

Saurion

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Chapter 1

Todo List

Member `EXTERNAL_set_socket` (int p)

Eliminar

Member `read_chunk` (void **dest, size_t *len, struct request *const req)

add message constraint

validar `msg_size`, crear maximos

validar `offsets`

Chapter 2

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2.1 Modules

Here is a list of all modules:

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3.1 Class List

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4.1 File List

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Chapter 5

Module Documentation

5.1 LowSaurion

The `saurion` class is designed to efficiently handle asynchronous input/output events on Linux systems using the `io_uring` API. Its main purpose is to manage network operations such as socket connections, reads, writes, and closures by leveraging an event-driven model that enhances performance and scalability in highly concurrent applications.

Classes

- struct `saurion`
Main structure for managing `io_uring` and socket events.

Macros

- `#define PACKING_SZ 128`
Defines the memory alignment size for structures in the `saurion` class.

Functions

- int `EXTERNAL_set_socket` (int p)
- struct `saurion` * `saurion_create` (uint32_t n_threads)
Creates an instance of the `saurion` structure.
- int `saurion_start` (struct `saurion` *s)
Starts event processing in the `saurion` structure.
- void `saurion_stop` (const struct `saurion` *s)
Stops event processing in the `saurion` structure.
- void `saurion_destroy` (struct `saurion` *s)
Destroys the `saurion` structure and frees all associated resources.
- void `saurion_send` (struct `saurion` *s, const int fd, const char *const msg)
Sends a message through a socket using `io_uring`.
- int `allocate_iovec` (struct iovec *iov, size_t amount, size_t pos, size_t size, void **chd_ptr)
- int `initialize_iovec` (struct iovec *iov, size_t amount, size_t pos, const void *msg, size_t size, uint8_t h)
Initializes a specified `iovec` structure with a message fragment.
- int `set_request` (struct `request` **r, struct `Node` **l, size_t s, const void *m, uint8_t h)
Sets up a request and allocates `iovec` structures for data handling in `liburing`.
- int `read_chunk` (void **dest, size_t *len, struct `request` *const req)
Reads a message chunk from the request's `iovec` buffers, handling messages that may span multiple `iovec` entries.
- void `free_request` (struct `request` *req, void **children_ptr, size_t amount)

5.1.1 Detailed Description

The `saurion` class is designed to efficiently handle asynchronous input/output events on Linux systems using the `io_uring` API. Its main purpose is to manage network operations such as socket connections, reads, writes, and closures by leveraging an event-driven model that enhances performance and scalability in highly concurrent applications.

This function allocates memory for each `struct iovec`

The main structure, `saurion`, encapsulates `io_uring` rings and facilitates synchronization between multiple threads through the use of mutexes and a thread pool that distributes operations in parallel. This allows efficient handling of I/O operations across several sockets simultaneously, without blocking threads during operations.

The messages are composed of three main parts:

- A header, which is an unsigned 64-bit number representing the length of the message body.
- A body, which contains the actual message data.
- A footer, which consists of 8 bits set to 0.

For example, for a message with 9000 bytes of content, the header would contain the number 9000, the body would consist of those 9000 bytes, and the footer would be 1 byte set to 0.

When these messages are sent to the kernel, they are divided into chunks using `iovec`. Each chunk can hold a maximum of 8192 bytes and contains two fields:

- `iov_base`, which is an array where the chunk of the message is stored.
- `iov_len`, the number of bytes used in the `iov_base` array.

For the message with 9000 bytes, the `iovec` division would look like this:

- The first `iovec` would contain:
 - 8 bytes for the header (the length of the message body, 9000).
 - 8184 bytes of the message body.
 - `iov_len` would be 8192 bytes in total.
- The second `iovec` would contain:
 - The remaining 816 bytes of the message body.
 - 1 byte for the footer (set to 0).
 - `iov_len` would be 817 bytes in total.

The structure of the message is as follows:

```
+-----+-----+-----+
| Header | Body | Footer |
| (64 bits: 9000) | (Message Data) | (1 byte) |
+-----+-----+-----+
```

The structure of the `iovec` division is:

First iovec (8192 bytes):

iov_base	iov_len
8 bytes header, 8184 bytes of message	8192

Second iovec (817 bytes):

iov_base	iov_len
816 bytes of message, 1 byte footer (0)	817

Each I/O event can be monitored and managed through custom callbacks that handle connection, read, write, close, or error events on the sockets.

Basic usage example:

```
// Create the saurion structure with 4 threads
struct saurion *s = saurion_create(4);
// Start event processing
if (saurion_start(s) != 0) {
    // Handle the error
}
// Send a message through a socket
saurion_send(s, socket_fd, "Hello, World!");
// Stop event processing
saurion_stop(s);
// Destroy the structure and free resources
saurion_destroy(s);
```

In this example, the `saurion` structure is created with 4 threads to handle the workload. Event processing is started, allowing it to accept connections and manage I/O operations on sockets. After sending a message through a socket, the system can be stopped, and the resources are freed.

Author

Israel

Date

2024

This function allocates memory for each `struct iovec`. Every `struct iovec` consists of two member variables:

- `iov_base`, a `void *` array that will hold the data. All of them will allocate the same amount of memory (`CHUNK_SZ`) to avoid memory fragmentation.
- `iov_len`, an integer representing the size of the data stored in the `iovec`. The data size is `CHUNK_SZ` unless it's the last one, in which case it will hold the remaining bytes. In addition to initialization, the function adds the pointers to the allocated memory into a child array to simplify memory deallocation later on.

Parameters

<i>iov</i>	Structure to initialize.
<i>amount</i>	Total number of <code>iovec</code> to initialize.
<i>pos</i>	Current position of the <code>iovec</code> within the total <code>iovec</code> (<code>amount</code>).
<i>size</i>	Total size of the data to be stored in the <code>iovec</code> .
<i>chd_ptr</i>	Array to hold the pointers to the allocated memory.

Return values

<code>ERROR_CODE</code>	if there was an error during memory allocation.
<code>SUCCESS_CODE</code>	if the operation was successful.

Note

The last `iovec` will allocate only the remaining bytes if the total size is not a multiple of `CHUNK_SZ`.

5.1.2 Macro Definition Documentation

5.1.2.1 PACKING_SZ

```
#define PACKING_SZ 128
```

Defines the memory alignment size for structures in the `saurion` class.

`PACKING_SZ` is used to ensure that certain structures, such as `saurion_callbacks`, are aligned to a specific memory boundary. This can improve memory access performance and ensure compatibility with certain hardware architectures that require specific alignment.

In this case, the value is set to 128 bytes, meaning that structures marked with `__attribute__((aligned(PACKING_SZ)))` will be aligned to 128-byte boundaries.

Proper alignment can be particularly important in multithreaded environments or when working with low-level system APIs like `io_uring`, where unaligned memory accesses may introduce performance penalties.

Adjusting `PACKING_SZ` may be necessary depending on the hardware platform or specific performance requirements.

Definition at line 129 of file `low_saurion.h`.

5.1.3 Function Documentation

5.1.3.1 allocate_iovec()

```
int allocate_iovec (
    struct iovec * iov,
    size_t amount,
    size_t pos,
    size_t size,
    void ** chd_ptr )
```

Definition at line 114 of file `low_saurion.c`.

```
00114
00115     if (!iov || !chd_ptr) {
00116         return ERROR_CODE;
00117     }
00118     iov->iov_base = malloc(CHUNK_SZ);
00119     if (!iov->iov_base) {
00120         return ERROR_CODE;
00121     }
00122     iov->iov_len = (pos == (amount - 1) ? (size % CHUNK_SZ) : CHUNK_SZ);
00123     if (iov->iov_len == 0) {
00124         iov->iov_len = CHUNK_SZ;
00125     }
00126     chd_ptr[pos] = iov->iov_base;
00127     return SUCCESS_CODE;
00128 }
```

5.1.3.2 EXTERNAL_set_socket()

```
int EXTERNAL_set_socket (
    int p )
```

Todo Eliminar

Definition at line 548 of file [low_saurion.c](#).

```
00548                                     {
00549     int sock = 0;
00550     struct sockaddr_in srv_addr;
00551
00552     sock = socket(PF_INET, SOCK_STREAM, 0);
00553     if (sock < 1) {
00554         return ERROR_CODE;
00555     }
00556
00557     int enable = 1;
00558     if (setsockopt(sock, SOL_SOCKET, SO_REUSEADDR, &enable, sizeof(int)) < 0) {
00559         return ERROR_CODE;
00560     }
00561     if (setsockopt(sock, SOL_SOCKET, SO_REUSEPORT, &enable, sizeof(int)) < 0) {
00562         return ERROR_CODE;
00563     }
00564
00565     memset(&srv_addr, 0, sizeof(srv_addr));
00566     srv_addr.sin_family = AF_INET;
00567     srv_addr.sin_port = htons(p);
00568     srv_addr.sin_addr.s_addr = htonl(INADDR_ANY);
00569
00570     /* We bind to a port and turn this socket into a listening
00571     * socket.
00572     */
00573     if (bind(sock, (const struct sockaddr *)&srv_addr, sizeof(srv_addr)) < 0) {
00574         return ERROR_CODE;
00575     }
00576
00577     if (listen(sock, ACCEPT_QUEUE) < 0) {
00578         return ERROR_CODE;
00579     }
00580
00581     return sock;
00582 }
```

5.1.3.3 free_request()

```
void free_request (
    struct request * req,
    void ** children_ptr,
    size_t amount )
```

Definition at line 61 of file [low_saurion.c](#).

```
00061                                     {
00062     if (children_ptr) {
00063         free(children_ptr);
00064         children_ptr = NULL;
00065     }
00066     for (size_t i = 0; i < amount; ++i) {
00067         free(req->iiov[i].iov_base);
00068         req->iiov[i].iov_base = NULL;
00069     }
00070     free(req);
00071     req = NULL;
00072     free(children_ptr);
00073     children_ptr = NULL;
00074 }
```

5.1.3.4 initialize_iovec()

```
int initialize_iovec (
    struct iovec * iov,
    size_t amount,
    size_t pos,
    const void * msg,
    size_t size,
    uint8_t h ) [private]
```

Initializes a specified `iovec` structure with a message fragment.

This function populates the `iov_base` of the `iovec` structure with a portion of the message, depending on the position (`pos`) in the overall set of `iovec` structures. The message is divided into chunks, and for the first `iovec`, a header containing the size of the message is included. Optionally, padding or adjustments can be applied based on the `h` flag.

Parameters

<i>iov</i>	Pointer to the <code>iovec</code> structure to initialize.
<i>amount</i>	The total number of <code>iovec</code> structures.
<i>pos</i>	The current position of the <code>iovec</code> within the overall message split.
<i>msg</i>	Pointer to the message to be split across the <code>iovec</code> structures.
<i>size</i>	The total size of the message.
<i>h</i>	A flag (header flag) that indicates whether special handling is needed for the first <code>iovec</code> (adds the message size as a header) or for the last chunk.

Return values

<i>SUCCESS_CODE</i>	on successful initialization of the <code>iovec</code> .
<i>ERROR_CODE</i>	if the <code>iov</code> or its <code>iov_base</code> is null.

Note

For the first `iovec` (when `pos == 0`), the message size is copied into the beginning of the `iov_base` if the header flag (`h`) is set. Subsequent chunks are filled with message data, and the last chunk may have one byte reduced if `h` is set.

Attention

The message must be properly aligned and divided, especially when using the header flag to ensure no memory access issues.

Warning

If `msg` is null, the function will initialize the `iov_base` with zeros, essentially resetting the buffer.

Definition at line 77 of file [low_saurion.c](#).

```
00078
00079  if (!iov || !iov->iov_base) {
00080      return ERROR_CODE;
00081  }
00082  if (msg) {
00083      size_t len = iov->iov_len;
```



```

00084     char *dest = (char *)iov->iov_base;
00085     char *orig = (char *)msg + pos * CHUNK_SZ;
00086     size_t cpy_sz = 0;
00087     if (h) {
00088         if (pos == 0) {
00089             uint64_t send_size = htonll(size);
00090             memcpy(dest, &send_size, sizeof(uint64_t));
00091             dest += sizeof(uint64_t);
00092             len -= sizeof(uint64_t);
00093         } else {
00094             orig -= sizeof(uint64_t);
00095         }
00096         if ((pos + 1) == amount) {
00097             --len;
00098             cpy_sz = (len < size ? len : size);
00099             dest[cpy_sz] = 0;
00100         }
00101     }
00102     cpy_sz = (len < size ? len : size);
00103     memcpy(dest, orig, cpy_sz);
00104     dest += cpy_sz;
00105     size_t rem = CHUNK_SZ - (dest - (char *)iov->iov_base);
00106     memset(dest, 0, rem);
00107 } else {
00108     memset((char *)iov->iov_base, 0, CHUNK_SZ);
00109 }
00110 return SUCCESS_CODE;
00111 }

```

5.1.3.5 read_chunk()

```

int read_chunk (
    void ** dest,
    size_t * len,
    struct request *const req ) [private]

```

Reads a message chunk from the request's iovec buffers, handling messages that may span multiple iovec entries.

This function processes data from a `struct request`, which contains an array of `iovec` structures representing buffered data. Each message in the buffers starts with a `size_t` value indicating the size of the message, followed by the message content. The function reads the message size, allocates a buffer for the message content, and copies the data from the iovec buffers into this buffer. It handles messages that span multiple iovec entries and manages incomplete messages by storing partial data within the request structure for subsequent reads.

Parameters

out	<i>dest</i>	Pointer to a variable where the address of the allocated message buffer will be stored. The buffer is allocated by the function and must be freed by the caller.
out	<i>len</i>	Pointer to a <code>size_t</code> variable where the length of the read message will be stored. If a complete message is read, <code>*len</code> is set to the message size. If the message is incomplete, <code>*len</code> is set to 0.
in, out	<i>req</i>	Pointer to a <code>struct request</code> containing the iovec buffers and state information. The function updates the request's state to track the current position within the iovecs and any incomplete messages.

Note

The function assumes that each message is prefixed with its size (of type `size_t`), and that messages may span multiple iovec entries. It also assumes that the data in the iovec buffers is valid and properly aligned for reading `size_t` values.

