The GNU libmicrohttpd Reference Manual

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Marco Maggi (marco.maggi-ipsu@poste.it)
Christian Grothoff (christian@grothoff.org)

This manual is for GNU libmicrohttpd (version 0.9.48, 18 December 2015), a library for embedding an HTTP(S) server into C applications.

Short Contents

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1 Introduction

All symbols defined in the public API start with `MHD_`. MHD is a small HTTP daemon library. As such, it does not have any API for logging errors (you can only enable or disable logging to stderr). Also, it may not support all of the HTTP features directly, where applicable, portions of HTTP may have to be handled by clients of the library.

The library is supposed to handle everything that it must handle (because the API would not allow clients to do this), such as basic connection management; however, detailed interpretations of headers — such as range requests — and HTTP methods are left to clients. The library does understand `HEAD` and will only send the headers of the response and not the body, even if the client supplied a body. The library also understands headers that control connection management (specifically, `Connection: close` and `Expect: 100 continue` are understood and handled automatically).

MHD understands `POST` data and is able to decode certain formats (at the moment only `application/x-www-form-urlencoded` and `multipart/form-data`) using the post processor API. The data stream of a POST is also provided directly to the main application, so unsupported encodings could still be processed, just not conveniently by MHD.

The header file defines various constants used by the HTTP protocol. This does not mean that MHD actually interprets all of these values. The provided constants are exported as a convenience for users of the library. MHD does not verify that transmitted HTTP headers are part of the standard specification; users of the library are free to define their own extensions of the HTTP standard and use those with MHD.

All functions are guaranteed to be completely reentrant and thread-safe. MHD checks for allocation failures and tries to recover gracefully (for example, by closing the connection). Additionally, clients can specify resource limits on the overall number of connections, number of connections per IP address and memory used per connection to avoid resource exhaustion.

1.1 Scope

MHD is currently used in a wide range of implementations. Examples based on reports we've received from developers include:

- Embedded HTTP server on a cortex M3 (128 KB code space)
- Large-scale multimedia server (reportedly serving at the simulator limit of 7.5 GB/s)
- Administrative console (via HTTP/HTTPS) for network appliances

1.2 Thread modes and event loops

MHD supports four basic thread modes and up to three event loop styes.

The four basic thread modes are external (MHD creates no threads, event loop is fully managed by the application), internal (MHD creates one thread for all connections), thread pool (MHD creates a thread pool which is used to process all connections) and thread-per-connection (MHD creates one listen thread and then one thread per accepted connection).

These thread modes are then combined with the event loop styles. MHD support select, poll and epoll. epoll is only available on Linux, poll may not be available on some platforms.

Note that it is possible to combine MHD using epoll with an external select-based event loop.

The default (if no other option is passed) is "external select". The highest performance can typically be obtained with a thread pool using `epoll`. Apache Benchmark (ab) was used to compare the performance of `select` and `epoll` when using a thread pool and a large number of connections. Figure 1.1 shows the resulting plot from the `benchmark.c` example, which measures the latency between an incoming request and the completion of the transmission of the response. In this setting, the `epoll` thread pool with four threads was able to handle more than 45,000 connections per second on loopback (with Apache Benchmark running three processes on the same machine).

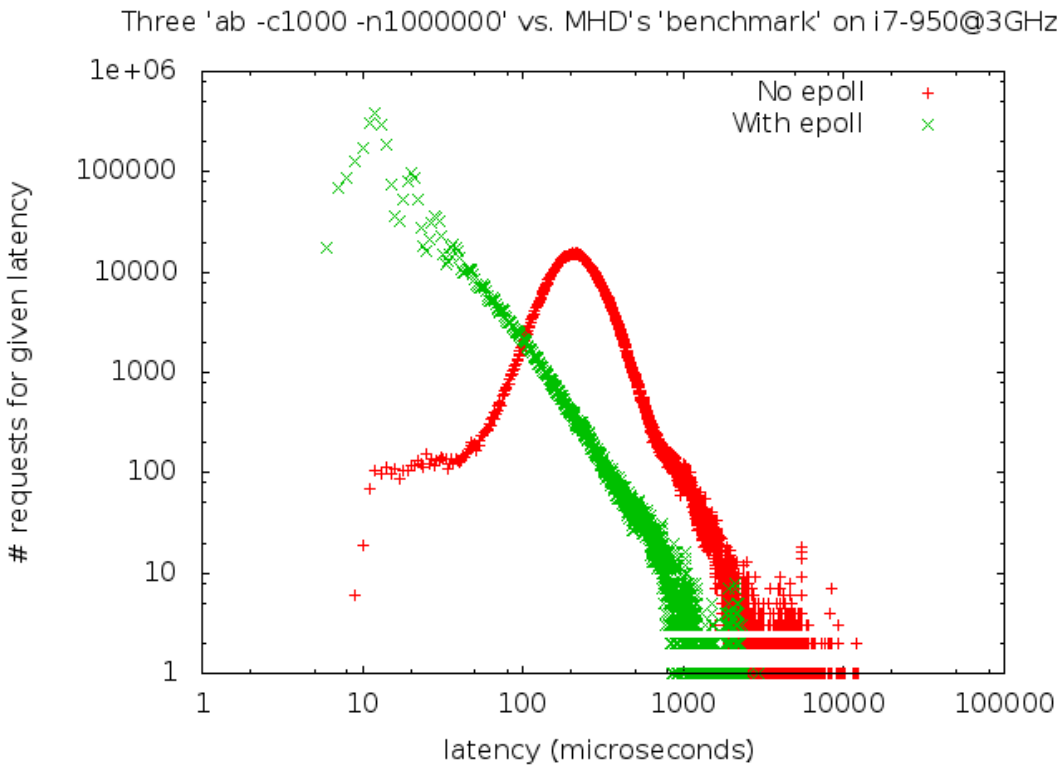

Figure 1.1: Performance measurements for select vs. epoll (with thread-pool).

Not all combinations of thread modes and event loop styles are supported. This is partially to keep the API simple, and partially because some combinations simply make no sense as others are strictly superior. Note that the choice of style depends first of all on the application logic, and then on the performance requirements. Applications that perform a blocking operation while handling a request within the callbacks from MHD must use a thread per connection. This is typically rather costly. Applications that do not support threads or that must run on embedded devices without thread-support must use the external mode. Using `epoll` is only supported on Linux, thus portable applications must at least have a fallback option available. Table 1.1 lists the sane combinations.

	select	**poll**	**epoll**
external	yes	no	yes
internal	yes	yes	yes
thread pool	yes	yes	yes
thread-per-connection	yes	yes	no

Table 1.1: Supported combinations of event styles and thread modes.

1.3 Compiling GNU libmicrohttpd

MHD uses the standard GNU system where the usual build process involves running

```
$ ./configure
$ make
$ make install
```

MHD supports various options to be given to configure to tailor the binary to a specific situation. Note that some of these options will remove portions of the MHD code that are required for binary-compatibility. They should only be used on embedded systems with tight resource constraints and no concerns about library versioning. Standard distributions including MHD are expected to always ship with all features enabled, otherwise unexpected incompatibilities can arise!

Here is a list of MHD-specific options that can be given to configure (canonical configure options such as "–prefix" are also supported, for a full list of options run "./configure –help"):

`‘‘--disable-curl’’`
: disable running testcases using libcurl

`‘‘--disable-largefile’’`
: disable support for 64-bit files

`‘‘--disable-messages’’`
: disable logging of error messages (smaller binary size, not so much fun for debugging)

`‘‘--disable-https’’`
: disable HTTPS support, even if GNUtls is found; this option must be used if eCOS license is desired as an option (in all cases the resulting binary falls under a GNU LGPL-only license)

`‘‘--disable-postprocessor’’`
: do not include the post processor API (results in binary incompatibility)

`‘‘--disable-dauth’’`
: do not include the authentication APIs (results in binary incompatibility)

`‘‘--disable-epoll`
: do not include epoll support, even on Linux (minimally smaller binary size, good for testing portability to non-Linux systems)

`‘‘--enable-coverage’’`
: set flags for analysis of code-coverage with gcc/gcov (results in slow, large binaries)

‘‘--with-gcrypt=PATH’’
: specifies path to libgcrypt installation

‘‘--with-gnutls=PATH’’
: specifies path to libgnutls installation

1.4 Validity of pointers

MHD will give applications access to its internal data structures via pointers via arguments and return values from its API. This creates the question as to how long those pointers are assured to stay valid.

Most MHD data structures are associated with the connection of an HTTP client. Thus, pointers associated with a connection are typically valid until the connection is finished, at which point MHD will call the `MHD_RequestCompletedCallback` if one is registered. Applications that have such a callback registered may assume that keys and values from the `MHD_KeyValueIterator`, return values from `MHD_lookup_connection_value` and the `url`, `method` and `version` arguments to the `MHD_AccessHandlerCallback` will remain valid until the respective `MHD_RequestCompletedCallback` is invoked.

In contrast, the `upload_data` argument of `MHD_RequestCompletedCallback` as well as all pointers from the `MHD_PostDataIterator` are only valid for the duration of the callback.

Pointers returned from `MHD_get_response_header` are valid as long as the response itself is valid.

1.5 Including the microhttpd.h header

Ideally, before including `"microhttpd.h"` you should add the necessary includes to define the `uint64_t`, `size_t`, `fd_set`, `socklen_t` and `struct sockaddr` data types. Which specific headers are needed may depend on your platform and your build system might include some tests to provide you with the necessary conditional operations. For possible suggestions consult `platform.h` and `configure.ac` in the MHD distribution.

Once you have ensured that you manually (!) included the right headers for your platform before "microhttpd.h", you should also add a line with `#define MHD_PLATFORM_H` which will prevent the "microhttpd.h" header from trying (and, depending on your platform, failing) to include the right headers.

If you do not define MHD_PLATFORM_H, the "microhttpd.h" header will automatically include headers needed on GNU/Linux systems (possibly causing problems when porting to other platforms).

1.6 SIGPIPE

MHD does not install a signal handler for SIGPIPE. On platforms where this is possible (such as GNU/Linux), it disables SIGPIPE for its I/O operations (by passing MSG_NOSIGNAL). On other platforms, SIGPIPE signals may be generated from network operations by MHD and will cause the process to die unless the developer explicitly installs a signal handler for SIGPIPE.

