback_external_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_external_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_anonymous_set

`void gsasl_server_callback_anonymous_set (`*Gsasl * `ctx`*, [Function]
Gsasl_server_callback_anonymous `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for deciding if user is permitted anonymous access. The function can be later retrieved using `gsasl_server_callback_anonymous_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_anonymous_get

`Gsasl_server_callback_anonymous` [Function]
`gsasl_server_callback_anonymous_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_anonymous_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_realm_set

`void gsasl_server_callback_realm_set (`*Gsasl * `ctx`*, [Function]
Gsasl_server_callback_realm `cb``)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server to know which realm it serves. The realm is used by the user to determine which username and password to use. The function can be later retrieved using `gsasl_server_callback_realm_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_realm_get

`Gsasl_server_callback_realm gsasl_server_callback_realm_get (Gsasl * ctx)` [Function]

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_realm_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_qop_set

`void gsasl_server_callback_qop_set (Gsasl * ctx, Gsasl_server_callback_qop cb)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server to know which quality of protection it accepts. The quality of protection eventually used is selected by the client though. It is currently used by the DIGEST-MD5 mechanism. The function can be later retrieved using `gsasl_server_callback_qop_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_qop_get

`Gsasl_server_callback_qop gsasl_server_callback_qop_get (Gsasl * ctx)` [Function]

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_qop_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_maxbuf_set

`void gsasl_server_callback_maxbuf_set (Gsasl * ctx, Gsasl_server_callback_maxbuf cb)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server to inform the client of the largest buffer the server is able to receive when using the DIGEST-MD5 "auth-int" or "auth-conf" Quality of Protection (qop). If this directive is missing, the default value 65536 will be assumed. The function can be later retrieved using `gsasl_server_callback_maxbuf_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_maxbuf_get

`Gsasl_server_callback_maxbuf` [Function]
`gsasl_server_callback_maxbuf_get (`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_maxbuf_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_cipher_set

`void gsasl_server_callback_cipher_set (`*Gsasl * ctx*, [Function]
Gsasl_server_callback_cipher cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server to inform the client of the cipher suites supported. The DES and 3DES ciphers must be supported for interoperability. It is currently used by the DIGEST-MD5 mechanism. The function can be later retrieved using `gsasl_server_callback_cipher_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_cipher_get

`Gsasl_server_callback_cipher` [Function]
`gsasl_server_callback_cipher_get (`*Gsasl * ctx*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_cipher_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_securid_set

`void gsasl_server_callback_securid_set (`*Gsasl * ctx*, [Function]
Gsasl_server_callback_securid cb`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for validating a user via the SECURID mechanism. The function should return GSASL_OK if user authenticated successfully, GSASL_SECURID_SERVER_NEED_ADDITIONAL_PASSCODE if it wants another passcode, GSASL_SECURID_SERVER_NEED_NEW_PIN if it wants a PIN change, or an error. When (and only when) GSASL_SECURID_SERVER_NEED_NEW_PIN is returned, suggestpin can be populated with a PIN code the server suggests, and suggestpinlen set to the length of the PIN. The function can be later retrieved using `gsasl_server_callback_securid_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_securid_get

`Gsasl_server_callback_securid` [Function]
`gsasl_server_callback_securid_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_securid_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_gssapi_set

`void gsasl_server_callback_gssapi_set (`*Gsasl * `ctx`*, [Function]
Gsasl_server_callback_gssapi `cb`*`)`

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server for checking if a GSSAPI user is authorized for username (by, e.g., calling `krb5_userok()`). The function should return GSASL_OK if the user should be permitted access, or an error code such as GSASL_AUTHENTICATION_ERROR on failure. The function can be later retrieved using `gsasl_server_callback_gssapi_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_gssapi_get

`Gsasl_server_callback_gssapi` [Function]
`gsasl_server_callback_gssapi_get (`*Gsasl * `ctx`*`)`

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_gssapi_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_service_set

`void gsasl_server_callback_service_set (`*Gsasl * `ctx`*, *Gsasl_server_callback_service `cb`*`)` [Function]

ctx: libgsasl handle.

cb: callback function

Specify the callback function to use in the server to set the name of the service. The service buffer should be a registered GSSAPI host-based service name, hostname the name of the server. The function can be later retrieved using `gsasl_server_callback_service_get()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_server_callback_service_get

`Gsasl_server_callback_service gsasl_server_callback_service_get (`*Gsasl * `ctx`*`)` [Function]

ctx: libgsasl handle.

Return value: Returns the callback earlier set by calling `gsasl_server_callback_service_set()`.

Deprecated: This function is part of the old callback interface. The new interface uses `gsasl_callback_set()` to set the application callback, and uses `gsasl_callback()` or `gsasl_property_get()` to invoke the callback for certain properties.

gsasl_stringprep_nfkc

`char * gsasl_stringprep_nfkc (`*const char * `in`*, *ssize_t `len`*`)` [Function]

in: a UTF-8 encoded string.

len: length of `str`, in bytes, or -1 if `str` is nul-terminated.