Warning

The caller is responsible for freeing the allocated message buffer pointed to by `*dest` when it is no longer needed.

Returns

int Returns SUCCESS_CODE on success, or ERROR_CODE on failure (malformed msg).

Return values

<code>SUCCESS_CODE</code>	No malformed message found.
<code>ERROR_CODE</code>	Malformed message found.

Todo add message constraint

validar msg_size, crear maximos

validar offsets

Remaining bytes of the message (content + header + foot) stored in the current IOVEC

Definition at line 350 of file `low_saurion.c`.

```

00350
00351 // Initial checks
00352 if (req->iovec_count == 0) {
00353     return ERROR_CODE;
00354 }
00355
00356 // Initizalization
00357 size_t max_iov_cont = 0; //< Total size of request
00358 for (size_t i = 0; i < req->iovec_count; ++i) {
00359     max_iov_cont += req->iov[i].iov_len;
00360 }
00361 size_t cont_sz = 0; //< Message content size
00362 size_t cont_rem = 0; //< Remaining bytes of message content
00363 size_t curr_iov = 0; //< IOVEC num currently reading
00364 size_t curr_iov_off = 0; //< Offset in bytes of the current IOVEC
00365 size_t dest_off = 0; //< Write offset on the destiny array
00366 void *dest_ptr = NULL; //< Destiny pointer, could be dest or prev
00367 if (req->prev && req->prev_size && req->prev_remain) {
00368     // There's a previous unfinished message
00369     cont_sz = req->prev_size;
00370     cont_rem = req->prev_remain;
00371     curr_iov = 0;
00372     curr_iov_off = 0;
00373     dest_off = cont_sz - cont_rem;
00374     if (cont_rem <= max_iov_cont) {
00375         *dest = req->prev;
00376         dest_ptr = *dest;
00377         req->prev = NULL;
00378         req->prev_size = 0;
00379         req->prev_remain = 0;
00380     } else {
00381         dest_ptr = req->prev;
00382         *dest = NULL;
00383     }
00384 } else if (req->next_iov || req->next_offset) {
00385     // Reading the next message
00386     curr_iov = req->next_iov;
00387     curr_iov_off = req->next_offset;
00388     cont_sz = *((size_t *) (req->iov[curr_iov].iov_base + curr_iov_off));
00389     cont_sz = ntohs(cont_sz);
00390     curr_iov_off += sizeof(uint64_t);
00391     cont_rem = cont_sz;
00392     dest_off = cont_sz - cont_rem;
00393     if ((curr_iov_off + cont_rem + 1) <= max_iov_cont) {
00394         *dest = malloc(cont_sz);
00395         dest_ptr = *dest;
00396     } else {
00397         req->prev = malloc(cont_sz);
00398         dest_ptr = req->prev;

```

```

00399     *dest = NULL;
00400     *len = 0;
00401 }
00402 } else {
00403     // Reading the first message
00404     curr_iov = 0;
00405     curr_iov_off = 0;
00406     cont_sz = *((size_t *) (req->iov[curr_iov].iov_base + curr_iov_off));
00407     cont_sz = ntohs(cont_sz);
00408     curr_iov_off += sizeof(uint64_t);
00409     cont_rem = cont_sz;
00410     dest_off = cont_sz - cont_rem;
00411     if (cont_rem <= max_iov_cont) {
00412         *dest = malloc(cont_sz);
00413         dest_ptr = *dest;
00414     } else {
00415         req->prev = malloc(cont_sz);
00416         dest_ptr = req->prev;
00417         *dest = NULL;
00418     }
00419 }
00421 size_t curr_iov_msg_rem = 0;
00422
00423 // Copy loop
00424 uint8_t ok = 1UL;
00425 while (1) {
00426     curr_iov_msg_rem = MIN(cont_rem, (req->iov[curr_iov].iov_len - curr_iov_off));
00427     memcpy(dest_ptr + dest_off, req->iov[curr_iov].iov_base + curr_iov_off, curr_iov_msg_rem);
00428     dest_off += curr_iov_msg_rem;
00429     curr_iov_off += curr_iov_msg_rem;
00430     cont_rem -= curr_iov_msg_rem;
00431     if (cont_rem <= 0) {
00432         // Finish reading
00433         if (*((uint8_t *) (req->iov[curr_iov].iov_base + curr_iov_off)) != 0) {
00434             ok = 0UL;
00435         }
00436         *len = cont_sz;
00437         ++curr_iov_off;
00438         break;
00439     }
00440     if (curr_iov_off >= (req->iov[curr_iov].iov_len)) {
00441         ++curr_iov;
00442         if (curr_iov == req->iovec_count) {
00443             break;
00444         }
00445         curr_iov_off = 0;
00446     }
00447 }
00448
00449 // Update status
00450 if (req->prev) {
00451     req->prev_size = cont_sz;
00452     req->prev_remain = cont_rem;
00453     *dest = NULL;
00454     len = 0;
00455 } else {
00456     req->prev_size = 0;
00457     req->prev_remain = 0;
00458 }
00459 if (curr_iov < req->iovec_count) {
00460     uint64_t next_sz = *((uint64_t *) (req->iov[curr_iov].iov_base + curr_iov_off));
00461     if ((req->iov[curr_iov].iov_len > curr_iov_off) && next_sz) {
00462         req->next_iov = curr_iov;
00463         req->next_offset = curr_iov_off;
00464     } else {
00465         req->next_iov = 0;
00466         req->next_offset = 0;
00467     }
00468 }
00469
00470 // Finish
00471 if (!ok) {
00472     // Esto solo es posible si no se encuentra un 0 al final de la lectura
00473     // buscar el siguiente 0 y ... probar fortuna
00474     free(dest_ptr);
00475     dest_ptr = NULL;
00476     *dest = NULL;
00477     *len = 0;
00478     req->next_iov = 0;
00479     req->next_offset = 0;
00480     for (size_t i = curr_iov; i < req->iovec_count; ++i) {
00481         for (size_t j = curr_iov_off; j < req->iov[i].iov_len; ++j) {
00482             uint8_t foot = *((uint8_t *) (req->iov[i].iov_base + j));
00483             if (foot == 0) {
00484                 req->next_iov = i;
00485                 req->next_offset = (j + 1) % req->iov[i].iov_len;
00486                 return ERROR_CODE;

```

```

00487     }
00488     }
00489     }
00490     return ERROR_CODE;
00491 }
00492 return SUCCESS_CODE;
00493 }

```

5.1.3.6 saurion_create()

```

struct saurion * saurion_create (
    uint32_t n_threads )

```

Creates an instance of the `saurion` structure.

This function initializes the `saurion` structure, sets up the eventfd, and configures the `io_uring` queue, preparing it for use. It also sets up the thread pool and any necessary synchronization mechanisms.

Parameters

<code>n_threads</code>	The number of threads to initialize in the thread pool.
------------------------	---

Returns

`struct saurion*` A pointer to the newly created `saurion` structure, or `NULL` if an error occurs.

Definition at line 585 of file `low_saurion.c`.

```

00585     {
00586     // Asignar memoria
00587     struct saurion *p = (struct saurion *)malloc(sizeof(struct saurion));
00588     if (!p) {
00589         return NULL;
00590     }
00591     // Inicializar mutex
00592     int ret = 0;
00593     ret = pthread_mutex_init(&p->status_m, NULL);
00594     if (ret) {
00595         free(p);
00596         return NULL;
00597     }
00598     ret = pthread_cond_init(&p->status_c, NULL);
00599     if (ret) {
00600         free(p);
00601         return NULL;
00602     }
00603     p->m_rings = (pthread_mutex_t *)malloc(n_threads * sizeof(pthread_mutex_t));
00604     if (!p->m_rings) {
00605         free(p);
00606         return NULL;
00607     }
00608     for (uint32_t i = 0; i < n_threads; ++i) {
00609         pthread_mutex_init(&(p->m_rings[i]), NULL);
00610     }
00611     // Inicializar miembros
00612     p->ss = 0;
00613     n_threads = (n_threads < 2 ? 2 : n_threads);
00614     n_threads = (n_threads > NUM_CORES ? NUM_CORES : n_threads);
00615     p->n_threads = n_threads;
00616     p->status = 0;
00617     p->list = NULL;
00618     p->cb.on_connected = NULL;
00619     p->cb.on_connected_arg = NULL;
00620     p->cb.on_readed = NULL;
00621     p->cb.on_readed_arg = NULL;
00622     p->cb.on_wrote = NULL;
00623     p->cb.on_wrote_arg = NULL;
00624     p->cb.on_closed = NULL;
00625     p->cb.on_closed_arg = NULL;

```

```

00626     p->cb.on_error = NULL;
00627     p->cb.on_error_arg = NULL;
00628     p->next = 0;
00629     // Inicializar efds
00630     p->efds = (int *)malloc(sizeof(int) * p->n_threads);
00631     if (!p->efds) {
00632         free(p->m_rings);
00633         free(p);
00634         return NULL;
00635     }
00636     for (uint32_t i = 0; i < p->n_threads; ++i) {
00637         p->efds[i] = eventfd(0, EFD_NONBLOCK);
00638         if (p->efds[i] == ERROR_CODE) {
00639             for (uint32_t j = 0; j < i; ++j) {
00640                 close(p->efds[j]);
00641             }
00642             free(p->efds);
00643             free(p->m_rings);
00644             free(p);
00645             return NULL;
00646         }
00647     }
00648     // Inicializar rings
00649     p->rings = (struct io_uring *)malloc(sizeof(struct io_uring) * p->n_threads);
00650     if (!p->rings) {
00651         for (uint32_t j = 0; j < p->n_threads; ++j) {
00652             close(p->efds[j]);
00653         }
00654         free(p->efds);
00655         free(p->m_rings);
00656         free(p);
00657         return NULL;
00658     }
00659     for (uint32_t i = 0; i < p->n_threads; ++i) {
00660         memset(&p->rings[i], 0, sizeof(struct io_uring));
00661         ret = io_uring_queue_init(SAURION_RING_SIZE, &p->rings[i], 0);
00662         if (ret) {
00663             for (uint32_t j = 0; j < p->n_threads; ++j) {
00664                 close(p->efds[j]);
00665             }
00666             free(p->efds);
00667             free(p->rings);
00668             free(p->m_rings);
00669             free(p);
00670             return NULL;
00671         }
00672     }
00673     p->pool = ThreadPool_create(p->n_threads);
00674     return p;
00675 }

```

5.1.3.7 saurion_destroy()

```

void saurion_destroy (
    struct saurion * s )

```

Destroys the `saurion` structure and frees all associated resources.

This function waits for the event processing to stop, frees the memory used by the `saurion` structure, and closes any open file descriptors. It ensures that no resources are leaked when the structure is no longer needed.

Parameters

<code>s</code>	Pointer to the <code>saurion</code> structure.
----------------	--

Definition at line 832 of file `low_saurion.c`.

```

00832     {
00833         pthread_mutex_lock(&s->status_m);
00834         while (s->status == 1) {
00835             pthread_cond_wait(&s->status_c, &s->status_m);
00836         }

```

```

00837 pthread_mutex_unlock(&s->status_m);
00838 ThreadPool_destroy(s->pool);
00839 for (uint32_t i = 0; i < s->n_threads; ++i) {
00840     io_uring_queue_exit(&s->rings[i]);
00841     pthread_mutex_destroy(&s->m_rings[i]);
00842 }
00843 free(s->m_rings);
00844 list_free(&s->list);
00845 for (uint32_t i = 0; i < s->n_threads; ++i) {
00846     close(s->efds[i]);
00847 }
00848 free(s->efds);
00849 if (!s->ss) {
00850     close(s->ss);
00851 }
00852 free(s->rings);
00853 pthread_mutex_destroy(&s->status_m);
00854 pthread_cond_destroy(&s->status_c);
00855 free(s);
00856 }

```

5.1.3.8 saurion_send()

```

void saurion_send (
    struct saurion * s,
    const int fd,
    const char *const msg )

```

Sends a message through a socket using io_uring.

This function prepares and sends a message through the specified socket using the io_uring event queue. The message is split into iovec structures for efficient transmission and sent asynchronously.

Parameters

<i>s</i>	Pointer to the <code>saurion</code> structure.
<i>fd</i>	File descriptor of the socket to which the message will be sent.
<i>msg</i>	Pointer to the character string (message) to be sent.

Definition at line 858 of file `low_saurion.c`.

```

00858 {
00859     add_write(s, fd, msg, next(s));
00860 }

```

5.1.3.9 saurion_start()

```

int saurion_start (
    struct saurion * s )

```

Starts event processing in the `saurion` structure.

This function begins accepting socket connections and handling io_uring events in a loop. It will run continuously until a stop signal is received, allowing the application to manage multiple socket events asynchronously.

Parameters

s	Pointer to the <code>saurion</code> structure.
----------	--

Returns

int Returns 0 on success, or 1 if an error occurs.

Definition at line 808 of file `low_saurion.c`.

```
00808 {
00809     pthread_mutex_init(&print_mutex, NULL);
00810     ThreadPool_init(s->pool);
00811     ThreadPool_add_default(s->pool, saurion_worker_master, s);
00812     struct saurion_wrapper *ss = NULL;
00813     for (uint32_t i = 1; i < s->n_threads; ++i) {
00814         ss = (struct saurion_wrapper *)malloc(sizeof(struct saurion_wrapper));
00815         ss->s = s;
00816         ss->sel = i;
00817         ThreadPool_add_default(s->pool, saurion_worker_slave, ss);
00818     }
00819     return SUCCESS_CODE;
00820 }
```

5.1.3.10 saurion_stop()

```
void saurion_stop (
    const struct saurion * s )
```

Stops event processing in the `saurion` structure.

This function sends a signal to the eventfd, indicating that the event loop should stop. It gracefully shuts down the processing of any remaining events before exiting.