Hence portable code using MHD must install a SIGPIPE handler or explicitly block the SIGPIPE signal. MHD does not do so in order to avoid messing with other parts of the

application that may need to handle SIGPIPE in a particular way. You can make your application handle SIGPIPE by calling the following function in `main`:

```
static void
catcher (int sig)
{
}

static void
ignore_sigpipe ()
{
  struct sigaction oldsig;
  struct sigaction sig;

  sig.sa_handler = &catcher;
  sigemptyset (&sig.sa_mask);
#ifdef SA_INTERRUPT
  sig.sa_flags = SA_INTERRUPT;  /* SunOS */
#else
  sig.sa_flags = SA_RESTART;
#endif
  if (0 != sigaction (SIGPIPE, &sig, &oldsig))
    fprintf (stderr,
             "Failed to install SIGPIPE handler: %s\n", strerror (errno));
}
```

1.7 MHD_UNSIGNED_LONG_LONG

Some platforms do not support `long long`. Hence MHD defines a macro `MHD_UNSIGNED_LONG_LONG` which will default to `unsigned long long`. For standard desktop operating systems, this is all you need to know.

However, if your platform does not support `unsigned long long`, you should change "platform.h" to define `MHD_LONG_LONG` and `MHD_UNSIGNED_LONG_LONG` to an appropriate alternative type and also define `MHD_LONG_LONG_PRINTF` and `MHD_UNSIGNED_LONG_LONG_PRINTF` to the corresponding format string for printing such a data type. Note that the "signed" versions are deprecated. Also, for historical reasons, `MHD_LONG_LONG_PRINTF` is without the percent sign, whereas `MHD_UNSIGNED_LONG_LONG_PRINTF` is with the percent sign. Newly written code should only use the unsigned versions. However, you need to define both in "platform.h" if you need to change the definition for the specific platform.

1.8 Portability to W32

libmicrohttpd in general ported well to W32. Most libmicrohttpd features are supported. W32 do not support some functions, like epoll and corresponding MHD features are not available on W32.

1.9 Portability to z/OS

To compile MHD on z/OS, extract the archive and run

```
iconv -f UTF-8 -t IBM-1047 contrib/ascebc > /tmp/ascebc.sh
chmod +x /tmp/ascebc.sh
for n in `find * -type f`
do
  /tmp/ascebc.sh $n
done
```

to convert all source files to EBCDIC. Note that you must run `configure` from the directory where the configure script is located. Otherwise, configure will fail to find the `contrib/xcc` script (which is a wrapper around the z/OS c89 compiler).

2 Constants

`MHD_FLAG` [Enumeration]

Options for the MHD daemon.

Note that if neither `MHD_USE_THREAD_PER_CONNECTION` nor `MHD_USE_SELECT_INTERNALLY` is used, the client wants control over the process and will call the appropriate microhttpd callbacks.

Starting the daemon may also fail if a particular option is not implemented or not supported on the target platform (i.e. no support for SSL, threads or IPv6). SSL support generally depends on options given during MHD compilation. Threaded operations (including `MHD_USE_SELECT_INTERNALLY`) are not supported on Symbian.

`MHD_NO_FLAG`
: No options selected.

`MHD_USE_DEBUG`
: Run in debug mode. If this flag is used, the library should print error messages and warnings to stderr. Note that for this run-time option to have any effect, MHD needs to be compiled with messages enabled. This is done by default except you ran configure with the `--disable-messages` flag set.

`MHD_USE_SSL`
: Run in HTTPS-mode. If you specify `MHD_USE_SSL` and MHD was compiled without SSL support, `MHD_start_daemon` will return NULL.

`MHD_USE_THREAD_PER_CONNECTION`
: Run using one thread per connection.

`MHD_USE_SELECT_INTERNALLY`
: Run using an internal thread doing `SELECT`.

`MHD_USE_IPv6`
: Run using the IPv6 protocol (otherwise, MHD will just support IPv4). If you specify `MHD_USE_IPV6` and the local platform does not support it, `MHD_start_daemon` will return NULL.

  If you want MHD to support IPv4 and IPv6 using a single socket, pass MHD_USE_DUAL_STACK, otherwise, if you only pass this option, MHD will try to bind to IPv6-only (resulting in no IPv4 support).

`MHD_USE_DUAL_STACK`
: Use a single socket for IPv4 and IPv6. Note that this will mean that IPv4 addresses are returned by MHD in the IPv6-mapped format (the 'struct sockaddr_in6' format will be used for IPv4 and IPv6).

`MHD_USE_PEDANTIC_CHECKS`
: Be pedantic about the protocol (as opposed to as tolerant as possible). Specifically, at the moment, this flag causes MHD to reject HTTP 1.1 connections without a `Host` header. This is required by the standard, but of course in violation of the "be as liberal as possible in what you

accept" norm. It is recommended to turn this **ON** if you are testing clients against MHD, and **OFF** in production.

`MHD_USE_POLL`
: Use `poll()` instead of `select()`. This allows sockets with descriptors `>= FD_SETSIZE`. This option currently only works in conjunction with `MHD_USE_THREAD_PER_CONNECTION` or `MHD_USE_INTERNAL_SELECT` (at this point). If you specify `MHD_USE_POLL` and the local platform does not support it, `MHD_start_daemon` will return NULL.

`MHD_USE_EPOLL_LINUX_ONLY`
: Use `epoll()` instead of `poll()` or `select()`. This allows sockets with descriptors `>= FD_SETSIZE`. This option is only available on Linux systems and does not work in conjunction with `MHD_USE_THREAD_PER_CONNECTION` (at this point). If you specify `MHD_USE_EPOLL_LINUX_ONLY` and the local platform does not support it, `MHD_start_daemon` will return NULL. Using `epoll()` instead of `select()` or `poll()` can in some situations result in significantly higher performance as the system call has fundamentally lower complexity (O(1) for `epoll()` vs. O(n) for `select()`/`poll()` where n is the number of open connections).

`MHD_SUPPRESS_DATE_NO_CLOCK`
: Suppress (automatically) adding the 'Date:' header to HTTP responses. This option should ONLY be used on systems that do not have a clock and that DO provide other mechanisms for cache control. See also RFC 2616, section 14.18 (exception 3).

`MHD_USE_NO_LISTEN_SOCKET`
: Run the HTTP server without any listen socket. This option only makes sense if `MHD_add_connection` is going to be used exclusively to connect HTTP clients to the HTTP server. This option is incompatible with using a thread pool; if it is used, `MHD_OPTION_THREAD_POOL_SIZE` is ignored.

`MHD_USE_PIPE_FOR_SHUTDOWN`
: Force MHD to use a signal pipe to notify the event loop (of threads) of our shutdown. This is required if an appliction uses `MHD_USE_INTERNAL_SELECT` or `MHD_USE_THREAD_PER_CONNECTION` and then performs `MHD_quiesce_daemon` (which eliminates our ability to signal termination via the listen socket). In these modes, `MHD_quiesce_daemon` will fail if this option was not set. Also, use of this option is automatic (as in, you do not even have to specify it), if `MHD_USE_NO_LISTEN_SOCKET` is specified. In "external" select mode, this option is always simply ignored.

  Using this option also guarantees that MHD will not call `shutdown()` on the listen socket, which means a parent process can continue to use the socket.

`MHD_USE_SUSPEND_RESUME`
: Enables using `MHD_suspend_connection` and `MHD_resume_connection`, as performing these calls requires some additional pipes to be created, and code not using these calls should not pay the cost.

`MHD_USE_TCP_FASTOPEN`
: Enable TCP_FASTOPEN on the listen socket. TCP_FASTOPEN is currently supported on Linux >= 3.6. On other systems using this option with cause `MHD_start_daemon` to fail.

`MHD_OPTION` [Enumeration]

MHD options. Passed in the varargs portion of `MHD_start_daemon()`.

`MHD_OPTION_END`
: No more options / last option. This is used to terminate the VARARGs list.

`MHD_OPTION_CONNECTION_MEMORY_LIMIT`
: Maximum memory size per connection (followed by a `size_t`). The default is 32 kB (32*1024 bytes) as defined by the internal constant `MHD_POOL_SIZE_DEFAULT`. Values above 128k are unlikely to result in much benefit, as half of the memory will be typically used for IO, and TCP buffers are unlikely to support window sizes above 64k on most systems.

`MHD_OPTION_CONNECTION_MEMORY_INCREMENT`
: Increment to use for growing the read buffer (followed by a `size_t`). The default is 1024 (bytes). Increasing this value will make MHD use memory for reading more aggressively, which can reduce the number of `recvfrom` calls but may increase the number of `sendto` calls. The given value must fit within MHD_OPTION_CONNECTION_MEMORY_LIMIT.

`MHD_OPTION_CONNECTION_LIMIT`
: Maximum number of concurrent connections to accept (followed by an `unsigned int`). The default is `FD_SETSIZE - 4` (the maximum number of file descriptors supported by `select` minus four for `stdin`, `stdout`, `stderr` and the server socket). In other words, the default is as large as possible.

  Note that if you set a low connection limit, you can easily get into trouble with browsers doing request pipelining. For example, if your connection limit is "1", a browser may open a first connection to access your "index.html" file, keep it open but use a second connection to retrieve CSS files, images and the like. In fact, modern browsers are typically by default configured for up to 15 parallel connections to a single server. If this happens, MHD will refuse to even accept the second connection until the first connection is closed — which does not happen until timeout. As a result, the browser will fail to render the page and seem to hang. If you expect your server to operate close to the connection limit, you should first consider using a lower timeout value and also possibly add a "Connection: close" header to your response to ensure that request pipelining is not used and connections are closed immediately after the request has completed:

```
MHD_add_response_header (response,
                         MHD_HTTP_HEADER_CONNECTION,
                         "close");
```

`MHD_OPTION_CONNECTION_TIMEOUT`
: After how many seconds of inactivity should a connection automatically be timed out? (followed by an `unsigned int`; use zero for no timeout). The default is zero (no timeout).