Converts a string into canonical form, standardizing such issues as whether a character with an accent is represented as a base character and combining accent or as a single precomposed character.

The normalization mode is NFKC (ALL COMPOSE). It standardizes differences that do not affect the text content, such as the above-mentioned accent representation. It standardizes the "compatibility" characters in Unicode, such as SUPERSCRIPT THREE to the standard forms (in this case DIGIT THREE). Formatting information may be lost but for most text operations such characters should be considered the same. It returns a result with composed forms rather than a maximally decomposed form.

Return value: Return a newly allocated string, that is the NFKC normalized form of `str`, o `NULL` on error.

Deprecated: No replacement functionality in GNU SASL, use GNU Libidn instead. Note that in SASL, you most likely want to use SASLprep and not bare NFKC, see `gsasl_saslprep()`.

gsasl_stringprep_saslprep

`char * gsasl_stringprep_saslprep (const char * in, int * stringprep_rc)` [Function]

in: input ASCII or UTF-8 string with data to prepare according to SASLprep.

stringprep_rc: pointer to output variable with stringprep error code, or `NULL` to indicate that you don't care about it.

Process a Unicode string for comparison, according to the "SASLprep" stringprep profile. This function is intended to be used by Simple Authentication and Security Layer (SASL) mechanisms (such as PLAIN, CRAM-MD5, and DIGEST-MD5) as well as other protocols exchanging user names and/or passwords.

Return value: Return a newly allocated string that is the "SASLprep" processed form of the input string, or `NULL` on error, in which case `stringprep_rc` contain the stringprep library error code.

Deprecated: Use `gsasl_saslprep()` instead.

gsasl_stringprep_trace

`char * gsasl_stringprep_trace (const char * in, int * stringprep_rc)` [Function]

in: input ASCII or UTF-8 string with data to prepare according to "trace".

stringprep_rc: pointer to output variable with stringprep error code, or `NULL` to indicate that you don't care about it.

Process a Unicode string for use as trace information, according to the "trace" stringprep profile. The profile is designed for use with the SASL ANONYMOUS Mechanism.

Return value: Return a newly allocated string that is the "trace" processed form of the input string, or `NULL` on error, in which case `stringprep_rc` contain the stringprep library error code.

Deprecated: No replacement functionality in GNU SASL, use GNU Libidn instead.

gsasl_md5pwd_get_password

`int gsasl_md5pwd_get_password (const char * filename, const char * username, char * key, size_t * keylen)` [Function]

filename: filename of file containing passwords.

username: username string.

key: output character array.

keylen: input maximum size of output character array, on output contains actual length of output array.

Retrieve password for user from specified file. To find out how large the output array must be, call this function with out=NULL.

The file should be on the UoW "MD5 Based Authentication" format, which means it is in text format with comments denoted by # first on the line, with user entries looking as "usernameTABpassword". This function removes CR and LF at the end of lines before processing. TAB, CR, and LF denote ASCII values 9, 13, and 10, respectively.

Return value: Return GSASL_OK if output buffer contains the password, GSASL_AUTHENTICATION_ERROR if the user could not be found, or other error code.

Deprecated: Use `gsasl_simple_getpass()` instead.

gsasl_base64_encode

`int gsasl_base64_encode (`*char const * **src**, size_t **srclength**, char * **target**, size_t **targsize***`)` [Function]

src: input byte array

srclength: size of input byte array

target: output byte array

targsize: size of output byte array

Encode data as base64. Converts characters, three at a time, starting at src into four base64 characters in the target area until the entire input buffer is encoded.

Return value: Returns the number of data bytes stored at the target, or -1 on error.

Deprecated: Use `gsasl_base64_to()` instead.

gsasl_base64_decode

`int gsasl_base64_decode (`*char const * **src**, char * **target**, size_t **targsize***`)` [Function]

src: input byte array

target: output byte array

targsize: size of output byte array

Decode Base64 data. Skips all whitespace anywhere. Converts characters, four at a time, starting at (or after) src from Base64 numbers into three 8 bit bytes in the target area.

Return value: Returns the number of data bytes stored at the target, or -1 on error.

Deprecated: Use `gsasl_base64_from()` instead.

B.1 Obsolete callback function prototypes

`int (*Gsasl_client_callback_anonymous) (`*Gsasl_session_ctx * **ctx**, char * **out**, size_t * **outlen***`)` [Prototype]

ctx: libgsasl handle.

out: output array with client token.

outlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should populate the output array with some input from the user and set the output array length, and return `GSASL_OK`, or fail with an error code.