Parameters

s	Pointer to the <code>saurion</code> structure.
----------	--

Definition at line 822 of file `low_saurion.c`.

```
00822 {
00823     uint64_t u = 1;
00824     for (uint32_t i = 0; i < s->n_threads; ++i) {
00825         while (write(s->efds[i], &u, sizeof(u)) < 0) {
00826             usleep(TIMEOUT_RETRY);
00827         }
00828     }
00829     ThreadPool_wait_empty(s->pool);
00830 }
```

5.1.3.11 set_request()

```
int set_request (
    struct request ** r,
    struct Node ** l,
    size_t s,
```

```
const void * m,
uint8_t h ) [private]
```

Sets up a request and allocates iovec structures for data handling in liburing.

This function configures a request structure that will be used to send or receive data through liburing's submission queues. It allocates the necessary iovec structures to split the data into manageable chunks, and optionally adds a header if specified. The request is inserted into a list tracking active requests for proper memory management and deallocation upon completion.

Parameters

<i>r</i>	Pointer to a pointer to the request structure. If NULL, a new request is created.
<i>l</i>	Pointer to the list of active requests (Node list) where the request will be inserted.
<i>s</i>	Size of the data to be handled. Adjusted if the header flag (<i>h</i>) is true.
<i>m</i>	Pointer to the memory block containing the data to be processed.
<i>h</i>	Header flag. If true, a header (<code>sizeof(uint64_t) + 1</code>) is added to the iovec data.

Returns

int Returns SUCCESS_CODE on success, or ERROR_CODE on failure (memory allocation issues or insertion failure).

Return values

<i>SUCCESS_CODE</i>	The request was successfully set up and inserted into the list.
<i>ERROR_CODE</i>	Memory allocation failed, or there was an error inserting the request into the list.

Note

The function handles memory allocation for the request and iovec structures, and ensures that the memory is freed properly if an error occurs. Pointers to the iovec blocks (*children_ptr*) are managed and used for proper memory deallocation.

Definition at line 131 of file [low_saurion.c](#).

```
00131
00132     uint64_t full_size = s;
00133     if (h) {
00134         full_size += (sizeof(uint64_t) + 1);
00135     }
00136     size_t amount = full_size / CHUNK_SZ;
00137     amount = amount + (full_size % CHUNK_SZ == 0 ? 0 : 1);
00138     struct request *temp =
00139         (struct request *)malloc(sizeof(struct request) + sizeof(struct iovec) * amount);
00140     if (!temp) {
00141         return ERROR_CODE;
00142     }
00143     if (!*r) {
00144         *r = temp;
00145         (*r)->prev = NULL;
00146         (*r)->prev_size = 0;
00147         (*r)->prev_remain = 0;
00148         (*r)->next_iov = 0;
00149         (*r)->next_offset = 0;
00150     } else {
00151         temp->client_socket = (*r)->client_socket;
00152         temp->event_type = (*r)->event_type;
00153         temp->prev = (*r)->prev;
00154         temp->prev_size = (*r)->prev_size;
00155         temp->prev_remain = (*r)->prev_remain;
00156         temp->next_iov = (*r)->next_iov;
00157         temp->next_offset = (*r)->next_offset;
```



```
00158     *r = temp;
00159 }
00160 struct request *req = *r;
00161 req->iovec_count = (int)amount;
00162 void **children_ptr = (void **)malloc(amount * sizeof(void *));
00163 if (!children_ptr) {
00164     free_request(req, children_ptr, 0);
00165     return ERROR_CODE;
00166 }
00167 for (size_t i = 0; i < amount; ++i) {
00168     if (!allocate_iovec(&req->iov[i], amount, i, full_size, children_ptr)) {
00169         free_request(req, children_ptr, amount);
00170         return ERROR_CODE;
00171     }
00172     if (!initialize_iovec(&req->iov[i], amount, i, m, s, h)) {
00173         free_request(req, children_ptr, amount);
00174         return ERROR_CODE;
00175     }
00176 }
00177 if (list_insert(l, req, amount, children_ptr)) {
00178     free_request(req, children_ptr, amount);
00179     return ERROR_CODE;
00180 }
00181 free(children_ptr);
00182 return SUCCESS_CODE;
00183 }
```


Chapter 6

Class Documentation

6.1 ThreadPool::AsyncMultiQueue Struct Reference

Public Member Functions

- [AsyncMultiQueue](#) ()
- [~AsyncMultiQueue](#) ()
- [AsyncMultiQueue](#) (const [AsyncMultiQueue](#) &)=delete
- [AsyncMultiQueue](#) & [operator=](#) (const [AsyncMultiQueue](#) &)=delete
- [AsyncMultiQueue](#) ([AsyncMultiQueue](#) &&)=delete
- [AsyncMultiQueue](#) & [operator=](#) ([AsyncMultiQueue](#) &&)=delete
- void [new_queue](#) (uint32_t qid, uint32_t cnt)
- void [remove_queue](#) (uint32_t qid)
- void [push](#) (uint32_t qid, void(*nfn)(void *), void *arg)
- [Task](#) * [front](#) (uint32_t &qid)
- void [pop](#) (uint32_t qid)
- void [clear](#) ()
- bool [empty](#) ()

Private Attributes

- std::unordered_map< uint32_t, [AsyncQueue](#) * > [m_queues](#)
- std::unordered_map< uint32_t, [AsyncQueue](#) * >::iterator [m_it](#)

6.1.1 Detailed Description

Definition at line 50 of file [threadpool.hpp](#).

6.1.2 Constructor & Destructor Documentation

6.1.2.1 AsyncMultiQueue() [1/3]

TP::AsyncMultiQueue::AsyncMultiQueue () [explicit]

Definition at line 52 of file [threadpool.cpp](#).

```
00052     {
00053     new_queue(0, 0);
00054     m_it = m_queues.begin();
00055 }
```

6.1.2.2 ~AsyncMultiQueue()

TP::AsyncMultiQueue::~AsyncMultiQueue ()

Definition at line 56 of file [threadpool.cpp](#).

```
00056     {
00057     for (auto& queue : m_queues) {
00058         delete queue.second;
00059     }
00060 }
```

6.1.2.3 AsyncMultiQueue() [2/3]

ThreadPool::AsyncMultiQueue::AsyncMultiQueue (
 const AsyncMultiQueue &) [delete]

6.1.2.4 AsyncMultiQueue() [3/3]

ThreadPool::AsyncMultiQueue::AsyncMultiQueue (
 AsyncMultiQueue &&) [delete]

6.1.3 Member Function Documentation

6.1.3.1 clear()

void TP::AsyncMultiQueue::clear ()

Definition at line 101 of file [threadpool.cpp](#).

```
00101     {
00102     if (empty()) {
00103         return;
00104     }
00105     auto newit = m_queues.begin();
00106     while (newit != m_queues.end()) {
00107         while (!newit->second->empty()) {
00108             delete newit->second->front();
00109             newit->second->pop();
00110         }
00111         ++newit;
00112     }
00113 }
```

6.1.3.2 empty()

bool TP::AsyncMultiQueue::empty ()

Definition at line 115 of file [threadpool.cpp](#).

```
00115     {
00116     for (auto& queue : m_queues) {
00117         if (!queue.second->empty()) {
00118             return false;
00119         }
00120     }
00121     return true;
00122 }
```

6.1.3.3 front()

Task * TP::AsyncMultiQueue::front (
 uint32_t & qid)

Definition at line 80 of file [threadpool.cpp](#).

```
00080     {
00081     if (empty()) {
00082         throw std::out_of_range("empty queue");
00083     }
00084     auto newit = m_it;
00085     ++newit;
00086     while (newit != m_it) {
00087         if (newit == m_queues.end()) {
00088             newit = m_queues.begin();
00089         }
00090         if (!newit->second->empty()) {
00091             break;
00092         }
00093         ++newit;
00094     }
00095     Task* task = newit->second->front();
00096     qid = newit->first;
00097     m_it = newit;
00098     return task;
00099 }
```

6.1.3.4 new_queue()

void TP::AsyncMultiQueue::new_queue (
 uint32_t qid,
 uint32_t cnt)

Definition at line 62 of file [threadpool.cpp](#).

```
00062     {
00063     if (m_queues.find(qid) != m_queues.end()) {
00064         throw std::out_of_range("queue already exists");
00065     }
00066     m_queues.emplace(qid, new TP::AsyncQueue(cnt));
00067 }
```

6.1.3.5 operator=() [1/2]

AsyncMultiQueue & ThreadPool::AsyncMultiQueue::operator= (
 AsyncMultiQueue &&) [delete]

6.1.3.6 operator=() [2/2]

```
AsyncMultiQueue & ThreadPool::AsyncMultiQueue::operator= (
    const AsyncMultiQueue & ) [delete]
```

6.1.3.7 pop()

```
void TP::AsyncMultiQueue::pop (
    uint32_t qid )
```

Definition at line 100 of file [threadpool.cpp](#).

```
00100 { m_queues.at(qid)->pop(); }
```

6.1.3.8 push()

```
void TP::AsyncMultiQueue::push (
    uint32_t qid,
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 77 of file [threadpool.cpp](#).

```
00077 {
00078     m_queues.at(qid)->push(new Task{nfn, arg});
00079 }
```

6.1.3.9 remove_queue()

```
void TP::AsyncMultiQueue::remove_queue (
    uint32_t qid )
```

Definition at line 68 of file [threadpool.cpp](#).

```
00068 {
00069     auto queue = m_queues.find(qid);
00070     if (queue == m_queues.end()) {
00071         throw std::out_of_range("queue not found");
00072     }
00073     delete queue->second;
00074     m_queues.erase(qid);
00075 }
```

6.1.4 Member Data Documentation

6.1.4.1 m_it

```
std::unordered_map<uint32_t, AsyncQueue*>::iterator ThreadPool::AsyncMultiQueue::m_it [private]
```

Definition at line 53 of file [threadpool.hpp](#).

6.1.4.2 m_queues

```
std::unordered_map<uint32_t, AsyncQueue*> ThreadPool::AsyncMultiQueue::m_queues [private]
```

Definition at line 52 of file [threadpool.hpp](#).

The documentation for this struct was generated from the following files:

- [/_w/saurion/saurion/include/threadpool.hpp](#)
- [/_w/saurion/saurion/src/threadpool.cpp](#)

6.2 ThreadPool::AsyncQueue Struct Reference

Public Member Functions

- [AsyncQueue](#) (uint32_t cnt)
- [~AsyncQueue](#) ()
- [AsyncQueue](#) (const [AsyncQueue](#) &)=delete
- [AsyncQueue](#) & operator= (const [AsyncQueue](#) &)=delete
- [AsyncQueue](#) ([AsyncQueue](#) &&)=delete
- [AsyncQueue](#) & operator= ([AsyncQueue](#) &&)=delete
- void [push](#) ([Task](#) *task)
- [Task](#) * [front](#) ()
- void [pop](#) ()
- bool [empty](#) ()

Private Attributes

- std::queue< [Task](#) * > [m_queue](#)
- uint32_t [m_max](#)
- uint32_t [m_cnt](#)
- pthread_mutex_t [m_mtx](#) = PTHREAD_MUTEX_INITIALIZER

6.2.1 Detailed Description

Definition at line 29 of file [threadpool.hpp](#).

6.2.2 Constructor & Destructor Documentation

6.2.2.1 AsyncQueue() [1/3]

```
TP::AsyncQueue::AsyncQueue (
    uint32_t cnt ) [explicit]
```

Definition at line 16 of file [threadpool.cpp](#).

```
00016 :   m_max(cnt), m_cnt(0) {}
```

6.2.2.2 ~AsyncQueue()

```
TP::AsyncQueue::~~AsyncQueue ( )
```

Definition at line 18 of file [threadpool.cpp](#).

```
00018 { pthread_mutex_destroy(&m_mtx); }
```

6.2.2.3 AsyncQueue() [2/3]

```
ThreadPool::AsyncQueue::AsyncQueue (
    const AsyncQueue & ) [delete]
```

6.2.2.4 AsyncQueue() [3/3]

```
ThreadPool::AsyncQueue::AsyncQueue (
    AsyncQueue && ) [delete]
```

6.2.3 Member Function Documentation

6.2.3.1 empty()

```
bool TP::AsyncQueue::empty ( )
```

Definition at line 43 of file [threadpool.cpp](#).

```
00043     {
00044     pthread_mutex_lock(&m_mtx);
00045     bool empty = m_queue.empty();
00046     pthread_mutex_unlock(&m_mtx);
00047     return empty;
00048 }
```


6.2.3.2 front()

`Task * TP::AsyncQueue::front ()`

Definition at line 25 of file [threadpool.cpp](#).

```

00025     {
00026     pthread_mutex_lock(&m_mtx);
00027     if ((m_cnt >= m_max) && (m_max != 0)) {
00028         pthread_mutex_unlock(&m_mtx);
00029         throw std::out_of_range("reached max parallel tasks");
00030     }
00031     Task* task = m_queue.front();
00032     m_queue.pop();
00033     ++m_cnt;
00034     pthread_mutex_unlock(&m_mtx);
00035     return task;
00036 }

```

6.2.3.3 operator=() [1/2]

`AsyncQueue & ThreadPool::AsyncQueue::operator= (`
`AsyncQueue &&) [delete]`

6.2.3.4 operator=() [2/2]

`AsyncQueue & ThreadPool::AsyncQueue::operator= (`
`const AsyncQueue &) [delete]`

6.2.3.5 pop()

`void TP::AsyncQueue::pop ()`

Definition at line 37 of file [threadpool.cpp](#).

```

00037     {
00038     pthread_mutex_lock(&m_mtx);
00039     --m_cnt;
00040     pthread_mutex_unlock(&m_mtx);
00041 }

```

6.2.3.6 push()

`void TP::AsyncQueue::push (`
`Task * task)`

Definition at line 20 of file [threadpool.cpp](#).