`MHD_OPTION_NOTIFY_COMPLETED`
: Register a function that should be called whenever a request has been completed (this can be used for application-specific clean up). Requests that have never been presented to the application (via `MHD_AccessHandlerCallback()`) will not result in notifications.

  This option should be followed by **TWO** pointers. First a pointer to a function of type `MHD_RequestCompletedCallback()` and second a pointer to a closure to pass to the request completed callback. The second pointer maybe `NULL`.

`MHD_OPTION_NOTIFY_CONNECTION`
: Register a function that should be called when the TCP connection to a client is opened or closed. Note that `MHD_OPTION_NOTIFY_COMPLETED` and the `con_cls` argument to the `MHD_AccessHandlerCallback` are per HTTP request (and there can be multiple HTTP requests per TCP connection). The registered callback is called twice per TCP connection, with `MHD_CONNECTION_NOTIFY_STARTED` and `MHD_CONNECTION_NOTIFY_CLOSED` respectively. An additional argument can be used to store TCP connection specific information, which can be retrieved using `MHD_CONNECTION_INFO_SOCKET_CONTEXT` during the lifetime of the TCP connection. The respective location is not the same as the HTTP-request-specific `con_cls` from the `MHD_AccessHandlerCallback`.

  This option should be followed by **TWO** pointers. First a pointer to a function of type `MHD_NotifyConnectionCallback()` and second a pointer to a closure to pass to the request completed callback. The second pointer maybe `NULL`.

`MHD_OPTION_PER_IP_CONNECTION_LIMIT`
: Limit on the number of (concurrent) connections made to the server from the same IP address. Can be used to prevent one IP from taking over all of the allowed connections. If the same IP tries to establish more than the specified number of connections, they will be immediately rejected. The option should be followed by an `unsigned int`. The default is zero, which means no limit on the number of connections from the same IP address.

`MHD_OPTION_SOCK_ADDR`
: Bind daemon to the supplied socket address. This option should be followed by a `struct sockaddr *`. If `MHD_USE_IPv6` is specified, the `struct sockaddr*` should point to a `struct sockaddr_in6`, otherwise to a `struct sockaddr_in`. If this option is not specified, the daemon will listen to incoming connections from anywhere. If you use this option, the 'port' argument from `MHD_start_daemon` is ignored and the port from the given `struct sockaddr *` will be used instead.

`MHD_OPTION_URI_LOG_CALLBACK`

Specify a function that should be called before parsing the URI from the client. The specified callback function can be used for processing the URI (including the options) before it is parsed. The URI after parsing will no longer contain the options, which maybe inconvenient for logging. This option should be followed by two arguments, the first one must be of the form

```
void * my_logger(void * cls, const char * uri, struct MHD_Connection *
```

where the return value will be passed as `*con_cls` in calls to the `MHD_AccessHandlerCallback` when this request is processed later; returning a value of `NULL` has no special significance; (however, note that if you return non-`NULL`, you can no longer rely on the first call to the access handler having `NULL == *con_cls` on entry) `cls` will be set to the second argument following MHD_OPTION_URI_LOG_CALLBACK. Finally, `uri` will be the 0-terminated URI of the request.

Note that during the time of this call, most of the connection's state is not initialized (as we have not yet parsed he headers). However, information about the connecting client (IP, socket) is available.

`MHD_OPTION_HTTPS_MEM_KEY`

Memory pointer to the private key to be used by the HTTPS daemon. This option should be followed by an "const char*" argument. This should be used in conjunction with 'MHD_OPTION_HTTPS_MEM_CERT'.

`MHD_OPTION_HTTPS_KEY_PASSWORD`

Memory pointer to the password that decrypts the private key to be used by the HTTPS daemon. This option should be followed by an "const char*" argument. This should be used in conjunction with 'MHD_OPTION_HTTPS_MEM_KEY'.

The password (or passphrase) is only used immediately during `MHD_start_daemon()`. Thus, the application may want to erase it from memory afterwards for additional security.

`MHD_OPTION_HTTPS_MEM_CERT`

Memory pointer to the certificate to be used by the HTTPS daemon. This option should be followed by an "const char*" argument. This should be used in conjunction with 'MHD_OPTION_HTTPS_MEM_KEY'.

`MHD_OPTION_HTTPS_MEM_TRUST`

Memory pointer to the CA certificate to be used by the HTTPS daemon to authenticate and trust clients certificates. This option should be followed by an "const char*" argument. The presence of this option activates the request of certificate to the client. The request to the client is marked optional, and it is the responsibility of the server to check the presence of the certificate if needed. Note that most browsers will only present a client certificate only if they have one matching the specified CA, not sending any certificate otherwise.

`MHD_OPTION_HTTPS_CRED_TYPE`
: Daemon credentials type. Either certificate or anonymous, this option should be followed by one of the values listed in "enum gnutls_credentials_type_t".

`MHD_OPTION_HTTPS_PRIORITIES`
: SSL/TLS protocol version and ciphers. This option must be followed by an "const char *" argument specifying the SSL/TLS protocol versions and ciphers that are acceptable for the application. The string is passed unchanged to gnutls_priority_init. If this option is not specified, "NORMAL" is used.

`MHD_OPTION_HTTPS_CERT_CALLBACK`
: Use a callback to determine which X.509 certificate should be used for a given HTTPS connection. This option should be followed by a argument of type "gnutls_certificate_retrieve_function2 *". This option provides an alternative to MHD_OPTION_HTTPS_MEM_KEY and MHD_OPTION_HTTPS_MEM_CERT. You must use this version if multiple domains are to be hosted at the same IP address using TLS's Server Name Indication (SNI) extension. In this case, the callback is expected to select the correct certificate based on the SNI information provided. The callback is expected to access the SNI data using gnutls_server_name_get(). Using this option requires GnuTLS 3.0 or higher.

`MHD_OPTION_DIGEST_AUTH_RANDOM`
: Digest Authentication nonce's seed.

  This option should be followed by two arguments. First an integer of type "size_t" which specifies the size of the buffer pointed to by the second argument in bytes. Note that the application must ensure that the buffer of the second argument remains allocated and unmodified while the daemon is running. For security, you SHOULD provide a fresh random nonce when using MHD with Digest Authentication.

`MHD_OPTION_NONCE_NC_SIZE`
: Size of an array of nonce and nonce counter map. This option must be followed by an "unsigned int" argument that have the size (number of elements) of a map of a nonce and a nonce-counter. If this option is not specified, a default value of 4 will be used (which might be too small for servers handling many requests). If you do not use digest authentication at all, you can specify a value of zero to save some memory.

  You should calculate the value of NC_SIZE based on the number of connections per second multiplied by your expected session duration plus a factor of about two for hash table collisions. For example, if you expect 100 digest-authenticated connections per second and the average user to stay on your site for 5 minutes, then you likely need a value of about 60000. On the other hand, if you can only expect only 10 digest-authenticated connections per second, tolerate browsers getting a fresh

nonce for each request and expect a HTTP request latency of 250 ms, then a value of about 5 should be fine.

`MHD_OPTION_LISTEN_SOCKET`
: Listen socket to use. Pass a listen socket for MHD to use (systemd-style). If this option is used, MHD will not open its own listen socket(s). The argument passed must be of type "int" and refer to an existing socket that has been bound to a port and is listening.

`MHD_OPTION_EXTERNAL_LOGGER`
: Use the given function for logging error messages. This option must be followed by two arguments; the first must be a pointer to a function of type 'void fun(void * arg, const char * fmt, va_list ap)' and the second a pointer of type 'void*' which will be passed as the "arg" argument to "fun".

  Note that MHD will not generate any log messages without the MHD_USE_DEBUG flag set and if MHD was compiled with the "–disable-messages" flag.

`MHD_OPTION_THREAD_POOL_SIZE`
: Number (unsigned int) of threads in thread pool. Enable thread pooling by setting this value to to something greater than 1. Currently, thread model must be MHD_USE_SELECT_INTERNALLY if thread pooling is enabled (`MHD_start_daemon` returns `NULL` for an unsupported thread model).

`MHD_OPTION_ARRAY`
: This option can be used for initializing MHD using options from an array. A common use for this is writing an FFI for MHD. The actual options given are in an array of 'struct MHD_OptionItem', so this option requires a single argument of type 'struct MHD_OptionItem'. The array must be terminated with an entry `MHD_OPTION_END`.

  An example for code using MHD_OPTION_ARRAY is:

```
struct MHD_OptionItem ops[] = {
 { MHD_OPTION_CONNECTION_LIMIT, 100, NULL },
 { MHD_OPTION_CONNECTION_TIMEOUT, 10, NULL },
 { MHD_OPTION_END, 0, NULL }
};
d = MHD_start_daemon(0, 8080, NULL, NULL, dh, NULL,
                     MHD_OPTION_ARRAY, ops,
                     MHD_OPTION_END);
```

  For options that expect a single pointer argument, the second member of the `struct MHD_OptionItem` is ignored. For options that expect two pointer arguments, the first argument must be cast to `intptr_t`.

`MHD_OPTION_UNESCAPE_CALLBACK`
: Specify a function that should be called for unescaping escape sequences in URIs and URI arguments. Note that this function will NOT be used by the MHD_PostProcessor. If this option is not specified, the default

method will be used which decodes escape sequences of the form "%HH". This option should be followed by two arguments, the first one must be of the form

```
size_t my_unescaper(void * cls, struct MHD_Connection *c, char *s)
```

where the return value must be `strlen(s)` and `s` should be updated. Note that the unescape function must not lengthen `s` (the result must be shorter than the input and still be 0-terminated). `cls` will be set to the second argument following MHD_OPTION_UNESCAPE_CALLBACK.

`MHD_OPTION_THREAD_STACK_SIZE`

Maximum stack size for threads created by MHD. This option must be followed by a `size_t`). Not specifying this option or using a value of zero means using the system default (which is likely to differ based on your platform).

`MHD_OPTION_TCP_FASTQUEUE_QUEUE_SIZE`

When the flag `MHD_USE_TCP_FASTOPEN` is used, this option sets the connection handshake queue size for the TCP FASTOPEN connections. Note that a TCP FASTOPEN connection handshake occupies more resources than a TCP handshake as the SYN packets also contain DATA which is kept in the associate state until handshake is completed. If this option is not given the queue size is set to a default value of 10. This option must be followed by a `unsigned int`.