If OUT is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_server_callback_anonymous)` (*Gsasl_session_ctx * `ctx`, const char * `token`) [Prototype]

ctx: libgsasl handle.

ctx: output array with client token.

ctx: on input the maximum size of the output array, on output contains the actual size of the output array. If OUT is

Type of callback function the application implements. It should return `GSASL_OK` if user should be permitted anonymous access, otherwise `GSASL_AUTHENTICATION_ERROR`.

`int (*Gsasl_client_callback_authentication_id)` (*Gsasl_session_ctx * `ctx`, char * `out`, size_t * `outlen`) [Prototype]

ctx: libgsasl handle.

out: output array with authentication identity.

outlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should populate the output array with authentiction identity of user and set the output array length, and return `GSASL_OK`, or fail with an error code. The authentication identity must be encoded in UTF-8, but need not be normalized in any way.

If OUT is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_client_callback_authorization_id)` (*Gsasl_session_ctx * `ctx`, char * `out`, size_t * `outlen`) [Prototype]

ctx: libgsasl handle.

out: output array with authorization identity.

outlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should populate the output array with authorization identity of user and set the output array length, and return `GSASL_OK`, or fail with an error code. The authorization identity must be encoded in UTF-8, but need not be normalized in any way.

If OUT is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_client_callback_service)` (*Gsasl_session_ctx* * **`ctx`**, *char* * **`service`**, *size_t* * **`servicelen`**, *char* * **`hostname`**, *size_t* * **`hostnamelen`**, *char* * **`servicename`**, *size_t* * **`servicenamelen`**) [Prototype]

ctx: libgsasl handle.

service: output array with name of service.

servicelen: on input the maximum size of the service output array, on output contains the actual size of the service output array.

hostname: output array with hostname of server.

hostnamelen: on input the maximum size of the hostname output array, on output contains the actual size of the hostname output array.

servicename: output array with generic name of server in case of replication (DIGEST-MD5 only).

servicenamelen: on input the maximum size of the servicename output array, on output contains the actual size of the servicename output array.

Type of callback function the application implements. It should retrieve the service (which should be a registered GSSAPI host based service name, such as "imap") on the server, hostname of server (usually canoncial DNS hostname) and optionally generic service name of server in case of replication (e.g. "mail.example.org" when the hostname is "mx42.example.org", see the RFC 2831 for more information). It should return GSASL_OK, or an error such as GSASL_AUTHENTICATION_ERROR if it fails.

If SERVICE, HOSTNAME or SERVICENAME is NULL, the function should only populate SERVICELEN, HOSTNAMELEN or SERVICENAMELEN with the output length of the respective field, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size. Furthermore, SERVICENAMELEN may also be NULL, indicating that the mechanism is not interested in this field.

`int (*Gsasl_server_callback_cram_md5)` (*Gsasl_session_ctx* * **`ctx`**, *char* * **`username`**, *char* * **`challenge`**, *char* * **`response`**) [Prototype]

ctx: libgsasl handle.

username: input array with username.

challenge: input array with CRAM-MD5 challenge.

response: input array with CRAM-MD5 response.

Type of callback function the application implements. It should return GSASL_OK if and only if the validation of the provided credential was succesful. GSASL_AUTHENTICATION_ERROR is a good failure if authentication failed, but any available return code may be used.

`int (*Gsasl_server_callback_digest_md5)` (*Gsasl_session_ctx* * **`ctx`**, *char* * **`username`**, *char* * **`realm`**, *char* * **`secrethash`**) [Prototype]

ctx: libgsasl handle.

username: input array with authentication identity of user.

realm: input array with realm of user.

secrethash: output array that should contain hash of username, realm and password as described for the DIGEST-MD5 mechanism.

Type of callback function the application implements. It should retrieve the secret hash for the given user in given realm and return GSASL_OK, or an error such as GSASL_AUTHENTICATION_ERROR if it fails. The secrethash buffer is guaranteed to have size for the fixed length MD5 hash.

`int (*Gsasl_server_callback_external) (`*Gsasl_session_ctx* * `ctx``)` [Prototype]

ctx: libgsasl handle.

Type of callback function the application implements. It should return `GSASL_OK` if user is authenticated by out of band means, otherwise `GSASL_AUTHENTICATION_ERROR`.

`int (*Gsasl_server_callback_gssapi) (`*Gsasl_session_ctx* * `ctx`, *char* * `clientname`, *char* * `authentication_id``)` [Prototype]

ctx: libgsasl handle.

clientname: input array with GSSAPI client name.

authentication_id: input array with authentication identity.