```

00020     {
00021     pthread_mutex_lock(&m_mtx);
00022     m_queue.push(task);
00023     pthread_mutex_unlock(&m_mtx);
00024 }

```

6.2.4 Member Data Documentation

6.2.4.1 m_cnt

```
uint32_t ThreadPool::AsyncQueue::m_cnt [private]
```

Definition at line 33 of file [threadpool.hpp](#).

6.2.4.2 m_max

```
uint32_t ThreadPool::AsyncQueue::m_max [private]
```

Definition at line 32 of file [threadpool.hpp](#).

6.2.4.3 m_mtx

```
pthread_mutex_t ThreadPool::AsyncQueue::m_mtx = PTHREAD_MUTEX_INITIALIZER [private]
```

Definition at line 34 of file [threadpool.hpp](#).

6.2.4.4 m_queue

```
std::queue<Task*> ThreadPool::AsyncQueue::m_queue [private]
```

Definition at line 31 of file [threadpool.hpp](#).

The documentation for this struct was generated from the following files:

- [/__w/saurion/saurion/include/threadpool.hpp](#)
- [/__w/saurion/saurion/src/threadpool.cpp](#)

6.3 Node Struct Reference

Collaboration diagram for Node:

Public Attributes

- void * [ptr](#)
- size_t [size](#)
- struct [Node](#) ** [children](#)
- struct [Node](#) * [next](#)

6.3.1 Detailed Description

Definition at line 6 of file [linked_list.c](#).

6.3.2 Member Data Documentation

6.3.2.1 children

```
struct Node** Node::children
```

Definition at line 9 of file [linked_list.c](#).

6.3.2.2 next

```
struct Node* Node::next
```

Definition at line 10 of file [linked_list.c](#).

6.3.2.3 ptr

```
void* Node::ptr
```

Definition at line 7 of file [linked_list.c](#).

6.3.2.4 size

```
size_t Node::size
```

Definition at line 8 of file [linked_list.c](#).

The documentation for this struct was generated from the following file:

- [/_w/saurion/saurion/src/linked_list.c](#)

6.4 request Struct Reference

Public Attributes

- void * [prev](#)
- size_t [prev_size](#)
- size_t [prev_remain](#)
- size_t [next_iov](#)
- size_t [next_offset](#)
- int [event_type](#)
- size_t [iovec_count](#)
- int [client_socket](#)
- struct iovec [iov](#) []

6.4.1 Detailed Description

Definition at line 15 of file [low_saurion.c](#).

6.4.2 Member Data Documentation

6.4.2.1 client_socket

```
int request::client_socket
```

Definition at line 23 of file [low_saurion.c](#).

6.4.2.2 event_type

```
int request::event_type
```

Definition at line 21 of file [low_saurion.c](#).

6.4.2.3 iov

```
struct iovec request::iov[]
```

Definition at line 24 of file [low_saurion.c](#).

6.4.2.4 iovec_count

```
size_t request::iovec_count
```

Definition at line 22 of file [low_saurion.c](#).

6.4.2.5 next_iov

```
size_t request::next_iov
```

Definition at line 19 of file [low_saurion.c](#).

6.4.2.6 next_offset

```
size_t request::next_offset
```

Definition at line 20 of file [low_saurion.c](#).

6.4.2.7 prev

```
void* request::prev
```

Definition at line 16 of file [low_saurion.c](#).

6.4.2.8 prev_remain

```
size_t request::prev_remain
```

Definition at line 18 of file [low_saurion.c](#).

6.4.2.9 prev_size

```
size_t request::prev_size
```

Definition at line 17 of file [low_saurion.c](#).

The documentation for this struct was generated from the following file:

- [/_w/saurion/saurion/src/low_saurion.c](#)

6.5 saurion Struct Reference

Main structure for managing io_uring and socket events.

```
#include <low_saurion.h>
```

Collaboration diagram for saurion:

Classes

- struct [saurion_callbacks](#)
Structure containing callback functions to handle socket events.

Public Attributes

- struct io_uring * [rings](#)
- pthread_mutex_t * [m_rings](#)
- int [ss](#)
- int * [efds](#)
- struct [Node](#) * [list](#)
- pthread_mutex_t [status_m](#)
- pthread_cond_t [status_c](#)
- int [status](#)
- [ThreadPool](#) * [pool](#)
- uint32_t [n_threads](#)
- uint32_t [next](#)

6.5.1 Detailed Description

Main structure for managing io_uring and socket events.

This structure contains all the necessary data to handle the io_uring event queue and the callbacks for socket events, enabling efficient asynchronous I/O operations.

Definition at line [137](#) of file [low_saurion.h](#).

6.5.2 Member Data Documentation

6.5.2.1 efds

```
int* saurion::efds
```

Eventfd descriptors used for internal signaling between threads.

Definition at line [142](#) of file [low_saurion.h](#).

6.5.2.2 list

```
struct Node* saurion::list
```

Linked list for storing active requests.

Definition at line 143 of file [low_saurion.h](#).

6.5.2.3 m_rings

```
pthread_mutex_t* saurion::m_rings
```

Array of mutexes to protect the io_uring rings during concurrent access.

Definition at line 140 of file [low_saurion.h](#).

6.5.2.4 n_threads

```
uint32_t saurion::n_threads
```

Number of threads in the thread pool.

Definition at line 148 of file [low_saurion.h](#).

6.5.2.5 next

```
uint32_t saurion::next
```

Index of the next io_uring ring to which an event will be added.

Definition at line 149 of file [low_saurion.h](#).

6.5.2.6 pool

```
ThreadPool* saurion::pool
```

Thread pool for executing tasks in parallel.

Definition at line 147 of file [low_saurion.h](#).

6.5.2.7 rings

```
struct io_uring* saurion::rings
```

Array of `io_uring` structures for managing the event queue.

Definition at line 138 of file [low_saurion.h](#).

6.5.2.8 ss

```
int saurion::ss
```

Server socket descriptor for accepting connections.

Definition at line 141 of file [low_saurion.h](#).

6.5.2.9 status

```
int saurion::status
```

Current status of the structure (e.g., running, stopped).

Definition at line 146 of file [low_saurion.h](#).

6.5.2.10 status_c

```
pthread_cond_t saurion::status_c
```

Condition variable to signal changes in the structure's state.

Definition at line 145 of file [low_saurion.h](#).

6.5.2.11 status_m

```
pthread_mutex_t saurion::status_m
```

Mutex to protect the state of the structure.

Definition at line 144 of file [low_saurion.h](#).

The documentation for this struct was generated from the following file:

- [/__w/saurion/saurion/include/low_saurion.h](#)

6.6 Saurion Class Reference

```
#include <saurion.hpp>
```

Collaboration diagram for Saurion:

Public Types

- using [ConnectedCb](#) = void(*)(const int, void *)
- using [ReadedCb](#) = void(*)(const int, const void *const, const ssize_t, void *)
- using [WroteCb](#) = void(*)(const int, void *)
- using [ClosedCb](#) = void(*)(const int, void *)
- using [ErrorCb](#) = void(*)(const int, const char *const, const ssize_t, void *)

Public Member Functions

- [Saurion](#) (const uint32_t thds, const int sock) noexcept
- [~Saurion](#) ()
- [Saurion](#) (const [Saurion](#) &)=delete
- [Saurion](#) ([Saurion](#) &&)=delete
- [Saurion](#) & [operator=](#) (const [Saurion](#) &)=delete
- [Saurion](#) & [operator=](#) ([Saurion](#) &&)=delete
- void [init](#) () noexcept
- void [stop](#) () noexcept
- [Saurion](#) * [on_connected](#) ([ConnectedCb](#) ncb, void *arg) noexcept
- [Saurion](#) * [on_readed](#) ([ReadedCb](#) ncb, void *arg) noexcept
- [Saurion](#) * [on_wrote](#) ([WroteCb](#) ncb, void *arg) noexcept
- [Saurion](#) * [on_closed](#) ([ClosedCb](#) ncb, void *arg) noexcept
- [Saurion](#) * [on_error](#) ([ErrorCb](#) ncb, void *arg) noexcept
- void [send](#) (const int fd, const char *const msg) noexcept

Private Attributes

- struct [saurion](#) * [s](#)

6.6.1 Detailed Description

Definition at line 6 of file [saurion.hpp](#).

6.6.2 Member Typedef Documentation

6.6.2.1 ClosedCb

```
using Saurion::ClosedCb = void (*)(const int, void *)
```

Definition at line 11 of file [saurion.hpp](#).

6.6.2.2 ConnectedCb

using [Saurion::ConnectedCb](#) = void (*) (const int, void *)

Definition at line 8 of file [saurion.hpp](#).

6.6.2.3 ErrorCb

using [Saurion::ErrorCb](#) = void (*) (const int, const char *const, const ssize_t, void *)

Definition at line 12 of file [saurion.hpp](#).

6.6.2.4 ReadedCb

using [Saurion::ReadedCb](#) = void (*) (const int, const void *const, const ssize_t, void *)

Definition at line 9 of file [saurion.hpp](#).

6.6.2.5 WroteCb

using [Saurion::WroteCb](#) = void (*) (const int, void *)

Definition at line 10 of file [saurion.hpp](#).

6.6.3 Constructor & Destructor Documentation

6.6.3.1 Saurion() [1/3]

```
Saurion::Saurion (  
    const uint32_t thds,  
    const int sck ) [explicit], [noexcept]
```

Definition at line 7 of file [saurion.cpp](#).

```
00007                                     {  
00008     this->s = saurion_create(thds);  
00009     if (!this->s) {  
00010         return;  
00011     }  
00012     this->s->ss = sck;  
00013 }
```

6.6.3.2 ~Saurion()

```
Saurion::~~Saurion ( )
```

Definition at line 15 of file [saurion.cpp](#).

```
00015 { saurion_destroy(this->s); }
```

6.6.3.3 Saurion() [2/3]

```
Saurion::Saurion (
    const Saurion & ) [delete]
```

6.6.3.4 Saurion() [3/3]

```
Saurion::Saurion (
    Saurion && ) [delete]
```

6.6.4 Member Function Documentation

6.6.4.1 init()

```
void Saurion::init ( ) [noexcept]
```

Definition at line 17 of file [saurion.cpp](#).

```
00017 {
00018     if (!saurion_start(this->s)) {
00019         return;
00020     }
00021 }
```

6.6.4.2 on_closed()

```
Saurion * Saurion::on_closed (
    Saurion::ClosedCb ncb,
    void * arg ) [noexcept]
```

Definition at line 43 of file [saurion.cpp](#).

```
00043 {
00044     s->cb.on_closed = ncb;
00045     s->cb.on_closed_arg = arg;
00046     return this;
00047 }
```

6.6.4.3 on_connected()

```
Saurion * Saurion::on_connected (
    Saurion::ConnectedCb ncb,
    void * arg ) [noexcept]
```

Definition at line 25 of file [saurion.cpp](#).

```
00025 {
00026     s->cb.on_connected = ncb;
00027     s->cb.on_connected_arg = arg;
00028     return this;
00029 }
```

6.6.4.4 on_error()

```
Saurion * Saurion::on_error (
    Saurion::ErrorCb ncb,
    void * arg ) [noexcept]
```

Definition at line 49 of file [saurion.cpp](#).

```
00049 {
00050     s->cb.on_error = ncb;
00051     s->cb.on_error_arg = arg;
00052     return this;
00053 }
```

6.6.4.5 on_readed()

```
Saurion * Saurion::on_readed (
    Saurion::ReadedCb ncb,
    void * arg ) [noexcept]
```

Definition at line 31 of file [saurion.cpp](#).

```
00031 {
00032     s->cb.on_readed = ncb;
00033     s->cb.on_readed_arg = arg;
00034     return this;
00035 }
```

6.6.4.6 on_wrote()

```
Saurion * Saurion::on_wrote (
    Saurion::WroteCb ncb,
    void * arg ) [noexcept]
```

Definition at line 37 of file [saurion.cpp](#).

```
00037 {
00038     s->cb.on_wrote = ncb;
00039     s->cb.on_wrote_arg = arg;
00040     return this;
00041 }
```

6.6.4.7 operator=() [1/2]

```
Saurion & Saurion::operator= (
    const Saurion & ) [delete]
```

6.6.4.8 operator=() [2/2]

```
Saurion & Saurion::operator= (
    Saurion && ) [delete]
```

6.6.4.9 send()

```
void Saurion::send (
    const int fd,
    const char *const msg ) [noexcept]
```

Definition at line 55 of file [saurion.cpp](#).

```
00055 { saurion_send(this->s, fd, msg); }
```

6.6.4.10 stop()

```
void Saurion::stop ( ) [noexcept]
```

Definition at line 23 of file [saurion.cpp](#).

```
00023 { saurion_stop(this->s); }
```

6.6.5 Member Data Documentation

6.6.5.1 s

```
struct saurion* Saurion::s [private]
```

Definition at line 34 of file [saurion.hpp](#).

The documentation for this class was generated from the following files:

- [/__w/saurion/saurion/include/saurion.hpp](#)
- [/__w/saurion/saurion/src/saurion.cpp](#)

6.7 saurion::saurion_callbacks Struct Reference

Structure containing callback functions to handle socket events.