`MHD_OPTION_HTTPS_MEM_DHPARAMS`

Memory pointer for the Diffie-Hellman parameters (dh.pem) to be used by the HTTPS daemon for key exchange. This option must be followed by a `const char *` argument. The argument would be a zero-terminated string with a PEM encoded PKCS3 DH parameters structure suitable for passing to `gnutls_dh_parms_import_pkcs3`.

`MHD_OPTION_LISTENING_ADDRESS_REUSE`

This option must be followed by a `unsigned int` argument. If this option is present and true (nonzero) parameter is given, allow reusing the address:port of the listening socket (using `SO_REUSEPORT` on most platforms, and `SO_REUSEADDR` on Windows). If a false (zero) parameter is given, disallow reusing the the address:port of the listening socket (this usually requires no special action, but `SO_EXCLUSIVEADDRUSE` is needed on Windows). If this option is not present, default behaviour is undefined (currently, `SO_REUSEADDR` is used on all platforms, which disallows address:port reusing with the exception of Windows).

`MHD_OptionItem` [C Struct]

Entry in an MHD_OPTION_ARRAY. See the `MHD_OPTION_ARRAY` option argument for its use.

The `option` member is used to specify which option is specified in the array. The other members specify the respective argument.

Note that for options taking only a single pointer, the `ptr_value` member should be set. For options taking two pointer arguments, the first pointer must be cast to

`intptr_t` and both the `value` and the `ptr_value` members should be used to pass the two pointers.

`MHD_ValueKind` [Enumeration]

The `MHD_ValueKind` specifies the source of the key-value pairs in the HTTP protocol.

`MHD_RESPONSE_HEADER_KIND`
: Response header.

`MHD_HEADER_KIND`
: HTTP header.

`MHD_COOKIE_KIND`
: Cookies. Note that the original HTTP header containing the cookie(s) will still be available and intact.

`MHD_POSTDATA_KIND`
: `POST` data. This is available only if a content encoding supported by MHD is used (currently only URL encoding), and only if the posted content fits within the available memory pool. Note that in that case, the upload data given to the `MHD_AccessHandlerCallback()` will be empty (since it has already been processed).

`MHD_GET_ARGUMENT_KIND`
: `GET` (URI) arguments.

`MHD_FOOTER_KIND`
: HTTP footer (only for http 1.1 chunked encodings).

`MHD_RequestTerminationCode` [Enumeration]

The `MHD_RequestTerminationCode` specifies reasons why a request has been terminated (or completed).

`MHD_REQUEST_TERMINATED_COMPLETED_OK`
: We finished sending the response.

`MHD_REQUEST_TERMINATED_WITH_ERROR`
: Error handling the connection (resources exhausted, other side closed connection, application error accepting request, etc.)

`MHD_REQUEST_TERMINATED_TIMEOUT_REACHED`
: No activity on the connection for the number of seconds specified using `MHD_OPTION_CONNECTION_TIMEOUT`.

`MHD_REQUEST_TERMINATED_DAEMON_SHUTDOWN`
: We had to close the session since MHD was being shut down.

`MHD_ResponseMemoryMode` [Enumeration]

The `MHD_ResponeMemoryMode` specifies how MHD should treat the memory buffer given for the response in `MHD_create_response_from_buffer`.

`MHD_RESPMEM_PERSISTENT`
: Buffer is a persistent (static/global) buffer that won't change for at least the lifetime of the response, MHD should just use it, not free it, not copy it, just keep an alias to it.

`MHD_RESPMEM_MUST_FREE`
: Buffer is heap-allocated with `malloc` (or equivalent) and should be freed by MHD after processing the response has concluded (response reference counter reaches zero).

`MHD_RESPMEM_MUST_COPY`
: Buffer is in transient memory, but not on the heap (for example, on the stack or non-malloc allocated) and only valid during the call to `MHD_create_response_from_buffer`. MHD must make its own private copy of the data for processing.

`MHD_ResponseFlags` [Enumeration]

Response-specific flags. Passed as an argument to `MHD_set_response_options()`.

`MHD_RF_NONE`
: No special handling.

`MHD_RF_HTTP_VERSION_1_0_ONLY`
: Only respond in conservative HTTP 1.0-mode. In particular, do not (automatically) sent "Connection" headers and always close the connection after generating the response.

`MHD_ResponseOptions` [Enumeration]

Response-specific options. Passed in the varargs portion of `MHD_set_response_options()`.

`MHD_RO_END`
: No more options / last option. This is used to terminate the VARARGs list.

3 Structures type definition

`MHD_Daemon` [C Struct]
: Handle for the daemon (listening on a socket for HTTP traffic).

`MHD_Connection` [C Struct]
: Handle for a connection / HTTP request. With HTTP/1.1, multiple requests can be run over the same connection. However, MHD will only show one request per TCP connection to the client at any given time.

`MHD_Response` [C Struct]
: Handle for a response.

`MHD_PostProcessor` [C Struct]
: Handle for `POST` processing.

`MHD_ConnectionInfo` [C Union]
: Information about a connection.

`MHD_DaemonInfo` [C Union]
: Information about an MHD daemon.

4 Callback functions definition

`int *MHD_AcceptPolicyCallback` (*void *cls, const struct sockaddr * addr, socklen_t addrlen*) [Function Pointer]

Invoked in the context of a connection to allow or deny a client to connect. This callback return `MHD_YES` if connection is allowed, `MHD_NO` if not.

cls custom value selected at callback registration time;

addr address information from the client;

addrlen length of the address information.

`int *MHD_AccessHandlerCallback` (*void *cls, struct MHD_Connection * connection, const char *url, const char *method, const char *version, const char *upload_data, size_t *upload_data_size, void **con_cls*) [Function Pointer]

Invoked in the context of a connection to answer a request from the client. This callback must call MHD functions (example: the `MHD_Response` ones) to provide content to give back to the client and return an HTTP status code (i.e. `200` for OK, `404`, etc.).

Chapter 11 [microhttpd-post], page 37, for details on how to code this callback.

Must return `MHD_YES` if the connection was handled successfully, `MHD_NO` if the socket must be closed due to a serious error while handling the request

cls custom value selected at callback registration time;

url the URL requested by the client;

method the HTTP method used by the client (`GET`, `PUT`, `DELETE`, `POST`, etc.);

version the HTTP version string (i.e. `HTTP/1.1`);

upload_data
the data being uploaded (excluding headers):

`POST` data **will** be made available incrementally in *upload_data*; even if `POST` data is available, the first time the callback is invoked there won't be upload data, as this is done just after MHD parses the headers. If supported by the client and the HTTP version, the application can at this point queue an error response to possibly avoid the upload entirely. If no response is generated, MHD will (if required) automatically send a 100 CONTINUE reply to the client.

Afterwards, POST data will be passed to the callback to be processed incrementally by the application. The application may return `MHD_NO` to forcefully terminate the TCP connection without generating a proper HTTP response. Once all of the upload data has been provided to the application, the application will be called again with 0 bytes of upload data. At this point, a response should be queued to complete the handling of the request.

upload_data_size
: set initially to the size of the *upload_data* provided; this callback must update this value to the number of bytes **NOT** processed; unless external select is used, the callback maybe required to process at least some data. If the callback fails to process data in multi-threaded or internal-select mode and if the read-buffer is already at the maximum size that MHD is willing to use for reading (about half of the maximum amount of memory allowed for the connection), then MHD will abort handling the connection and return an internal server error to the client. In order to avoid this, clients must be able to process upload data incrementally and reduce the value of `upload_data_size`.

con_cls
: reference to a pointer, initially set to `NULL`, that this callback can set to some address and that will be preserved by MHD for future calls for this request;

since the access handler may be called many times (i.e., for a `PUT/POST` operation with plenty of upload data) this allows the application to easily associate some request-specific state;

if necessary, this state can be cleaned up in the global `MHD_RequestCompletedCallback` (which can be set with the `MHD_OPTION_NOTIFY_COMPLETED`).

`void *MHD_RequestCompletedCallback` (*void *cls, struct MHD_Connectionconnection, void **con_cls, enum MHD_RequestTerminationCode toe*) [Function Pointer]

Signature of the callback used by MHD to notify the application about completed requests.

cls custom value selected at callback registration time;

connection
: connection handle;

con_cls value as set by the last call to the `MHD_AccessHandlerCallback`;

toe reason for request termination see `MHD_OPTION_NOTIFY_COMPLETED`.

`int *MHD_KeyValueIterator` (*void *cls, enum MHD_ValueKind kind, const char *key, const char *value*) [Function Pointer]

Iterator over key-value pairs. This iterator can be used to iterate over all of the cookies, headers, or `POST`-data fields of a request, and also to iterate over the headers that have been added to a response.

cls custom value specified when iteration was triggered;

kind kind of the header we are looking at

key key for the value, can be an empty string

value value corresponding value, can be NULL

Return `MHD_YES` to continue iterating, `MHD_NO` to abort the iteration.

`int *MHD_ContentReaderCallback` (*void *cls, uint64_t pos, char *buf, size_t max*) [Function Pointer]

Callback used by MHD in order to obtain content. The callback has to copy at most *max* bytes of content into *buf*. The total number of bytes that has been placed into *buf* should be returned.

Note that returning zero will cause MHD to try again. Thus, returning zero should only be used in conjunction with `MHD_suspend_connection()` to avoid busy waiting.

While usually the callback simply returns the number of bytes written into *buf*, there are two special return value:

`MHD_CONTENT_READER_END_OF_STREAM` (-1) should be returned for the regular end of transmission (with chunked encoding, MHD will then terminate the chunk and send any HTTP footers that might be present; without chunked encoding and given an unknown response size, MHD will simply close the connection; note that while returning `MHD_CONTENT_READER_END_OF_STREAM` is not technically legal if a response size was specified, MHD accepts this and treats it just as `MHD_CONTENT_READER_END_WITH_ERROR`.