Type of callback function the application implements. It should return GSASL_OK if and only if the GSSAPI user is authorized to log on as the given authentication_id. GSASL_AUTHENTICATION_ERROR is a good failure if authentication failed, but any available return code may be used. This callback is usually implemented in the application as a call to krb5_kuserok(), such as:

```
int
callback_gssapi (Gsasl_session_ctx *ctx,
 char *clientname,
 char *authentication_id)
{
  int rc = GSASL_AUTHENTICATION_ERROR;

  krb5_principal p;
  krb5_context kcontext;

  krb5_init_context (&kcontext);

  if (krb5_parse_name (kcontext, clientname, &p) != 0)
    return -1;
  if (krb5_kuserok (kcontext, p, authentication_id))
    rc = GSASL_OK;
  krb5_free_principal (kcontext, p);

  return rc;
}
```

`int (*Gsasl_client_callback_passcode) (`*Gsasl_session_ctx* * `ctx`, *char* * `out`, *size_t* * `outlen``)` [Prototype]

ctx: libgsasl handle.

out: output array with passcode.

outlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should populate the output array with passcode of user and set the output array length, and return `GSASL_OK`, or fail with an error code.

If OUT is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_client_callback_password) (`*Gsasl_session_ctx* * **`ctx`**, *char* * **`out`**, *size_t* * **`outlen`**`)` [Prototype]

ctx: libgsasl handle.

out: output array with password.

outlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should populate the output array with password of user and set the output array length, and return `GSASL_OK`, or fail with an error code. The password must be encoded in UTF-8, but need not be normalized in any way.

If OUT is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_server_callback_retrieve) (`*Gsasl_session_ctx* * **`ctx`**, *char* * **`authentication_id`**, *char* * **`authorization_id`**, *char* * **`realm`**, *char* * **`key`**, *size_t* * **`keylen`**`)` [Prototype]

ctx: libgsasl handle.

authentication_id: input array with authentication identity.

authorization_id: input array with authorization identity, or NULL.

realm: input array with realm of user, or NULL.

key: output array with key for authentication identity.

keylen: on input the maximum size of the key output array, on output contains the actual size of the key output array.

Type of callback function the application implements. It should retrieve the password for the indicated user and return GSASL_OK, or an error code such as GSASL_AUTHENTICATION_ERROR. The key must be encoded in UTF-8, but need not be normalized in any way.

If KEY is NULL, the function should only populate the KEYLEN output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_server_callback_validate) (`*Gsasl_session_ctx* * **`ctx`**, *char* * **`authentication_id`**, *char* * **`authorization_id`**, *char* * **`passcode`**, *char* * **`pin`**, *char* * **`suggestpin`**, *size_t* * **`suggestpinlen`**`)` [Prototype]

ctx: libgsasl handle.

authorization_id: input array with authorization identity.

authentication_id: input array with authentication identity.

passcode: input array with passcode.

pin: input array with new pin (this may be NULL).

suggestpin: output array with new suggested PIN.

suggestpinlen: on input the maximum size of the output array, on output contains the actual size of the output array.

Type of callback function the application implements. It should return GSASL_OK if and only if the validation of the provided credential was succesful. GSASL_AUTHENTICATION_ERROR is a good failure if authentication failed, but any available return code may be used.

Two SECURID specific error codes also exists. The function can return GSASL_SECURID_SERVER_NEED_ADDITIONAL_PASSCODE to request that the client generate a new passcode. It can also return GSASL_SECURID_SERVER_NEED_NEW_PIN to request that the client generate a new PIN. If the server wishes to suggest a new PIN it can populate the SUGGESTPIN field.

If SUGGESTPIN is NULL, the function should only populate the output length field with the length, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_server_callback_service) (`*Gsasl_session_ctx * `ctx`, char * `service`, size_t * `servicelen`, char * `hostname`, size_t * `hostnamelen`*`)` [Prototype]

ctx: libgsasl handle.

service: output array with name of service.

servicelen: on input the maximum size of the service output array, on output contains the actual size of the service output array.

hostname: output array with hostname of server.

hostnamelen: on input the maximum size of the hostname output array, on output contains the actual size of the hostname output array.

Type of callback function the application implements. It should retrieve the service (which should be a registered GSSAPI host based service name, such as "imap") the server provides and hostname of server (usually canoncial DNS hostname). It should return GSASL_OK, or an error such as GSASL_AUTHENTICATION_ERROR if it fails.

If SERVICE or HOSTNAME is NULL, the function should only populate SERVICELEN or HOSTNAMELEN with the output length of the respective field, and return GSASL_OK. This usage may be used by the caller to allocate the proper buffer size.

`int (*Gsasl_server_callback_validate) (`*Gsasl_session_ctx * `ctx`, char * `authorization_id`, char * `authentication_id`, char * `password`*`)` [Prototype]

ctx: libgsasl handle.

authorization_id: input array with authorization identity.

authentication_id: input array with authentication identity.

password: input array with password.

Type of callback function the application implements. It should return GSASL_OK if and only if the validation of the provided credential was succesful. GSASL_AUTHENTICATION_ERROR is a good failure if authentication failed, but any available return code may be used.

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