```
#include <low_saurion.h>
```

Public Attributes

- void(* [on_connected](#))(const int fd, void *arg)
Callback for handling new connections.
- void * [on_connected_arg](#)
- void(* [on_readed](#))(const int fd, const void *const content, const ssize_t len, void *arg)
Callback for handling read events.
- void * [on_readed_arg](#)
- void(* [on_wrote](#))(const int fd, void *arg)
Callback for handling write events.
- void * [on_wrote_arg](#)
- void(* [on_closed](#))(const int fd, void *arg)
Callback for handling socket closures.
- void * [on_closed_arg](#)
- void(* [on_error](#))(const int fd, const char *const content, const ssize_t len, void *arg)
Callback for handling error events.
- void * [on_error_arg](#)

6.7.1 Detailed Description

Structure containing callback functions to handle socket events.

This structure holds pointers to callback functions for handling events such as connection establishment, reading, writing, closing, and errors on sockets. Each callback has an associated argument pointer that can be passed along when the callback is invoked.

Definition at line 159 of file [low_saurion.h](#).

6.7.2 Member Data Documentation

6.7.2.1 on_closed

```
void(* saurion::saurion_callbacks::on_closed) (const int fd, void *arg)
```

Callback for handling socket closures.

Parameters

<i>fd</i>	File descriptor of the closed socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 195 of file [low_saurion.h](#).

6.7.2.2 on_closed_arg

```
void* saurion::saurion_callbacks::on_closed_arg
```

Additional argument for the close callback.

Definition at line 196 of file [low_saurion.h](#).

6.7.2.3 on_connected

```
void(* saurion::saurion_callbacks::on_connected) (const int fd, void *arg)
```

Callback for handling new connections.

Parameters

<i>fd</i>	File descriptor of the connected socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 166 of file [low_saurion.h](#).

6.7.2.4 on_connected_arg

```
void* saurion::saurion_callbacks::on_connected_arg
```

Additional argument for the connection callback.

Definition at line 167 of file [low_saurion.h](#).

6.7.2.5 on_error

```
void(* saurion::saurion_callbacks::on_error) (const int fd, const char *const content, const  
ssize_t len, void *arg)
```

Callback for handling error events.

Parameters

<i>fd</i>	File descriptor of the socket where the error occurred.
<i>content</i>	Pointer to the error message.
<i>len</i>	Length of the error message.
<i>arg</i>	Additional user-provided argument.

Definition at line 206 of file [low_saurion.h](#).

6.7.2.6 on_error_arg

```
void* saurion::saurion_callbacks::on_error_arg
```

Additional argument for the error callback.

Definition at line 207 of file [low_saurion.h](#).

6.7.2.7 on_readed

```
void(* saurion::saurion_callbacks::on_readed) (const int fd, const void *const content, const
ssize_t len, void *arg)
```

Callback for handling read events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>content</i>	Pointer to the data that was read.
<i>len</i>	Length of the data that was read.
<i>arg</i>	Additional user-provided argument.

Definition at line 177 of file [low_saurion.h](#).

6.7.2.8 on_readed_arg

```
void* saurion::saurion_callbacks::on_readed_arg
```

Additional argument for the read callback.

Definition at line 178 of file [low_saurion.h](#).

6.7.2.9 on_wrote

```
void(* saurion::saurion_callbacks::on_wrote) (const int fd, void *arg)
```

Callback for handling write events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 186 of file [low_saurion.h](#).

6.7.2.10 on_wrote_arg

```
void* saurion::saurion_callbacks::on_wrote_arg
```

Additional argument for the write callback.

Definition at line 187 of file [low_saurion.h](#).

The documentation for this struct was generated from the following file:

- [/_w/saurion/saurion/include/low_saurion.h](#)

6.8 saurion_callbacks Struct Reference

Structure containing callback functions to handle socket events.

```
#include <low_saurion.h>
```

Public Attributes

- void(* [on_connected](#))(const int fd, void *arg)
Callback for handling new connections.
- void * [on_connected_arg](#)
- void(* [on_readed](#))(const int fd, const void *const content, const ssize_t len, void *arg)
Callback for handling read events.
- void * [on_readed_arg](#)
- void(* [on_wrote](#))(const int fd, void *arg)
Callback for handling write events.
- void * [on_wrote_arg](#)
- void(* [on_closed](#))(const int fd, void *arg)
Callback for handling socket closures.
- void * [on_closed_arg](#)
- void(* [on_error](#))(const int fd, const char *const content, const ssize_t len, void *arg)
Callback for handling error events.
- void * [on_error_arg](#)

6.8.1 Detailed Description

Structure containing callback functions to handle socket events.

This structure holds pointers to callback functions for handling events such as connection establishment, reading, writing, closing, and errors on sockets. Each callback has an associated argument pointer that can be passed along when the callback is invoked.

Definition at line 21 of file [low_saurion.h](#).

6.8.2 Member Data Documentation

6.8.2.1 on_closed

```
void(* saurion_callbacks::on_closed) (const int fd, void *arg)
```

Callback for handling socket closures.

Parameters

<i>fd</i>	File descriptor of the closed socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 57 of file [low_saurion.h](#).

6.8.2.2 on_closed_arg

```
void* saurion_callbacks::on_closed_arg
```

Additional argument for the close callback.

Definition at line 58 of file [low_saurion.h](#).

6.8.2.3 on_connected

```
void(* saurion_callbacks::on_connected) (const int fd, void *arg)
```

Callback for handling new connections.

Parameters

<i>fd</i>	File descriptor of the connected socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 28 of file [low_saurion.h](#).

6.8.2.4 on_connected_arg

```
void* saurion_callbacks::on_connected_arg
```

Additional argument for the connection callback.

Definition at line 29 of file [low_saurion.h](#).

6.8.2.5 on_error

```
void(* saurion_callbacks::on_error) (const int fd, const char *const content, const ssize_t len, void *arg)
```

Callback for handling error events.

Parameters

<i>fd</i>	File descriptor of the socket where the error occurred.
<i>content</i>	Pointer to the error message.
<i>len</i>	Length of the error message.
<i>arg</i>	Additional user-provided argument.

Definition at line 68 of file [low_saurion.h](#).

6.8.2.6 on_error_arg

```
void* saurion_callbacks::on_error_arg
```

Additional argument for the error callback.

Definition at line 69 of file [low_saurion.h](#).

6.8.2.7 on_readed

```
void(* saurion_callbacks::on_readed) (const int fd, const void *const content, const ssize_t len, void *arg)
```

Callback for handling read events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>content</i>	Pointer to the data that was read.
<i>len</i>	Length of the data that was read.
<i>arg</i>	Additional user-provided argument.

Definition at line 39 of file [low_saurion.h](#).

6.8.2.8 on_readed_arg

```
void* saurion_callbacks::on_readed_arg
```

Additional argument for the read callback.

Definition at line 40 of file [low_saurion.h](#).

6.8.2.9 on_wrote

```
void(* saurion_callbacks::on_wrote) (const int fd, void *arg)
```

Callback for handling write events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 48 of file [low_saurion.h](#).

6.8.2.10 on_wrote_arg

```
void* saurion_callbacks::on_wrote_arg
```

Additional argument for the write callback.

Definition at line 49 of file [low_saurion.h](#).

The documentation for this struct was generated from the following file:

- [/__w/saurion/saurion/include/low_saurion.h](#)

6.9 saurion_wrapper Struct Reference

Collaboration diagram for saurion_wrapper:

Public Attributes

- struct [saurion](#) * [s](#)
- uint32_t [sel](#)

6.9.1 Detailed Description

Definition at line 31 of file [low_saurion.c](#).

6.9.2 Member Data Documentation

6.9.2.1 s

```
struct saurion* saurion_wrapper::s
```

Definition at line 32 of file [low_saurion.c](#).

6.9.2.2 sel

```
uint32_t saurion_wrapper::sel
```

Definition at line 33 of file [low_saurion.c](#).

The documentation for this struct was generated from the following file:

- [/_w/saurion/saurion/src/low_saurion.c](#)

6.10 Task Struct Reference

```
#include <threadpool.hpp>
```

Public Member Functions

- [Task](#) (void(*fn)(void *), void *narg)
- [Task](#) (const [Task](#) &)=delete
- [Task](#) ([Task](#) &&)=delete
- [Task](#) & [operator=](#) (const [Task](#) &)=delete
- [Task](#) & [operator=](#) ([Task](#) &&)=delete
- [~Task](#) ()=default

Public Attributes

- void(* [function](#))(void *)
- void * [argument](#)

6.10.1 Detailed Description

Definition at line 14 of file [threadpool.hpp](#).

6.10.2 Constructor & Destructor Documentation

6.10.2.1 Task() [1/3]

```
T::Task (  
    void(*) (void *) nfn,  
    void * narg ) [explicit]
```

Definition at line 13 of file [threadpool.cpp](#).

```
00013 : function(nfn), argument(narg) {}
```

6.10.2.2 Task() [2/3]

```
Task::Task (  
    const Task & ) [delete]
```

6.10.2.3 Task() [3/3]

```
Task::Task (  
    Task && ) [delete]
```

6.10.2.4 ~Task()

```
Task::~Task ( ) [default]
```

6.10.3 Member Function Documentation

6.10.3.1 operator=() [1/2]

```
Task & Task::operator= (
    const Task & ) [delete]
```

6.10.3.2 operator=() [2/2]

```
Task & Task::operator= (
    Task && ) [delete]
```

6.10.4 Member Data Documentation

6.10.4.1 argument

```
void* Task::argument
```

Definition at line 16 of file [threadpool.hpp](#).

6.10.4.2 function

```
void(* Task::function) (void *)
```

Definition at line 15 of file [threadpool.hpp](#).

The documentation for this struct was generated from the following files:

- [/__w/saurion/saurion/include/threadpool.hpp](#)
- [/__w/saurion/saurion/src/threadpool.cpp](#)

6.11 ThreadPool Class Reference

```
#include <threadpool.hpp>
```

Collaboration diagram for ThreadPool:

Classes

- struct [AsyncMultiQueue](#)
- struct [AsyncQueue](#)

Public Member Functions

- [ThreadPool](#) ()
- [ThreadPool](#) (size_t num_threads)
- [ThreadPool](#) (const [ThreadPool](#) &)=delete
- [ThreadPool](#) & operator= (const [ThreadPool](#) &)=delete
- [ThreadPool](#) ([ThreadPool](#) &&)=delete
- [ThreadPool](#) & operator= ([ThreadPool](#) &&)=delete
- void [init](#) ()
- void [stop](#) ()
- void [add](#) (uint32_t qid, void(*nfn)(void *), void *arg)
- void [add](#) (void(*nfn)(void *), void *arg)
- void [new_queue](#) (uint32_t qid, uint32_t cnt)
- void [remove_queue](#) (uint32_t qid)
- bool [empty](#) ()
- void [wait_empty](#) ()
- ~[ThreadPool](#) ()

Private Types

- typedef struct [ThreadPool::AsyncQueue](#) [AsyncQueue](#)
- typedef struct [ThreadPool::AsyncMultiQueue](#) [AsyncMultiQueue](#)

Private Member Functions

- void [wait_closeable](#) ()
- void [thread_worker](#) ()

Static Private Member Functions

- static void * [thread_entry](#) (void *arg)

Private Attributes

- size_t [m_nth](#)
- size_t [m_started](#)
- [AsyncMultiQueue](#) [m_queues](#)
- pthread_mutex_t [m_q_mtx](#) = PTHREAD_MUTEX_INITIALIZER
- pthread_cond_t [m_q_cond](#) = PTHREAD_COND_INITIALIZER
- pthread_t * [m_ths](#)
- volatile sig_atomic_t [m_fstop](#)
- volatile sig_atomic_t [m_faccept](#)

Static Private Attributes

- static pthread_mutex_t [s_mtx](#) = PTHREAD_MUTEX_INITIALIZER

6.11.1 Detailed Description

Definition at line 27 of file [threadpool.hpp](#).

6.11.2 Member Typedef Documentation

6.11.2.1 AsyncMultiQueue

```
typedef struct ThreadPool::AsyncMultiQueue ThreadPool::AsyncMultiQueue [private]
```

6.11.2.2 AsyncQueue

```
typedef struct ThreadPool::AsyncQueue ThreadPool::AsyncQueue [private]
```

6.11.3 Constructor & Destructor Documentation

6.11.3.1 ThreadPool() [1/4]

```
TP::ThreadPool ( )
```

Definition at line 128 of file [threadpool.cpp](#).

```
00128 :   ThreadPool(4) {}
```

6.11.3.2 ThreadPool() [2/4]

```
TP::ThreadPool (
    size_t num_threads ) [explicit]
```

Definition at line 130 of file [threadpool.cpp](#).

```
00131 :   m_nth(num_threads < 2 ? 2 : num_threads),
00132 :   m_started(0),
00133 :   m_ths(new pthread_t[m_nth]{0}),
00134 :   m_fstop(0),
00135 :   m_faccept(0) {}
```

6.11.3.3 ThreadPool() [3/4]

```
ThreadPool::ThreadPool (
    const ThreadPool & ) [delete]
```

6.11.3.4 ThreadPool() [4/4]

```
ThreadPool::ThreadPool (
    ThreadPool && ) [delete]
```

6.11.3.5 ~ThreadPool()

```
TP::~~ThreadPool ( )
```

Definition at line 233 of file [threadpool.cpp](#).

```
00233     {
00234     stop();
00235     m_queues.clear();
00236     delete[] m_ths;
00237     pthread_mutex_destroy(&s_mtx);
00238 }
```

6.11.4 Member Function Documentation

6.11.4.1 add() [1/2]

```
void TP::add (
    uint32_t qid,
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 169 of file [threadpool.cpp](#).

```
00169     {
00170     if (m_faccept == 0) {
00171         throw std::logic_error("threadpool already closed");
00172     }
00173     if (nfn == nullptr) {
00174         throw std::logic_error("function pointer cannot be null");
00175     }
00176     bool failed = false;
00177     pthread_mutex_lock(&m_q_mtx);
00178     try {
00179         m_queues.push(qid, nfn, arg);
00180     } catch (const std::out_of_range& e) {
00181         failed = true;
00182     }
00183     pthread_cond_signal(&m_q_cond);
00184     pthread_mutex_unlock(&m_q_mtx);
00185     if (failed) {
00186         throw std::out_of_range("queue not found");
00187     }
00188 }
```

6.11.4.2 add() [2/2]

```
void TP::add (
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 189 of file [threadpool.cpp](#).

```
00189     {
00190     add(0, nfn, arg); // Agregar a la cola por defecto
00191 }
```

6.11.4.3 empty()

```
bool TP::empty ( )
```

Definition at line 218 of file [threadpool.cpp](#).

```
00218 { return m_queues.empty(); }
```

6.11.4.4 init()

```
void TP::init ( )
```

Definition at line 137 of file [threadpool.cpp](#).

```
00137     {
00138     if (m_started != 0) {
00139         return;
00140     }
00141     m_faccept = 1;
00142     m_fstop = 0;
00143     pthread_mutex_lock(&s_mtx);
00144     for (size_t i = 0; i < m_nth; ++i) {
00145         pthread_create(&m_ths[i], nullptr, thread_entry, this);
00146         ++m_started;
00147     }
00148     pthread_mutex_unlock(&s_mtx);
00149 }
```

6.11.4.5 new_queue()

```
void TP::new_queue (
    uint32_t qid,
    uint32_t cnt )
```

Definition at line 192 of file [threadpool.cpp](#).