`MHD_CONTENT_READER_END_WITH_ERROR` (-2) is used to indicate a server error generating the response; this will cause MHD to simply close the connection immediately. If a response size was given or if chunked encoding is in use, this will indicate an error to the client. Note, however, that if the client does not know a response size and chunked encoding is not in use, then clients will not be able to tell the difference between `MHD_CONTENT_READER_END_WITH_ERROR` and `MHD_CONTENT_READER_END_OF_STREAM`. This is not a limitation of MHD but rather of the HTTP protocol.

cls custom value selected at callback registration time;

pos position in the datastream to access; note that if an `MHD_Response` object is re-used, it is possible for the same content reader to be queried multiple times for the same data; however, if an `MHD_Response` is not re-used, MHD guarantees that *pos* will be the sum of all non-negative return values obtained from the content reader so far.

Return `-1` on error (MHD will no longer try to read content and instead close the connection with the client).

`void *MHD_ContentReaderFreeCallback` (*void *cls*) [Function Pointer]

This method is called by MHD if we are done with a content reader. It should be used to free resources associated with the content reader.

`int *MHD_PostDataIterator` (*void *cls, enum MHD_ValueKind kind, const char *key, const char *filename, const char *content_type, const char *transfer_encoding, const char *data, uint64_t off, size_t size*) [Function Pointer]

Iterator over key-value pairs where the value maybe made available in increments and/or may not be zero-terminated. Used for processing `POST` data.

cls custom value selected at callback registration time;

kind type of the value;

key zero-terminated key for the value;

filename name of the uploaded file, `NULL` if not known;

content_type
mime-type of the data, `NULL` if not known;

transfer_encoding
encoding of the data, `NULL` if not known;

data pointer to size bytes of data at the specified offset;

off offset of data in the overall value;

size number of bytes in data available.

Return `MHD_YES` to continue iterating, `MHD_NO` to abort the iteration.

5 Starting and stopping the server

`void MHD_set_panic_func` (*MHD_PanicCallback cb, void *cls*) [Function]

Set a handler for fatal errors.

cb function to call if MHD encounters a fatal internal error. If no handler was set explicitly, MHD will call `abort`.

cls closure argument for cb; the other arguments are the name of the source file, line number and a string describing the nature of the fatal error (which can be `NULL`)

`struct MHD_Daemon * MHD_start_daemon` (*unsigned int flags, unsigned short port, MHD_AcceptPolicyCallback apc, void *apc_cls, MHD_AccessHandlerCallback dh, void *dh_cls, ...*) [Function]

Start a webserver on the given port.

flags OR-ed combination of `MHD_FLAG` values;

port port to bind to;

apc callback to call to check which clients will be allowed to connect; you can pass `NULL` in which case connections from any IP will be accepted;

apc_cls extra argument to *apc*;

dh default handler for all URIs;

dh_cls extra argument to *dh*.

Additional arguments are a list of options (type-value pairs, terminated with `MHD_OPTION_END`). It is mandatory to use `MHD_OPTION_END` as last argument, even when there are no additional arguments.

Return `NULL` on error, handle to daemon on success.

`int MHD_quiesce_daemon` (*struct MHD_Daemon *daemon*) [Function]

Stop accepting connections from the listening socket. Allows clients to continue processing, but stops accepting new connections. Note that the caller is responsible for closing the returned socket; however, if MHD is run using threads (anything but external select mode), it must not be closed until AFTER `MHD_stop_daemon` has been called (as it is theoretically possible that an existing thread is still using it).

This function is useful in the special case that a listen socket is to be migrated to another process (i.e. a newer version of the HTTP server) while existing connections should continue to be processed until they are finished.

Return `-1` on error (daemon not listening), the handle to the listen socket otherwise.

`void MHD_stop_daemon` (*struct MHD_Daemon *daemon*) [Function]

Shutdown an HTTP daemon.

`int MHD_run` (*struct MHD_Daemon *daemon*) [Function]

Run webserver operations (without blocking unless in client callbacks). This method should be called by clients in combination with `MHD_get_fdset()` if the client-controlled `select`-method is used.

This function will work for external `poll` and `select` mode. However, if using external `select` mode, you may want to instead use `MHD_run_from_select`, as it is more efficient.

daemon daemon to process connections of

Return `MHD_YES` on success, `MHD_NO` if this daemon was not started with the right options for this call.

`int MHD_run_from_select` (*struct MHD_Daemon *daemon, const fd_set *read_fd_set, const fd_set *write_fd_set, const fd_set *except_fd_set*) [Function]

Run webserver operations given sets of ready socket handles.

This method should be called by clients in combination with `MHD_get_fdset` if the client-controlled (external) select method is used.

You can use this function instead of `MHD_run` if you called `select` on the result from `MHD_get_fdset`. File descriptors in the sets that are not controlled by MHD will be ignored. Calling this function instead of `MHD_run` is more efficient as MHD will not have to call `select` again to determine which operations are ready.

daemon daemon to process connections of

read_fd_set
set of descriptors that must be ready for reading without blocking

write_fd_set
set of descriptors that must be ready for writing without blocking

except_fd_set
ignored, can be NULL

Return `MHD_YES` on success, `MHD_NO` on serious internal errors.

`void MHD_add_connection` (*struct MHD_Daemon *daemon, int client_socket, const struct sockaddr *addr, socklen_t addrlen*) [Function]

Add another client connection to the set of connections managed by MHD. This API is usually not needed (since MHD will accept inbound connections on the server socket). Use this API in special cases, for example if your HTTP server is behind NAT and needs to connect out to the HTTP client, or if you are building a proxy.

If you use this API in conjunction with a internal select or a thread pool, you must set the option `MHD_USE_PIPE_FOR_SHUTDOWN` to ensure that the freshly added connection is immediately processed by MHD.

The given client socket will be managed (and closed!) by MHD after this call and must no longer be used directly by the application afterwards.

daemon daemon that manages the connection

client_socket
: socket to manage (MHD will expect to receive an HTTP request from this socket next).

addr
: IP address of the client

addrlen
: number of bytes in addr

This function will return `MHD_YES` on success, `MHD_NO` if this daemon could not handle the connection (i.e. malloc failed, etc). The socket will be closed in any case; 'errno' is set to indicate further details about the error.

6 Implementing external `select`

`int MHD_get_fdset` (*struct MHD_Daemon *daemon, fd_set * read_fd_set, fd_set * write_fd_set, fd_set * except_fd_set, int *max_fd*) [Function]

Obtain the `select()` sets for this daemon. The daemon's socket is added to *read_fd_set*. The list of currently existent connections is scanned and their file descriptors added to the correct set.

After the call completed successfully: the variable referenced by *max_fd* references the file descriptor with highest integer identifier. The variable must be set to zero before invoking this function.

Return `MHD_YES` on success, `MHD_NO` if: the arguments are invalid (example: `NULL` pointers); this daemon was not started with the right options for this call.

`int MHD_get_timeout` (*struct MHD_Daemon *daemon, unsigned long long *timeout*) [Function]

Obtain timeout value for select for this daemon (only needed if connection timeout is used). The returned value is how many milliseconds `select` should at most block, not the timeout value set for connections. This function must not be called if the `MHD_USE_THREAD_PER_CONNECTION` mode is in use (since then it is not meaningful to ask for a timeout, after all, there is concurrenct activity). The function must also not be called by user-code if `MHD_USE_INTERNAL_SELECT` is in use. In the latter case, the behavior is undefined.

daemon which daemon to obtain the timeout from.

timeout will be set to the timeout (in milliseconds).

Return `MHD_YES` on success, `MHD_NO` if timeouts are not used (or no connections exist that would necessiate the use of a timeout right now).

7 Handling requests

`int` MHD_get_connection_values (*struct MHD_Connection *connection, enum MHD_ValueKind kind, MHD_KeyValueIterator iterator, void *iterator_cls*) [Function]

Get all the headers matching *kind* from the request. The *kind* argument can be a bitmask, ORing the various header kinds that are requested.

The *iterator* callback is invoked once for each header, with *iterator_cls* as first argument. After version 0.9.19, the headers are iterated in the same order as they were received from the network; previous versions iterated over the headers in reverse order.

`MHD_get_connection_values` returns the number of entries iterated over; this can be less than the number of headers if, while iterating, *iterator* returns `MHD_NO`.

iterator can be `NULL`: in this case this function just counts and returns the number of headers.

In the case of `MHD_GET_ARGUMENT_KIND`, the *value* argument will be `NULL` if the URL contained a key without an equals operator. For example, for a HTTP request to the URL "http://foo/bar?key", the *value* argument is `NULL`; in contrast, a HTTP request to the URL "http://foo/bar?key=", the *value* argument is the empty string. The normal case is that the URL contains "http://foo/bar?key=value" in which case *value* would be the string "value" and *key* would contain the string "key".

`int` MHD_set_connection_value (*struct MHD_Connection *connection, enum MHD_ValueKind kind, const char *key, const char *value*) [Function]

This function can be used to append an entry to the list of HTTP headers of a connection (so that the `MHD_get_connection_values function` will return them – and the MHD PostProcessor will also see them). This maybe required in certain situations (see Mantis #1399) where (broken) HTTP implementations fail to supply values needed by the post processor (or other parts of the application).

This function MUST only be called from within the MHD_AccessHandlerCallback (otherwise, access maybe improperly synchronized). Furthermore, the client must guarantee that the key and value arguments are 0-terminated strings that are NOT freed until the connection is closed. (The easiest way to do this is by passing only arguments to permanently allocated strings.).

connection is the connection for which the entry for *key* of the given *kind* should be set to the given *value*.

The function returns `MHD_NO` if the operation could not be performed due to insufficient memory and `MHD_YES` on success.

`const char *` MHD_lookup_connection_value (*struct MHD_Connection *connection, enum MHD_ValueKind kind, const char *key*) [Function]

Get a particular header value. If multiple values match the *kind*, return one of them (the "first", whatever that means). *key* must reference a zero-terminated ASCII-coded string representing the header to look for: it is compared against the headers using `strcasecmp()`, so case is ignored. A value of `NULL` for *key* can be

used to lookup 'trailing' values without a key, for example if a URI is of the form "http://example.com/?trailer", a *key* of `NULL` can be used to access "tailer" The function returns `NULL` if no matching item was found.

8 Building responses to requests

Response objects handling by MHD is asynchronous with respect to the application execution flow. Instances of the `MHD_Response` structure are not associated to a daemon and neither to a client connection: they are managed with reference counting.