```
00192     {
00193     pthread_mutex_lock(&m_q_mtx);
00194     try {
00195         m_queues.new_queue(qid, cnt);
00196     } catch (const std::out_of_range& e) {
00197         pthread_mutex_unlock(&m_q_mtx);
00198         throw e;
00199     }
00200     pthread_mutex_unlock(&m_q_mtx);
00201 }
```

6.11.4.6 operator=() [1/2]

```
ThreadPool & ThreadPool::operator= (
    const ThreadPool & ) [delete]
```

6.11.4.7 operator=() [2/2]

```
ThreadPool & ThreadPool::operator= (
    ThreadPool && ) [delete]
```

6.11.4.8 remove_queue()

```
void TP::remove_queue (
    uint32_t qid )
```

Definition at line 202 of file [threadpool.cpp](#).

```
00202 {
00203     if (qid != 0) {
00204         bool failed = false;
00205         pthread_mutex_lock(&m_q_mtx);
00206         try {
00207             m_queues.remove_queue(qid);
00208         } catch (const std::out_of_range& e) {
00209             failed = true;
00210         }
00211         pthread_cond_signal(&m_q_cond);
00212         pthread_mutex_unlock(&m_q_mtx);
00213         if (failed) {
00214             throw std::out_of_range("queue not found");
00215         }
00216     }
00217 }
```

6.11.4.9 stop()

```
void TP::stop ( )
```

Definition at line 150 of file [threadpool.cpp](#).

```
00150 {
00151     if (m_started == 0) {
00152         return;
00153     }
00154     m_fstop = 0;
00155     m_faccept = 0;
00156     wait_empty();
00157     pthread_mutex_lock(&m_q_mtx);
00158     m_fstop = 1;
00159     pthread_cond_broadcast(&m_q_cond);
00160     pthread_mutex_unlock(&m_q_mtx);
00161     // Detener los hilos
00162     for (size_t i = 0; i < m_started; ++i) {
00163         pthread_join(m_ths[i], nullptr);
00164     }
00165     m_started = 0;
00166     m_nth = 0;
00167 }
00168 }
```

6.11.4.10 thread_entry()

```
void * TP::thread_entry (
    void * arg ) [static], [private]
```

Definition at line 265 of file [threadpool.cpp](#).

```
00265     {
00266     auto* pool = static_cast<TP*>(arg);
00267     pool->thread_worker();
00268     return nullptr;
00269 }
```

6.11.4.11 thread_worker()

```
void TP::thread_worker ( ) [private]
```

Definition at line 240 of file [threadpool.cpp](#).

```
00240     {
00241     // Lógica del trabajador del hilo
00242     uint32_t qid = 0;
00243     while (m_fstop == 0) {
00244     // Buscar una tarea para ejecutar
00245     try {
00246     pthread_mutex_lock(&m_q_mtx);
00247     Task* task = m_queues.front(qid);
00248     pthread_cond_signal(&m_q_cond);
00249     pthread_mutex_unlock(&m_q_mtx);
00250     try {
00251     task->function(task->argument);
00252     } catch (...) {
00253     }
00254     delete task; // TODO delete task
00255     pthread_mutex_lock(&m_q_mtx);
00256     m_queues.pop(qid);
00257     pthread_cond_broadcast(&m_q_cond);
00258     pthread_mutex_unlock(&m_q_mtx);
00259     } catch (const std::out_of_range& e) {
00260     pthread_mutex_unlock(&m_q_mtx);
00261     wait_closeable();
00262     }
00263     }
00264 }
```

6.11.4.12 wait_closeable()

```
void TP::wait_closeable ( ) [private]
```

Definition at line 219 of file [threadpool.cpp](#).

```
00219     {
00220     pthread_mutex_lock(&m_q_mtx);
00221     while (empty() && m_fstop == 0) {
00222     pthread_cond_wait(&m_q_cond, &m_q_mtx);
00223     }
00224     pthread_mutex_unlock(&m_q_mtx);
00225 }
```

6.11.4.13 wait_empty()

```
void TP::wait_empty ( )
```

Definition at line 226 of file [threadpool.cpp](#).

```
00226         {  
00227     pthread_mutex_lock(&m_q_mtx);  
00228     while (!m_queues.empty()) {  
00229         pthread_cond_wait(&m_q_cond, &m_q_mtx);  
00230     }  
00231     pthread_mutex_unlock(&m_q_mtx);  
00232 }
```

6.11.5 Member Data Documentation

6.11.5.1 m_faccept

```
volatile sig_atomic_t ThreadPool::m_faccept [private]
```

Definition at line 106 of file [threadpool.hpp](#).

6.11.5.2 m_fstop

```
volatile sig_atomic_t ThreadPool::m_fstop [private]
```

Definition at line 105 of file [threadpool.hpp](#).

6.11.5.3 m_nth

```
size_t ThreadPool::m_nth [private]
```

Definition at line 98 of file [threadpool.hpp](#).

6.11.5.4 m_q_cond

```
pthread_cond_t ThreadPool::m_q_cond = PTHREAD_COND_INITIALIZER [private]
```

Definition at line 102 of file [threadpool.hpp](#).

6.11.5.5 m_q_mtx

```
pthread_mutex_t ThreadPool::m_q_mtx = PTHREAD_MUTEX_INITIALIZER [private]
```

Definition at line 101 of file [threadpool.hpp](#).

6.11.5.6 m_queues

```
AsyncMultiQueue ThreadPool::m_queues [private]
```

Definition at line 100 of file [threadpool.hpp](#).

6.11.5.7 m_started

```
size_t ThreadPool::m_started [private]
```

Definition at line 99 of file [threadpool.hpp](#).

6.11.5.8 m_ths

```
pthread_t* ThreadPool::m_ths [private]
```

Definition at line 104 of file [threadpool.hpp](#).

6.11.5.9 s_mtx

```
pthread_mutex_t TP::s_mtx = PTHREAD_MUTEX_INITIALIZER [static], [private]
```

Definition at line 103 of file [threadpool.hpp](#).

The documentation for this class was generated from the following files:

- [/__w/saurion/saurion/include/threadpool.hpp](#)
- [/__w/saurion/saurion/src/threadpool.cpp](#)

Chapter 7

File Documentation

7.1 /__w/saurion/saurion/include/cthreadpool.hpp File Reference

This graph shows which files directly or indirectly include this file:

Typedefs

- typedef struct [ThreadPool](#) [ThreadPool](#)

Functions

- [ThreadPool](#) * [ThreadPool_create](#) (size_t num_threads)
- [ThreadPool](#) * [ThreadPool_create_default](#) (void)
- void [ThreadPool_init](#) ([ThreadPool](#) *thp)
- void [ThreadPool_stop](#) ([ThreadPool](#) *thp)
- void [ThreadPool_add](#) ([ThreadPool](#) *thp, uint32_t qid, void(*nfn)(void *), void *arg)
- void [ThreadPool_add_default](#) ([ThreadPool](#) *thp, void(*nfn)(void *), void *arg)
- void [ThreadPool_new_queue](#) ([ThreadPool](#) *thp, uint32_t qid, uint32_t cnt)
- void [ThreadPool_remove_queue](#) ([ThreadPool](#) *thp, uint32_t qid)
- bool [ThreadPool_empty](#) ([ThreadPool](#) *thp)
- void [ThreadPool_wait_empty](#) ([ThreadPool](#) *thp)
- void [ThreadPool_destroy](#) ([ThreadPool](#) *thp)

7.1.1 Typedef Documentation

7.1.1.1 ThreadPool

```
typedef struct ThreadPool ThreadPool
```

Definition at line 8 of file [cthreadpool.hpp](#).

7.1.2 Function Documentation

7.1.2.1 ThreadPool_add()

```
void ThreadPool_add (
    ThreadPool * thp,
    uint32_t qid,
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 11 of file [cthreadpool.cpp](#).

```
00011 { thp->add(qid, nfn, arg); }
```

7.1.2.2 ThreadPool_add_default()

```
void ThreadPool_add_default (
    ThreadPool * thp,
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 13 of file [cthreadpool.cpp](#).

```
00013 { thp->add(nfn, arg); }
```

7.1.2.3 ThreadPool_create()

```
ThreadPool * ThreadPool_create (
    size_t num_threads )
```

Definition at line 3 of file [cthreadpool.cpp](#).

```
00003 { return new ThreadPool(num_threads); }
```

7.1.2.4 ThreadPool_create_default()

```
ThreadPool * ThreadPool_create_default (
    void )
```

Definition at line 5 of file [cthreadpool.cpp](#).

```
00005 { return new ThreadPool(); }
```

7.1.2.5 ThreadPool_destroy()

```
void ThreadPool_destroy (
    ThreadPool * thp )
```

Definition at line 23 of file [cthreadpool.cpp](#).

```
00023 { delete thp; }
```

7.1.2.6 ThreadPool_empty()

```
bool ThreadPool_empty (
    ThreadPool * thp )
```

Definition at line 19 of file [cthreadpool.cpp](#).

```
00019 { return thp->empty(); }
```

7.1.2.7 ThreadPool_init()

```
void ThreadPool_init (
    ThreadPool * thp )
```

Definition at line 7 of file [cthreadpool.cpp](#).

```
00007 { thp->init(); }
```

7.1.2.8 ThreadPool_new_queue()

```
void ThreadPool_new_queue (
    ThreadPool * thp,
    uint32_t qid,
    uint32_t cnt )
```

Definition at line 15 of file [cthreadpool.cpp](#).

```
00015 { thp->new_queue(qid, cnt); }
```

7.1.2.9 ThreadPool_remove_queue()

```
void ThreadPool_remove_queue (
    ThreadPool * thp,
    uint32_t qid )
```

Definition at line 17 of file [cthreadpool.cpp](#).

```
00017 { thp->remove_queue(qid); }
```

7.1.2.10 ThreadPool_stop()

```
void ThreadPool_stop (
    ThreadPool * thp )
```

Definition at line 9 of file [cthreadpool.cpp](#).

```
00009 { thp->stop(); }
```

7.1.2.11 ThreadPool_wait_empty()

```
void ThreadPool_wait_empty (
    ThreadPool * thp )
```

Definition at line 21 of file [cthreadpool.cpp](#).

```
00021 { thp->wait_empty(); }
```

7.2 cthreadpool.hpp

[Go to the documentation of this file.](#)

```
00001 #ifndef THREADPOOL_H
00002 #define THREADPOOL_H
00003
00004 #ifdef __cplusplus
00005 #include "threadpool.hpp"
00006 extern "C" {
00007 #else
00008 typedef struct ThreadPool ThreadPool;
00009 #endif // __cplusplus
00010
00011 ThreadPool *ThreadPool_create(size_t num_threads);
00012
00013 ThreadPool *ThreadPool_create_default(void);
00014
00015 void ThreadPool_init(ThreadPool *thp);
00016
00017 void ThreadPool_stop(ThreadPool *thp);
00018
00019 void ThreadPool_add(ThreadPool *thp, uint32_t qid, void (*nfn)(void *), void *arg);
00020
00021 void ThreadPool_add_default(ThreadPool *thp, void (*nfn)(void *), void *arg);
00022
00023 void ThreadPool_new_queue(ThreadPool *thp, uint32_t qid, uint32_t cnt);
00024
00025 void ThreadPool_remove_queue(ThreadPool *thp, uint32_t qid);
00026
00027 bool ThreadPool_empty(ThreadPool *thp);
00028
00029 void ThreadPool_wait_empty(ThreadPool *thp);
00030
00031 void ThreadPool_destroy(ThreadPool *thp);
00032
00033 #ifdef __cplusplus
00034 }
00035 #endif // __cplusplus
00036
00037 #endif // !THREADPOOL_H
```

7.3 /__w/saurion/saurion/include/linked_list.h File Reference

```
#include <stddef.h>
```

Include dependency graph for linked_list.h:

7.4 linked_list.h

[Go to the documentation of this file.](#)

```

00001 #ifndef LINKED_LIST_H
00002 #define LINKED_LIST_H
00003
00004 #ifdef __cplusplus
00005 extern "C" {
00006 #endif
00007
00008 #include <stddef.h>
00009
00010 struct Node;
00011
00012 int list_insert(struct Node** head, void* ptr, size_t amount, void** children);
00013
00014 void list_delete_node(struct Node** head, void* ptr);
00015
00016 void list_free(struct Node** head);
00017
00018 #ifdef __cplusplus
00019 }
00020 #endif
00021
00022 #endif // !LINKED_LIST_H

```

7.5 /__w/saurion/saurion/include/low_saurion.h File Reference

```

#include <liburing.h>
#include <pthread.h>
#include "config.h"
#include "cthreadpool.hpp"
#include "linked_list.h"

```

Include dependency graph for low_saurion.h: This graph shows which files directly or indirectly include this file:

Classes

- struct [saurion](#)
Main structure for managing io_uring and socket events.
- struct [saurion::saurion_callbacks](#)
Structure containing callback functions to handle socket events.
- struct [saurion_callbacks](#)
Structure containing callback functions to handle socket events.

Macros

- #define [PACKING_SZ](#) 128
Defines the memory alignment size for structures in the saurion class.

Functions

- int [EXTERNAL_set_socket](#) (int p)
- struct [saurion](#) * [saurion_create](#) (uint32_t n_threads)
Creates an instance of the saurion structure.
- int [saurion_start](#) (struct [saurion](#) *s)
Starts event processing in the saurion structure.
- void [saurion_stop](#) (const struct [saurion](#) *s)
Stops event processing in the saurion structure.
- void [saurion_destroy](#) (struct [saurion](#) *s)
Destroys the saurion structure and frees all associated resources.
- void [saurion_send](#) (struct [saurion](#) *s, const int fd, const char *const msg)
Sends a message through a socket using io_uring.

Variables

- void(* [on_connected](#))(const int fd, void *arg)
Callback for handling new connections.
- void * [on_connected_arg](#)
- void(* [on_readed](#))(const int fd, const void *const content, const ssize_t len, void *arg)
Callback for handling read events.
- void * [on_readed_arg](#)
- void(* [on_wrote](#))(const int fd, void *arg)
Callback for handling write events.
- void * [on_wrote_arg](#)
- void(* [on_closed](#))(const int fd, void *arg)
Callback for handling socket closures.
- void * [on_closed_arg](#)
- void(* [on_error](#))(const int fd, const char *const content, const ssize_t len, void *arg)
Callback for handling error events.
- void * [on_error_arg](#)
- struct io_uring * [rings](#)
- pthread_mutex_t * [m_rings](#)
- int [ss](#)
- int * [efds](#)
- struct [Node](#) * [list](#)
- pthread_mutex_t [status_m](#)
- pthread_cond_t [status_c](#)
- int [status](#)
- [ThreadPool](#) * [pool](#)
- uint32_t [n_threads](#)
- uint32_t [next](#)

7.5.1 Variable Documentation

7.5.1.1 efds