In the simplest case: we allocate a new `MHD_Response` structure for each response, we use it once and finally we destroy it.

MHD allows more efficient resources usages.

Example: we allocate a new `MHD_Response` structure for each response **kind**, we use it every time we have to give that response and we finally destroy it only when the daemon shuts down.

8.1 Enqueuing a response

`int` `MHD_queue_response` (*struct MHD_Connection *connection, unsigned int status_code, struct MHD_Response *response*) [Function]

Queue a response to be transmitted to the client as soon as possible but only after MHD_AccessHandlerCallback returns. This function checks that it is legal to queue a response at this time for the given connection. It also increments the internal reference counter for the response object (the counter will be decremented automatically once the response has been transmitted).

connection
: the connection identifying the client;

status_code
: HTTP status code (i.e. `200` for OK);

response
: response to transmit.

Return `MHD_YES` on success or if message has been queued. Return `MHD_NO`: if arguments are invalid (example: `NULL` pointer); on error (i.e. reply already sent).

`void` `MHD_destroy_response` (*struct MHD_Response *response*) [Function]

Destroy a response object and associated resources (decrement the reference counter). Note that MHD may keep some of the resources around if the response is still in the queue for some clients, so the memory may not necessarily be freed immediately.

An explanation of reference counting[1]:

1. a `MHD_Response` object is allocated:

```
struct MHD_Response * response = MHD_create_response_from_buffer(...);
/* here: reference counter = 1 */
```

2. the `MHD_Response` object is enqueued in a `MHD_Connection`:

```
MHD_queue_response(connection, , response);
/* here: reference counter = 2 */
```

[1] Note to readers acquainted to the Tcl API: reference counting on `MHD_Connection` structures is handled in the same way as Tcl handles `Tcl_Obj` structures through `Tcl_IncrRefCount()` and `Tcl_DecrRefCount()`.

3. the creator of the response object discharges responsibility for it:

```
MHD_destroy_response(response);
/* here: reference counter = 1 */
```

4. the daemon handles the connection sending the response's data to the client then decrements the reference counter by calling `MHD_destroy_response()`: the counter's value drops to zero and the `MHD_Response` object is released.

8.2 Creating a response object

`struct MHD_Response * MHD_create_response_from_callback` [Function]
(*uint64_t size, size_t block_size, MHD_ContentReaderCallback crc, void *crc_cls, MHD_ContentReaderFreeCallback crfc*)

Create a response object. The response object can be extended with header information and then it can be used any number of times.

size size of the data portion of the response, `-1` for unknown;

block_size preferred block size for querying *crc* (advisory only, MHD may still call *crc* using smaller chunks); this is essentially the buffer size used for IO, clients should pick a value that is appropriate for IO and memory performance requirements;

crc callback to use to obtain response data;

crc_cls extra argument to *crc*;

crfc callback to call to free *crc_cls* resources.

Return `NULL` on error (i.e. invalid arguments, out of memory).

`struct MHD_Response * MHD_create_response_from_fd` (*uint64_t size, int fd*) [Function]

Create a response object. The response object can be extended with header information and then it can be used any number of times.

size size of the data portion of the response (should be smaller or equal to the size of the file)

fd file descriptor referring to a file on disk with the data; will be closed when response is destroyed; note that 'fd' must be an actual file descriptor (not a pipe or socket) since MHD might use 'sendfile' or 'seek' on it. The descriptor should be in blocking-IO mode.

Return `NULL` on error (i.e. invalid arguments, out of memory).

`struct MHD_Response *` [Function]
`MHD_create_response_from_fd_at_offset` (*size_t size, int fd, off_t offset*)

Create a response object. The response object can be extended with header information and then it can be used any number of times. Note that you need to be a bit careful about `off_t` when writing this code. Depending on your platform, MHD is likely to have been compiled with support for 64-bit files. When you compile your

own application, you must make sure that `off_t` is also a 64-bit value. If not, your compiler may pass a 32-bit value as `off_t`, which will result in 32-bits of garbage.

If you use the autotools, use the `AC_SYS_LARGEFILE` autoconf macro and make sure to include the generated `config.h` file before `microhttpd.h` to avoid problems. If you do not have a build system and only want to run on a GNU/Linux system, you could also use

```
#define _FILE_OFFSET_BITS 64
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <microhttpd.h>
```

to ensure 64-bit `off_t`. Note that if your operating system does not support 64-bit files, MHD will be compiled with a 32-bit `off_t` (in which case the above would be wrong).

size size of the data portion of the response (number of bytes to transmit from the file starting at offset).

fd file descriptor referring to a file on disk with the data; will be closed when response is destroyed; note that 'fd' must be an actual file descriptor (not a pipe or socket) since MHD might use 'sendfile' or 'seek' on it. The descriptor should be in blocking-IO mode.

offset offset to start reading from in the file

Return `NULL` on error (i.e. invalid arguments, out of memory).

`struct MHD_Response * MHD_create_response_from_buffer` [Function]
(*size_t size, void *data, enum MHD_ResponseMemoryMode mode*)

Create a response object. The response object can be extended with header information and then it can be used any number of times.

size size of the data portion of the response;

buffer the data itself;

mode memory management options for buffer; use MHD_RESPMEM_PERSISTENT if the buffer is static/global memory, use MHD_RESPMEM_MUST_FREE if the buffer is heap-allocated and should be freed by MHD and MHD_RESPMEM_MUST_COPY if the buffer is in transient memory (i.e. on the stack) and must be copied by MHD;

Return `NULL` on error (i.e. invalid arguments, out of memory).

`struct MHD_Response * MHD_create_response_from_data` (*size_t size, void *data, int must_free, int must_copy*) [Function]

Create a response object. The response object can be extended with header information and then it can be used any number of times. This function is deprecated, use `MHD_create_response_from_buffer` instead.

size size of the data portion of the response;

data the data itself;

must_free if true: MHD should free data when done;

must_copy
if true: MHD allocates a block of memory and use it to make a copy of *data* embedded in the returned `MHD_Response` structure; handling of the embedded memory is responsibility of MHD; *data* can be released anytime after this call returns.

Return `NULL` on error (i.e. invalid arguments, out of memory).

Example: create a response from a statically allocated string:

```
const char * data = "<html><body><p>Error!</p></body></html>";

struct MHD_Connection * connection = ...;
struct MHD_Response *   response;

response = MHD_create_response_from_buffer (strlen(data), data,
                                            MHD_RESPMEM_PERSISTENT);
MHD_queue_response(connection, 404, response);
MHD_destroy_response(response);
```

8.3 Adding headers to a response

`int MHD_add_response_header` (*struct MHD_Response *response, const char *header, const char *content*) [Function]

Add a header line to the response. The strings referenced by *header* and *content* must be zero-terminated and they are duplicated into memory blocks embedded in *response*.

Notice that the strings must not hold newlines, carriage returns or tab chars.

Return `MHD_NO` on error (i.e. invalid header or content format or memory allocation error).

`int MHD_add_response_footer` (*struct MHD_Response *response, const char *footer, const char *content*) [Function]

Add a footer line to the response. The strings referenced by *footer* and *content* must be zero-terminated and they are duplicated into memory blocks embedded in *response*.

Notice that the strings must not hold newlines, carriage returns or tab chars. You can add response footers at any time before signalling the end of the response to MHD (not just before calling 'MHD_queue_response'). Footers are useful for adding cryptographic checksums to the reply or to signal errors encountered during data generation. This call was introduced in MHD 0.9.3.

Return `MHD_NO` on error (i.e. invalid header or content format or memory allocation error).

`int MHD_del_response_header` (*struct MHD_Response *response, const char *header, const char *content*) [Function]

Delete a header (or footer) line from the response. Return `MHD_NO` on error (arguments are invalid or no such header known).

8.4 Setting response options

`int MHD_set_response_options` (*struct MHD_Response *response, enum MHD_ResponseFlags flags, ...*) [Function]

Set special flags and options for a response.

Calling this functions sets the given flags and options for the response.

response which response should be modified;

flags flags to set for the response;

Additional arguments are a list of options (type-value pairs, terminated with `MHD_RO_END`). It is mandatory to use `MHD_RO_END` as last argument, even when there are no additional arguments.

Return `MHD_NO` on error, `MHD_YES` on success.

8.5 Inspecting a response object

`int MHD_get_response_headers` (*struct MHD_Response *response, MHD_KeyValueIterator iterator, void *iterator_cls*) [Function]

Get all of the headers added to a response.

Invoke the *iterator* callback for each header in the response, using *iterator_cls* as first argument. Return number of entries iterated over. *iterator* can be `NULL`: in this case the function just counts headers.

iterator should not modify the its key and value arguments, unless we know what we are doing.

`const char * MHD_get_response_header` (*struct MHD_Response *response, const char *key*) [Function]

Find and return a pointer to the value of a particular header from the response. *key* must reference a zero-terminated string representing the header to look for. The search is case sensitive. Return `NULL` if header does not exist or *key* is `NULL`.

We should not modify the value, unless we know what we are doing.

9 Flow control.

Sometimes it may be possible that clients upload data faster than an application can process it, or that an application needs an extended period of time to generate a response. If `MHD_USE_THREAD_PER_CONNECTION` is used, applications can simply deal with this by performing their logic within the thread and thus effectively blocking connection processing by MHD. In all other modes, blocking logic must not be placed within the callbacks invoked by MHD as this would also block processing of other requests, as a single thread may be responsible for tens of thousands of connections.

Instead, applications using thread modes other than `MHD_USE_THREAD_PER_CONNECTION` should use the following functions to perform flow control.

`int MHD_suspend_connection` (*struct MHD_Connection *connection*) [Function]

Suspend handling of network data for a given connection. This can be used to dequeue a connection from MHD's event loop (external select, internal select or thread pool; not applicable to thread-per-connection!) for a while.

If you use this API in conjunction with a internal select or a thread pool, you must set the option `MHD_USE_SUSPEND_RESUME` to ensure that a resumed connection is immediately processed by MHD.

Suspended connections continue to count against the total number of connections allowed (per daemon, as well as per IP, if such limits are set). Suspended connections will NOT time out; timeouts will restart when the connection handling is resumed. While a connection is suspended, MHD will not detect disconnects by the client.