```
int* efds
```

Eventfd descriptors used for internal signaling between threads.

Definition at line 4 of file [low_saurion.h](#).

7.5.1.2 list

```
struct Node* list
```

Linked list for storing active requests.

Definition at line 5 of file [low_saurion.h](#).

7.5.1.3 `m_rings`

```
pthread_mutex_t* m_rings
```

Array of mutexes to protect the io_uring rings during concurrent access.

Definition at line 2 of file [low_saurion.h](#).

7.5.1.4 `n_threads`

```
uint32_t n_threads
```

Number of threads in the thread pool.

Definition at line 10 of file [low_saurion.h](#).

7.5.1.5 `next`

```
uint32_t next
```

Index of the next io_uring ring to which an event will be added.

Definition at line 11 of file [low_saurion.h](#).

7.5.1.6 `on_closed`

```
void(* on_closed)(const int fd, void *arg) (  
    const int fd,  
    void * arg )
```

Callback for handling socket closures.

Parameters

<i>fd</i>	File descriptor of the closed socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 35 of file [low_saurion.h](#).

7.5.1.7 `on_closed_arg`

```
void * on_closed_arg
```

Additional argument for the close callback.

Definition at line 36 of file [low_saurion.h](#).

7.5.1.8 on_connected

```
void(* on_connected)(const int fd, void *arg) (  
    const int fd,  
    void * arg )
```

Callback for handling new connections.

Parameters

<i>fd</i>	File descriptor of the connected socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 6 of file [low_saurion.h](#).

7.5.1.9 on_connected_arg

```
void * on_connected_arg
```

Additional argument for the connection callback.

Definition at line 7 of file [low_saurion.h](#).

7.5.1.10 on_error

```
void(* on_error)(const int fd, const char *const content, const ssize_t len, void *arg) (  
    const int fd,  
    const char *const content,  
    const ssize_t len,  
    void * arg )
```

Callback for handling error events.

Parameters

<i>fd</i>	File descriptor of the socket where the error occurred.
<i>content</i>	Pointer to the error message.
<i>len</i>	Length of the error message.
<i>arg</i>	Additional user-provided argument.

Definition at line 46 of file [low_saurion.h](#).

7.5.1.11 `on_error_arg`

```
void * on_error_arg
```

Additional argument for the error callback.

Definition at line 47 of file [low_saurion.h](#).

7.5.1.12 `on_readed`

```
void(* on_readed)(const int fd, const void *const content, const ssize_t len, void *arg) (  
    const int fd,  
    const void *const content,  
    const ssize_t len,  
    void * arg )
```

Callback for handling read events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>content</i>	Pointer to the data that was read.
<i>len</i>	Length of the data that was read.
<i>arg</i>	Additional user-provided argument.

Definition at line 17 of file [low_saurion.h](#).

7.5.1.13 `on_readed_arg`

```
void * on_readed_arg
```

Additional argument for the read callback.

Definition at line 18 of file [low_saurion.h](#).

7.5.1.14 `on_wrote`

```
void(* on_wrote)(const int fd, void *arg) (  
    const int fd,  
    void * arg )
```

Callback for handling write events.

Parameters

<i>fd</i>	File descriptor of the socket.
<i>arg</i>	Additional user-provided argument.

Definition at line 26 of file [low_saurion.h](#).

7.5.1.15 on_wrote_arg

```
void * on_wrote_arg
```

Additional argument for the write callback.

Definition at line 27 of file [low_saurion.h](#).

7.5.1.16 pool

```
ThreadPool* pool
```

Thread pool for executing tasks in parallel.

Definition at line 9 of file [low_saurion.h](#).

7.5.1.17 rings

```
struct io_uring* rings
```

Array of `io_uring` structures for managing the event queue.

Definition at line 0 of file [low_saurion.h](#).

7.5.1.18 ss

```
int ss
```

Server socket descriptor for accepting connections.

Definition at line 3 of file [low_saurion.h](#).

7.5.1.19 status

```
int status
```

Current status of the structure (e.g., running, stopped).

Definition at line 8 of file [low_saurion.h](#).

7.5.1.20 status_c

```
pthread_cond_t status_c
```

Condition variable to signal changes in the structure's state.

Definition at line 7 of file [low_saurion.h](#).

7.5.1.21 status_m

```
pthread_mutex_t status_m
```

Mutex to protect the state of the structure.

Definition at line 6 of file [low_saurion.h](#).

7.6 low_saurion.h

[Go to the documentation of this file.](#)

```

00001
00098 #ifndef LOW_SAURION_H
00099 #define LOW_SAURION_H
00100
00101 #include <liburing.h>
00102 #include <pthread.h>
00103
00104 #include "config.h"
00105 #include "cthreadpool.hpp"
00106 #include "linked_list.h"
00107
00108 #ifdef __cplusplus
00109 extern "C" {
00110 #endif
00111
00129 #define PACKING_SZ 128
00130
00137 struct saurion {
00138     struct io_uring *rings;
00139     pthread_mutex_t
00140         *m_rings;
00141     int ss;
00142     int *efds;
00143     struct Node *list;
00144     pthread_mutex_t status_m;
00145     pthread_cond_t status_c;
00146     int status;
00147     ThreadPool *pool;
00148     uint32_t n_threads;
00149     uint32_t next;
00159     struct saurion_callbacks {
00166         void (*on_connected)(const int fd, void *arg);

```

```

00167     void *on_connected_arg;
00177     void (*on_readed)(const int fd, const void *const content, const ssize_t len, void *arg);
00178     void *on_readed_arg;
00186     void (*on_wrote)(const int fd, void *arg);
00187     void *on_wrote_arg;
00195     void (*on_closed)(const int fd, void *arg);
00196     void *on_closed_arg;
00206     void (*on_error)(const int fd, const char *const content, const ssize_t len, void *arg);
00207     void *on_error_arg;
00208 } __attribute__((aligned(PACKING_SZ))) cb;
00209 } __attribute__((aligned(PACKING_SZ)));
00210
00214 int EXTERNAL_set_socket(int p);
00215
00228 [[nodiscard]]
00229 struct saurion *saurion_create(uint32_t n_threads);
00230
00242 [[nodiscard]]
00243 int saurion_start(struct saurion *s);
00244
00254 void saurion_stop(const struct saurion *s);
00255
00266 void saurion_destroy(struct saurion *s);
00267
00280 void saurion_send(struct saurion *s, const int fd, const char *const msg);
00281
00282 #ifdef __cplusplus
00283 }
00284 #endif
00285
00286 #endif // !LOW_SAURION_H
00287

```

7.7 /__w/saurion/saurion/include/low_saurion_secret.h File Reference

```

#include <bits/types/struct_iovec.h>
#include <stddef.h>
#include <stdint.h>

```

Include dependency graph for low_saurion_secret.h:

Functions

- int [allocate_iovec](#) (struct iovec *iov, size_t amount, size_t pos, size_t size, void **chd_ptr)
- int [initialize_iovec](#) (struct iovec *iov, size_t amount, size_t pos, const void *msg, size_t size, uint8_t h)

Initializes a specified iovec structure with a message fragment.
- int [set_request](#) (struct [request](#) **r, struct [Node](#) **l, size_t s, const void *m, uint8_t h)

Sets up a request and allocates iovec structures for data handling in liburing.
- int [read_chunk](#) (void **dest, size_t *len, struct [request](#) *const req)

Reads a message chunk from the request's iovec buffers, handling messages that may span multiple iovec entries.
- void [free_request](#) (struct [request](#) *req, void **children_ptr, size_t amount)

7.8 low_saurion_secret.h

[Go to the documentation of this file.](#)

```

00001 #ifndef LOW_SAURION_SECRET_H
00002 #define LOW_SAURION_SECRET_H
00003
00004 #include <bits/types/struct_iovec.h>
00005 #include <stddef.h>
00006 #include <stdint.h>
00007
00008 #ifdef __cplusplus
00009 extern "C" {
00010 #endif
00015 struct request {

```

```

00016 void *prev;
00017 size_t prev_size;
00018 size_t prev_remain;
00019 size_t next_iov;
00020 size_t next_offset;
00021 int event_type;
00022 size_t iovec_count;
00023 int client_socket;
00024 struct iovec iov[];
00025 };
00059 [[nodiscard]]
00060 int allocate_iovec(struct iovec *iov, size_t amount, size_t pos, size_t size, void **chd_ptr);
00061
00094 [[nodiscard]]
00095 int initialize_iovec(struct iovec *iov, size_t amount, size_t pos, const void *msg, size_t size,
00096                     uint8_t h);
00097
00124 [[nodiscard]]
00125 int set_request(struct request **r, struct Node **l, size_t s, const void *m, uint8_t h);
00126
00162 [[nodiscard]]
00163 int read_chunk(void **dest, size_t *len, struct request *const req);
00164
00165 void free_request(struct request *req, void **children_ptr, size_t amount);
00169 #ifdef __cplusplus
00170 }
00171 #endif
00172
00173 #endif // !LOW_SAURION_SECRET_H

```

7.9 / __w/saurion/saurion/include/saurion.hpp File Reference

#include "low_saurion.h"

Include dependency graph for saurion.hpp: This graph shows which files directly or indirectly include this file:

Classes

- class [Saurion](#)

7.10 saurion.hpp

[Go to the documentation of this file.](#)

```

00001 #ifndef SAURION_HPP
00002 #define SAURION_HPP
00003
00004 #include "low_saurion.h"
00005
00006 class Saurion {
00007 public:
00008     using ConnectedCb = void (*)(const int, void *);
00009     using ReadedCb = void (*)(const int, const void *const, const ssize_t, void *);
00010     using WroteCb = void (*)(const int, void *);
00011     using ClosedCb = void (*)(const int, void *);
00012     using ErrorCb = void (*)(const int, const char *const, const ssize_t, void *);
00013
00014     explicit Saurion(const uint32_t thds, const int sock) noexcept;
00015     ~Saurion();
00016
00017     Saurion(const Saurion &) = delete;
00018     Saurion(Saurion &&) = delete;
00019     Saurion &operator=(const Saurion &) = delete;
00020     Saurion &operator=(Saurion &&) = delete;
00021
00022     void init() noexcept;
00023     void stop() noexcept;
00024
00025     Saurion *on_connected(ConnectedCb ncb, void *arg) noexcept;
00026     Saurion *on_readed(ReadedCb ncb, void *arg) noexcept;
00027     Saurion *on_wrote(WroteCb ncb, void *arg) noexcept;
00028     Saurion *on_closed(ClosedCb ncb, void *arg) noexcept;
00029     Saurion *on_error(ErrorCb ncb, void *arg) noexcept;

```

```

00030
00031     void send(const int fd, const char *const msg) noexcept;
00032
00033 private:
00034     struct saurion *s;
00035 };
00036
00037 #endif // !SAURION_HPP

```

7.11 /__w/saurion/saurion/include/threadpool.hpp File Reference

```

#include <bits/types/sig_atomic_t.h>
#include <pthread.h>
#include <cstdint>
#include <queue>
#include <unordered_map>

```

Include dependency graph for threadpool.hpp: This graph shows which files directly or indirectly include this file:

Classes

- struct [Task](#)
- class [ThreadPool](#)
- struct [ThreadPool::AsyncQueue](#)
- struct [ThreadPool::AsyncMultiQueue](#)

Enumerations

- enum [StopFlags](#) { [KINDLY](#) = 0x01 , [FORCE](#) = 0x02 }

7.11.1 Enumeration Type Documentation

7.11.1.1 StopFlags

```
enum StopFlags
```

Enumerator

KINDLY	
FORCE	

Definition at line 12 of file [threadpool.hpp](#).