The only safe time to suspend a connection is from the `MHD_AccessHandlerCallback` or from the respective `MHD_ContentReaderCallback` (but in this case the response object must not be shared among multiple connections).

Finally, it is an API violation to call `MHD_stop_daemon` while having suspended connections (this will at least create memory and socket leaks or lead to undefined behavior). You must explicitly resume all connections before stopping the daemon.

connection
: the connection to suspend

`int MHD_resume_connection` (*struct MHD_Connection *connection*) [Function]

Resume handling of network data for suspended connection. It is safe to resume a suspended connection at any time. Calling this function on a connection that was not previously suspended will result in undefined behavior.

connection
: the connection to resume

10 Utilizing Authentication

MHD support three types of client authentication.

Basic authentication uses a simple authentication method based on BASE64 algorithm. Username and password are exchanged in clear between the client and the server, so this method must only be used for non-sensitive content or when the session is protected with https. When using basic authentication MHD will have access to the clear password, possibly allowing to create a chained authentication toward an external authentication server.

Digest authentication uses a one-way authentication method based on MD5 hash algorithm. Only the hash will transit over the network, hence protecting the user password. The nonce will prevent replay attacks. This method is appropriate for general use, especially when https is not used to encrypt the session.

Client certificate authentication uses a X.509 certificate from the client. This is the strongest authentication mechanism but it requires the use of HTTPS. Client certificate authentication can be used simultaneously with Basic or Digest Authentication in order to provide a two levels authentication (like for instance separate machine and user authentication). A code example for using client certificates is presented in the MHD tutorial.

10.1 Using Basic Authentication

`char * MHD_basic_auth_get_username_password` (*struct MHD_Connection *connection, char** password*) [Function]

Get the username and password from the basic authorization header sent by the client. Return `NULL` if no username could be found, a pointer to the username if found. If returned value is not `NULL`, the value must be `free()`'ed.

password reference a buffer to store the password. It can be `NULL`. If returned value is not `NULL`, the value must be `free()`'ed.

`int MHD_queue_basic_auth_fail_response` (*struct MHD_Connection *connection, const char *realm, struct MHD_Response *response*) [Function]

Queues a response to request basic authentication from the client. Return `MHD_YES` if successful, otherwise `MHD_NO`.

realm must reference to a zero-terminated string representing the realm.

response a response structure to specify what shall be presented to the client with a 401 HTTP status.

10.2 Using Digest Authentication

`char * MHD_digest_auth_get_username` (*struct MHD_Connection *connection*) [Function]

Find and return a pointer to the username value from the request header. Return `NULL` if the value is not found or header does not exist. If returned value is not `NULL`, the value must be `free()`'ed.

`int MHD_digest_auth_check` (*struct MHD_Connection *connection, const char *realm, const char *username, const char *password, unsigned int nonce_timeout*) [Function]

Checks if the provided values in the WWW-Authenticate header are valid and sound according to RFC2716. If valid return `MHD_YES`, otherwise return `MHD_NO`.

realm must reference to a zero-terminated string representing the realm.

username must reference to a zero-terminated string representing the username, it is usually the returned value from MHD_digest_auth_get_username.

password must reference to a zero-terminated string representing the password, most probably it will be the result of a lookup of the username against a local database.

nonce_timeout is the amount of time in seconds for a nonce to be invalid. Most of the time it is sound to specify 300 seconds as its values.

`int MHD_queue_auth_fail_response` (*struct MHD_Connection *connection, const char *realm, const char *opaque, struct MHD_Response *response, int signal_stale*) [Function]

Queues a response to request authentication from the client, return `MHD_YES` if successful, otherwise `MHD_NO`.

realm must reference to a zero-terminated string representing the realm.

opaque must reference to a zero-terminated string representing a value that gets passed to the client and expected to be passed again to the server as-is. This value can be a hexadecimal or base64 string.

response a response structure to specify what shall be presented to the client with a 401 HTTP status.

signal_stale a value that signals "stale=true" in the response header to indicate the invalidity of the nonce and no need to ask for authentication parameters and only a new nonce gets generated. `MHD_YES` to generate a new nonce, `MHD_NO` to ask for authentication parameters.

Example: handling digest authentication requests and responses.

```
#define PAGE "<html><head><title>libmicrohttpd demo</title></head><body>Access granted
#define DENIED "<html><head><title>libmicrohttpd demo</title></head><body>Access denie
#define OPAQUE "11733b200778ce33060f31c9af70a870ba96ddd4"

static int
ahc_echo (void *cls,
          struct MHD_Connection *connection,
          const char *url,
          const char *method,
          const char *version,
          const char *upload_data, size_t *upload_data_size, void **ptr)
{
  struct MHD_Response *response;
  char *username;
  const char *password = "testpass";
```

```
  const char *realm = "test@example.com";
  int ret;

  username = MHD_digest_auth_get_username(connection);
  if (username == NULL)
    {
      response = MHD_create_response_from_buffer(strlen (DENIED),
         DENIED,
         MHD_RESPMEM_PERSISTENT);
      ret = MHD_queue_auth_fail_response(connection, realm,
 OPAQUE,
 response,
 MHD_NO);
      MHD_destroy_response(response);
      return ret;
    }
  ret = MHD_digest_auth_check(connection, realm,
      username,
      password,
      300);
  free(username);
  if ( (ret == MHD_INVALID_NONCE) ||
       (ret == MHD_NO) )
    {
      response = MHD_create_response_from_buffer(strlen (DENIED),
         DENIED,
         MHD_RESPMEM_PERSISTENT);
      if (NULL == response)
return MHD_NO;
      ret = MHD_queue_auth_fail_response(connection, realm,
 OPAQUE,
 response,
 (ret == MHD_INVALID_NONCE) ? MHD_YES : MHD_NO);
      MHD_destroy_response(response);
      return ret;
    }
  response = MHD_create_response_from_buffer (strlen(PAGE), PAGE,
        MHD_RESPMEM_PERSISTENT);
  ret = MHD_queue_response(connection, MHD_HTTP_OK, response);
  MHD_destroy_response(response);
  return ret;
}
```

11 Adding a POST processor

MHD provides the post processor API to make it easier for applications to parse the data of a client's POST request: the MHD_AccessHandlerCallback will be invoked multiple times to process data as it arrives; at each invocation a new chunk of data must be processed. The arguments *upload_data* and *upload_data_size* are used to reference the chunk of data.

When MHD_AccessHandlerCallback is invoked for a new connection: its ***con_cls* argument is set to NULL. When POST data comes in the upload buffer it is **mandatory** to use the *con_cls* to store a reference to per-connection data. The fact that the pointer was initially NULL can be used to detect that this is a new request.

One method to detect that a new connection was established is to set *con_cls to an unused integer:

```
int
access_handler (void *cls,
                struct MHD_Connection * connection,
                const char *url,
                const char *method, const char *version,
                const char *upload_data, size_t *upload_data_size,
                void **con_cls)
{
  static int old_connection_marker;
  int new_connection = (NULL == *con_cls);

  if (new_connection)
    {
      /* new connection with POST */
      *con_cls = &old_connection_marker;
    }

  ...
}
```

In contrast to the previous example, for POST requests in particular, it is more common to use the value of *con_cls to keep track of actual state used during processing, such as the post processor (or a struct containing a post processor):

```
int
access_handler (void *cls,
                struct MHD_Connection * connection,
                const char *url,
                const char *method, const char *version,
                const char *upload_data, size_t *upload_data_size,
                void **con_cls)
{
  struct MHD_PostProcessor * pp = *con_cls;

  if (pp == NULL)
    {
```

```
      pp = MHD_create_post_processor(connection, ...);
      *con_cls = pp;
      return MHD_YES;
    }
  if (*upload_data_size)
    {
      MHD_post_process(pp, upload_data, *upload_data_size);
      *upload_data_size = 0;
      return MHD_YES;
    }
  else
    {
      MHD_destroy_post_processor(pp);
      return MHD_queue_response(...);
    }
}
```

Note that the callback from `MHD_OPTION_NOTIFY_COMPLETED` should be used to destroy the post processor. This cannot be done inside of the access handler since the connection may not always terminate normally.

11.1 Programming interface for the POST processor

`struct MHD_PostProcessor * MHD_create_post_processor` (*struct MHD_Connection *connection, size_t buffer_size, MHD_PostDataIterator iterator, void *iterator_cls*) [Function]

Create a PostProcessor. A PostProcessor can be used to (incrementally) parse the data portion of a `POST` request.

connection the connection on which the `POST` is happening (used to determine the `POST` format);

buffer_size maximum number of bytes to use for internal buffering (used only for the parsing, specifically the parsing of the keys). A tiny value (256-1024) should be sufficient; do **NOT** use a value smaller than 256; for good performance, use 32k or 64k (i.e. 65536).

iterator iterator to be called with the parsed data; must **NOT** be `NULL`;

iterator_cls custom value to be used as first argument to *iterator*.

Return `NULL` on error (out of memory, unsupported encoding), otherwise a PP handle.

`int MHD_post_process` (*struct MHD_PostProcessor *pp, const char *post_data, size_t post_data_len*) [Function]

Parse and process `POST` data. Call this function when `POST` data is available (usually during an `MHD_AccessHandlerCallback`) with the *upload_data* and *upload_data_size*. Whenever possible, this will then cause calls to the `MHD_IncrementalKeyValueIterator`.

pp the post processor;

post_data *post_data_len* bytes of POST data;

post_data_len
length of *post_data*.

Return MHD_YES on success, MHD_NO on error (out-of-memory, iterator aborted, parse error).

int MHD_destroy_post_processor (*struct MHD_PostProcessor *pp*) [Function]
Release PostProcessor resources. After this function is being called, the PostProcessor is guaranteed to no longer call its iterator. There is no special call to the iterator to indicate the end of the post processing stream. After destroying the PostProcessor, the programmer should perform any necessary work to complete the processing of the iterator.

Return MHD_YES if processing completed nicely, MHD_NO if there were spurious characters or formatting problems with the post request. It is common to ignore the return value of this function.

12 Obtaining and modifying status information.

12.1 Obtaining state information about an MHD daemon

`const union MHD_DaemonInfo * MHD_get_daemon_info` (*struct MHD_Daemon *daemon, enum MHD_DaemonInfoType infoType, ...*) [Function]

Obtain information about the given daemon. This function is currently not fully implemented.

daemon the daemon about which information is desired;

infoType type of information that is desired

... additional arguments about the desired information (depending on infoType)

Returns a union with the respective member (depending on infoType) set to the desired information), or `NULL` in case the desired information is not available or applicable.

`MHD_DaemonInfoType` [Enumeration]

Values of this enum are used to specify what information about a daemon is desired.

`MHD_DAEMON_INFO_KEY_SIZE`
: Request information about the key size for a particular cipher algorithm. The cipher algorithm should be passed as an extra argument (of type 'enum MHD_GNUTLS_CipherAlgorithm'). No longer supported, using this value will cause `MHD_get_daemon_info` to return NULL.

`MHD_DAEMON_INFO_MAC_KEY_SIZE`
: Request information about the key size for a particular cipher algorithm. The cipher algorithm should be passed as an extra argument (of type 'enum MHD_GNUTLS_HashAlgorithm'). No longer supported, using this value will cause `MHD_get_daemon_info` to return NULL.

`MHD_DAEMON_INFO_LISTEN_FD`
: Request the file-descriptor number that MHD is using to listen to the server socket. This can be useful if no port was specified and a client needs to learn what port is actually being used by MHD. No extra arguments should be passed.

`MHD_DAEMON_INFO_EPOLL_FD_LINUX_ONLY`
: Request the file-descriptor number that MHD is using for epoll. If the build is not supporting epoll, NULL is returned; if we are using a thread pool or this daemon was not started with `MHD_USE_EPOLL_LINUX_ONLY`, (a pointer to) -1 is returned. If we are using `MHD_USE_SELECT_INTERNALLY` or are in 'external' select mode, the internal epoll FD is returned. This function must be used in external select mode with epoll to obtain the FD to call epoll on. No extra arguments should be passed.

`MHD_DAEMON_INFO_CURRENT_CONNECTIONS`
: Request the number of current connections handled by the daemon. No extra arguments should be passed and a pointer to a `union MHD_DaemonInfo` value is returned, with the `num_connections` member of type `unsigned int` set to the number of active connections.

  Note that in multi-threaded or internal-select mode, the real number of current connections may already be different when `MHD_get_daemon_info` returns. The number of current connections can be used (even in multi-threaded and internal-select mode) after `MHD_quiesce_daemon` to detect whether all connections have been handled.

12.2 Obtaining state information about a connection

`const union MHD_ConnectionInfo * MHD_get_connection_info` [Function]
(*struct MHD_Connection *daemon, enum MHD_ConnectionInfoType infoType, ...*)

Obtain information about the given connection.

connection
: the connection about which information is desired;

infoType
: type of information that is desired

...
: additional arguments about the desired information (depending on infoType)

Returns a union with the respective member (depending on infoType) set to the desired information), or `NULL` in case the desired information is not available or applicable.

`MHD_ConnectionInfoType` [Enumeration]

Values of this enum are used to specify what information about a connection is desired.

`MHD_CONNECTION_INFO_CIPHER_ALGO`
: What cipher algorithm is being used (HTTPS connections only). Takes no extra arguments. `NULL` is returned for non-HTTPS connections.

`MHD_CONNECTION_INFO_PROTOCOL,`
: Takes no extra arguments. Allows finding out the TLS/SSL protocol used (HTTPS connections only). `NULL` is returned for non-HTTPS connections.

`MHD_CONNECTION_INFO_CLIENT_ADDRESS`
: Returns information about the address of the client. Returns essentially a `struct sockaddr **` (since the API returns a `union MHD_ConnectionInfo *` and that union contains a `struct sockaddr *`).

`MHD_CONNECTION_INFO_GNUTLS_SESSION,`
: Takes no extra arguments. Allows access to the underlying GNUtls session, including access to the underlying GNUtls client certificate (HTTPS connections only). Takes no extra arguments. `NULL` is returned for non-HTTPS connections.

`MHD_CONNECTION_INFO_GNUTLS_CLIENT_CERT`,
: Dysfunctional (never implemented, deprecated). Use MHD_CONNECTION_INFO_GNUTLS_SESSION to get the `gnutls_session_t` and then call `gnutls_certificate_get_peers()`.

`MHD_CONNECTION_INFO_DAEMON`
: Returns information about `struct MHD_Daemon` which manages this connection.

`MHD_CONNECTION_INFO_CONNECTION_FD`
: Returns the file descriptor (usually a TCP socket) associated with this connection (in the "connect-fd" member of the returned struct). Note that manipulating the descriptor directly can have problematic consequences (as in, break HTTP). Applications might use this access to manipulate TCP options, for example to set the "TCP-NODELAY" option for COMET-like applications. Note that MHD will set TCP-CORK after sending the HTTP header and clear it after finishing the footers automatically (if the platform supports it). As the connection callbacks are invoked in between, those might be used to set different values for TCP-CORK and TCP-NODELAY in the meantime.

`MHD_CONNECTION_INFO_SOCKET_CONTEXT`
: Returns the client-specific pointer to a `void *` that was (possibly) set during a `MHD_NotifyConnectionCallback` when the socket was first accepted. Note that this is NOT the same as the `con_cls` argument of the `MHD_AccessHandlerCallback`. The `con_cls` is fresh for each HTTP request, while the `socket_context` is fresh for each socket.

12.3 Setting custom options for an individual connection

`int MHD_set_connection_option` (*struct MHD_Connection *daemon, enum MHD_CONNECTION_OPTION option, ...*) [Function]

Set a custom option for the given connection.

connection
: the connection for which an option should be set or modified;

option
: option to set

...
: additional arguments for the option (depending on option)

Returns `MHD_YES` on success, `MHD_NO` for errors (i.e. option argument invalid or option unknown).

`MHD_CONNECTION_OPTION` [Enumeration]

Values of this enum are used to specify which option for a connection should be changed.

`MHD_CONNECTION_OPTION_TIMEOUT`
: Set a custom timeout for the given connection. Specified as the number of seconds, given as an `unsigned int`. Use zero for no timeout.

13 Utility functions.

13.1 Testing for supported MHD features

`MHD_FEATURE` [Enumeration]

Values of this enum are used to specify what information about a daemon is desired.

`MHD_FEATURE_MESSAGES`
: Get whether messages are supported. If supported then in debug mode messages can be printed to stderr or to external logger.

`MHD_FEATURE_SSL`
: Get whether HTTPS is supported. If supported then flag MHD_USE_SSL and options MHD_OPTION_HTTPS_MEM_KEY, MHD_OPTION_HTTPS_MEM_CERT, MHD_OPTION_HTTPS_MEM_TRUST, MHD_OPTION_HTTPS_MEM_DHPARAMS, MHD_OPTION_HTTPS_CRED_TYPE, MHD_OPTION_HTTPS_PRIORITIES can be used.

`MHD_FEATURE_HTTPS_CERT_CALLBACK`
: Get whether option #MHD_OPTION_HTTPS_CERT_CALLBACK is supported.

`MHD_FEATURE_IPv6`
: Get whether IPv6 is supported. If supported then flag MHD_USE_IPv6 can be used.

`MHD_FEATURE_IPv6_ONLY`
: Get whether IPv6 without IPv4 is supported. If not supported then IPv4 is always enabled in IPv6 sockets and flag MHD_USE_DUAL_STACK if always used when MHD_USE_IPv6 is specified.

`MHD_FEATURE_POLL`
: Get whether `poll()` is supported. If supported then flag MHD_USE_POLL can be used.

`MHD_FEATURE_EPOLL`
: Get whether `epoll()` is supported. If supported then Flags MHD_USE_EPOLL_LINUX_ONLY and MHD_USE_EPOLL_INTERNALLY_LINUX_ONLY can be used.

`MHD_FEATURE_SHUTDOWN_LISTEN_SOCKET`
: Get whether shutdown on listen socket to signal other threads is supported. If not supported flag MHD_USE_PIPE_FOR_SHUTDOWN is automatically forced.

`MHD_FEATURE_SOCKETPAIR`
: Get whether a `socketpair()` is used internally instead of a `pipe()` to signal other threads.

`MHD_FEATURE_TCP_FASTOPEN`
: Get whether TCP Fast Open is supported. If supported then flag MHD_USE_TCP_FASTOPEN and option MHD_OPTION_TCP_FASTOPEN_QUEUE_SIZE can be used.

`MHD_FEATURE_BASIC_AUTH`
: Get whether HTTP Basic authorization is supported. If supported then functions `MHD_basic_auth_get_username_password()` and `MHD_queue_basic_auth_fail_response()` can be used.

`MHD_FEATURE_DIGEST_AUTH`
: Get whether HTTP Digest authorization is supported. If supported then options MHD_OPTION_DIGEST_AUTH_RANDOM, MHD_OPTION_NONCE_NC_SIZE and functions `MHD_digest_auth_check()`, can be used.

`MHD_FEATURE_POSTPROCESSOR`
: Get whether postprocessor is supported. If supported then functions `MHD_create_post_processor()`, `MHD_post_process()`, `MHD_destroy_post_processor()` can be used.

`int MHD_is_feature_supported` (*enum MHD_FEATURE feature*) [Function]

Get information about supported MHD features. Indicate that MHD was compiled with or without support for particular feature. Some features require additional support by the kernel. However, kernel support is not checked by this function.

feature type of requested information

Returns `MHD_YES` if the feature is supported, and `MHD_NO` if not.

13.2 Unescape strings

`size_t MHD_http_unescape` (*char *val*) [Function]

Process escape sequences ('%HH') Updates val in place; the result should be UTF-8 encoded and cannot be larger than the input. The result must also still be 0-terminated.

val value to unescape (modified in the process), must be a 0-terminated UTF-8 string.

Returns length of the resulting val (`strlen(val)` may be shorter afterwards due to elimination of escape sequences).

GNU-LGPL

Version 2.1, February 1999

[This is the first released version of the Lesser GPL. It also counts
as the successor of the GNU Library Public License, version 2, hence the
version number 2.1.]

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