```
00012 { KINDLY = 0x01, FORCE = 0x02 };
```

7.12 threadpool.hpp

[Go to the documentation of this file.](#)

```

00001 #ifndef THREADPOOL_HPP
00002 #define THREADPOOL_HPP
00003
00004 // Estructura para representar una tarea
00005 #include <bits/types/sig_atomic_t.h>
00006 #include <pthread.h>
00007
00008 #include <cstdint>
00009 #include <queue>
00010 #include <unordered_map>
00011
00012 enum StopFlags { KINDLY = 0x01, FORCE = 0x02 };
00013
00014 struct Task {
00015     void (*function)(void*);
00016     void* argument;
00017
00018     explicit Task(void (*nfn)(void*), void* narg);
00019     Task(const Task&) = delete;
00020     Task(Task&) = delete;
00021     Task& operator=(const Task&) = delete;
00022     Task& operator=(Task&) = delete;
00023     ~Task() = default;
00024 };
00025
00026 // Clase ThreadPool
00027 class ThreadPool {
00028 private:
00029     typedef struct AsyncQueue {
00030     private:
00031         std::queue<Task*> m_queue;
00032         uint32_t m_max;
00033         uint32_t m_cnt;
00034         pthread_mutex_t m_mtx = PTHREAD_MUTEX_INITIALIZER;
00035
00036     public:
00037         explicit AsyncQueue(uint32_t cnt);
00038         ~AsyncQueue();
00039         AsyncQueue(const AsyncQueue&) = delete;
00040         AsyncQueue& operator=(const AsyncQueue&) = delete;
00041         AsyncQueue(AsyncQueue&) = delete;
00042         AsyncQueue& operator=(AsyncQueue&) = delete;
00043
00044         void push(Task* task);
00045         Task* front();
00046         void pop();
00047
00048         bool empty();
00049     } AsyncQueue;
00050     typedef struct AsyncMultiQueue {
00051     private:
00052         std::unordered_map<uint32_t, AsyncQueue*> m_queues;
00053         std::unordered_map<uint32_t, AsyncQueue*>::iterator m_it;
00054
00055     public:
00056         explicit AsyncMultiQueue();
00057         ~AsyncMultiQueue();
00058         AsyncMultiQueue(const AsyncMultiQueue&) = delete;
00059         AsyncMultiQueue& operator=(const AsyncMultiQueue&) = delete;
00060         AsyncMultiQueue(AsyncMultiQueue&) = delete;
00061         AsyncMultiQueue& operator=(AsyncMultiQueue&) = delete;
00062
00063         void new_queue(uint32_t qid, uint32_t cnt);
00064         void remove_queue(uint32_t qid);
00065
00066         void push(uint32_t qid, void (*nfn)(void*), void* arg);
00067         Task* front(uint32_t& qid);
00068         void pop(uint32_t qid);
00069         void clear();
00070
00071         bool empty();
00072     } AsyncMultiQueue;
00073
00074     public:
00075         ThreadPool();
00076         explicit ThreadPool(size_t num_threads);
00077         ThreadPool(const ThreadPool&) = delete;
00078         ThreadPool& operator=(const ThreadPool&) = delete;
00079         ThreadPool(ThreadPool&) = delete;
00080         ThreadPool& operator=(ThreadPool&) = delete;
00081
00082         void init();
00083         void stop();
00084         void add(uint32_t qid, void (*nfn)(void*), void* arg);
00085         void add(void (*nfn)(void*), void* arg);
00086         void new_queue(uint32_t qid, uint32_t cnt);
00087         void remove_queue(uint32_t qid);

```

```

00088     bool empty();
00089
00090 private:
00091     void wait_closeable();
00092
00093 public:
00094     void wait_empty();
00095     ~ThreadPool();
00096
00097 private:
00098     size_t m_nth;
00099     size_t m_started;
00100     AsyncMultiQueue m_queues;
00101     pthread_mutex_t m_q_mtx = PTHREAD_MUTEX_INITIALIZER;
00102     pthread_cond_t m_q_cond = PTHREAD_COND_INITIALIZER;
00103     static pthread_mutex_t s_mtx;
00104     pthread_t* m_ths;
00105     volatile sig_atomic_t m_fstop;
00106     volatile sig_atomic_t m_faccept;
00107
00108     void thread_worker();
00109     static void* thread_entry(void* arg);
00110 };
00111
00112 #endif

```

7.13 /__w/saurion/saurion/src/cthreadpool.cpp File Reference

#include "cthreadpool.hpp"

Include dependency graph for cthreadpool.cpp:

Functions

- [ThreadPool * ThreadPool_create](#) (size_t num_threads)
- [ThreadPool * ThreadPool_create_default](#) (void)
- void [ThreadPool_init](#) (ThreadPool *thp)
- void [ThreadPool_stop](#) (ThreadPool *thp)
- void [ThreadPool_add](#) (ThreadPool *thp, uint32_t qid, void(*nfn)(void *), void *arg)
- void [ThreadPool_add_default](#) (ThreadPool *thp, void(*nfn)(void *), void *arg)
- void [ThreadPool_new_queue](#) (ThreadPool *thp, uint32_t qid, uint32_t cnt)
- void [ThreadPool_remove_queue](#) (ThreadPool *thp, uint32_t qid)
- bool [ThreadPool_empty](#) (ThreadPool *thp)
- void [ThreadPool_wait_empty](#) (ThreadPool *thp)
- void [ThreadPool_destroy](#) (ThreadPool *thp)

7.13.1 Function Documentation

7.13.1.1 ThreadPool_add()

```

void ThreadPool_add (
    ThreadPool * thp,
    uint32_t qid,
    void(*) (void *) nfn,
    void * arg )

```

Definition at line 11 of file [cthreadpool.cpp](#).

```
00011 { thp->add(qid, nfn, arg); }
```


7.13.1.2 ThreadPool_add_default()

```
void ThreadPool_add_default (
    ThreadPool * thp,
    void(*) (void *) nfn,
    void * arg )
```

Definition at line 13 of file [cthreadpool.cpp](#).

```
00013 { thp->add(nfn, arg); }
```

7.13.1.3 ThreadPool_create()

```
ThreadPool * ThreadPool_create (
    size_t num_threads )
```

Definition at line 3 of file [cthreadpool.cpp](#).

```
00003 { return new ThreadPool(num_threads); }
```

7.13.1.4 ThreadPool_create_default()

```
ThreadPool * ThreadPool_create_default (
    void )
```

Definition at line 5 of file [cthreadpool.cpp](#).

```
00005 { return new ThreadPool(); }
```

7.13.1.5 ThreadPool_destroy()

```
void ThreadPool_destroy (
    ThreadPool * thp )
```

Definition at line 23 of file [cthreadpool.cpp](#).

```
00023 { delete thp; }
```

7.13.1.6 ThreadPool_empty()

```
bool ThreadPool_empty (
    ThreadPool * thp )
```

Definition at line 19 of file [cthreadpool.cpp](#).

```
00019 { return thp->empty(); }
```

7.13.1.7 ThreadPool_init()

```
void ThreadPool_init (
    ThreadPool * thp )
```

Definition at line 7 of file [cthreadpool.cpp](#).

```
00007 { thp->init(); }
```

7.13.1.8 ThreadPool_new_queue()

```
void ThreadPool_new_queue (
    ThreadPool * thp,
    uint32_t qid,
    uint32_t cnt )
```

Definition at line 15 of file [cthreadpool.cpp](#).

```
00015 { thp->new_queue(qid, cnt); }
```

7.13.1.9 ThreadPool_remove_queue()

```
void ThreadPool_remove_queue (
    ThreadPool * thp,
    uint32_t qid )
```

Definition at line 17 of file [cthreadpool.cpp](#).

```
00017 { thp->remove_queue(qid); }
```

7.13.1.10 ThreadPool_stop()

```
void ThreadPool_stop (
    ThreadPool * thp )
```

Definition at line 9 of file [cthreadpool.cpp](#).

```
00009 { thp->stop(); }
```

7.13.1.11 ThreadPool_wait_empty()

```
void ThreadPool_wait_empty (
    ThreadPool * thp )
```

Definition at line 21 of file [cthreadpool.cpp](#).

```
00021 { thp->wait_empty(); }
```

7.14 cthreadpool.cpp

[Go to the documentation of this file.](#)

```
00001 #include "cthreadpool.hpp"
00002
00003 ThreadPool *ThreadPool_create(size_t num_threads) { return new ThreadPool(num_threads); }
00004
00005 ThreadPool *ThreadPool_create_default(void) { return new ThreadPool(); }
00006
00007 void ThreadPool_init(ThreadPool *thp) { thp->init(); }
00008
00009 void ThreadPool_stop(ThreadPool *thp) { thp->stop(); }
00010
00011 void ThreadPool_add(ThreadPool *thp, uint32_t qid, void (*nfn)(void *), void *arg) { thp->add(qid,
nfn, arg); }
00012
00013 void ThreadPool_add_default(ThreadPool *thp, void (*nfn)(void *), void *arg) { thp->add(nfn, arg); }
00014
00015 void ThreadPool_new_queue(ThreadPool *thp, uint32_t qid, uint32_t cnt) { thp->new_queue(qid, cnt); }
00016
00017 void ThreadPool_remove_queue(ThreadPool *thp, uint32_t qid) { thp->remove_queue(qid); }
00018
00019 bool ThreadPool_empty(ThreadPool *thp) { return thp->empty(); }
00020
00021 void ThreadPool_wait_empty(ThreadPool *thp) { thp->wait_empty(); }
00022
00023 void ThreadPool_destroy(ThreadPool *thp) { delete thp; }
```

7.15 /__w/saurion/saurion/src/linked_list.c File Reference

```
#include "linked_list.h"
#include <pthread.h>
#include <stdlib.h>
Include dependency graph for linked_list.c:
```

Classes

- struct [Node](#)

Functions

- struct [Node](#) * [create_node](#) (void *ptr, size_t amount, void **children)
- int [list_insert](#) (struct [Node](#) **head, void *ptr, size_t amount, void **children)
- void [free_node](#) (struct [Node](#) *current)
- void [list_delete_node](#) (struct [Node](#) **head, void *ptr)
- void [list_free](#) (struct [Node](#) **head)

Variables

- pthread_mutex_t [list_mutex](#) = PTHREAD_MUTEX_INITIALIZER

7.15.1 Function Documentation

7.15.1.1 create_node()

```
struct Node * create_node (
    void * ptr,
    size_t amount,
    void ** children )
```

Definition at line 17 of file [linked_list.c](#).

```
00017 {
00018     struct Node *new_node = (struct Node *)malloc(sizeof(struct Node));
00019     // LCOV_EXCL_START
00020     if (!new_node) {
00021         return NULL;
00022     }
00023     // LCOV_EXCL_STOP
00024     new_node->ptr = ptr;
00025     new_node->size = amount;
00026     new_node->children = NULL;
00027     if (amount > 0) {
00028         new_node->children = (struct Node **)malloc(sizeof(struct Node *) * amount);
00029         // LCOV_EXCL_START
00030         if (!new_node->children) {
00031             free(new_node);
00032             return NULL;
00033         }
00034         // LCOV_EXCL_STOP
00035         for (size_t i = 0; i < amount; ++i) {
00036             new_node->children[i] = (struct Node *)malloc(sizeof(struct Node));
00037             // LCOV_EXCL_START
00038             if (!new_node->children[i]) {
00039                 for (size_t j = 0; j < i; ++j) {
00040                     free(new_node->children[j]);
00041                 }
00042                 free(new_node);
00043                 return NULL;
00044             }
00045         }
00046     }
00047     // LCOV_EXCL_STOP
00048     for (size_t i = 0; i < amount; ++i) {
00049         new_node->children[i]->size = 0;
00050         new_node->children[i]->next = NULL;
00051         new_node->children[i]->ptr = children[i];
00052         new_node->children[i]->children = NULL;
00053     }
00054 }
00055 new_node->next = NULL;
00056 return new_node;
00057 }
```

7.15.1.2 free_node()

```
void free_node (
    struct Node * current )
```

Definition at line 81 of file [linked_list.c](#).

```
00081 {
00082     if (current->size > 0) {
00083         for (size_t i = 0; i < current->size; ++i) {
00084             free(current->children[i]->ptr);
00085             free(current->children[i]);
00086         }
00087         free(current->children);
00088     }
00089     free(current->ptr);
00090     free(current);
00091 }
```

7.15.1.3 list_delete_node()

```
void list_delete_node (
    struct Node ** head,
    void * ptr )
```

Definition at line 93 of file [linked_list.c](#).

```
00093                                     {
00094     pthread_mutex_lock(&list_mutex);
00095     struct Node *current = *head;
00096     struct Node *prev = NULL;
00097
00098     // Si el nodo a eliminar es el nodo cabeza
00099     if (current && current->ptr == ptr) {
00100         *head = current->next;
00101         free_node(current);
00102         pthread_mutex_unlock(&list_mutex);
00103         return;
00104     }
00105
00106     // Buscar el nodo a eliminar
00107     while (current && current->ptr != ptr) {
00108         prev = current;
00109         current = current->next;
00110     }
00111
00112     // Si el dato no se encuentra en la lista
00113     if (!current) {
00114         pthread_mutex_unlock(&list_mutex);
00115         return;
00116     }
00117
00118     // Desenlazar el nodo y liberarlo
00119     prev->next = current->next;
00120     free_node(current);
00121     pthread_mutex_unlock(&list_mutex);
00122 }
```

7.15.1.4 list_free()

```
void list_free (
    struct Node ** head )
```

Definition at line 124 of file [linked_list.c](#).

```
00124                                     {
00125     pthread_mutex_lock(&list_mutex);
00126     struct Node *current = *head;
00127     struct Node *next;
00128
00129     while (current) {
00130         next = current->next;
00131         free_node(current);
00132         current = next;
00133     }
00134
00135     *head = NULL;
00136     pthread_mutex_unlock(&list_mutex);
00137 }
```

7.15.1.5 list_insert()

```
int list_insert (
    struct Node ** head,
    void * ptr,
```

```

    size_t amount,
    void ** children )

```

Definition at line 59 of file [linked_list.c](#).

```

00059
00060     struct Node *new_node = create_node(ptr, amount, children);
00061     // LCOV_EXCL_START
00062     if (!new_node) {
00063         return 1;
00064     }
00065     // LCOV_EXCL_STOP
00066     pthread_mutex_lock(&list_mutex);
00067     if (!*head) {
00068         *head = new_node;
00069         pthread_mutex_unlock(&list_mutex);
00070         return 0;
00071     }
00072     struct Node *temp = *head;
00073     while (temp->next) {
00074         temp = temp->next;
00075     }
00076     temp->next = new_node;
00077     pthread_mutex_unlock(&list_mutex);
00078     return 0;
00079 }

```

7.15.2 Variable Documentation

7.15.2.1 list_mutex

```
pthread_mutex_t list_mutex = PTHREAD_MUTEX_INITIALIZER
```

Definition at line 14 of file [linked_list.c](#).

7.16 linked_list.c

[Go to the documentation of this file.](#)

```

00001 #include "linked_list.h"
00002
00003 #include <pthread.h>
00004 #include <stdlib.h>
00005
00006 struct Node {
00007     void *ptr;
00008     size_t size;
00009     struct Node **children;
00010     struct Node *next;
00011 };
00012
00013 // Global mutex for thread safety
00014 pthread_mutex_t list_mutex = PTHREAD_MUTEX_INITIALIZER;
00015
00016 // Función para crear un nuevo nodo
00017 struct Node *create_node(void *ptr, size_t amount, void **children) {
00018     struct Node *new_node = (struct Node *)malloc(sizeof(struct Node));
00019     // LCOV_EXCL_START
00020     if (!new_node) {
00021         return NULL;
00022     }
00023     // LCOV_EXCL_STOP
00024     new_node->ptr = ptr;
00025     new_node->size = amount;
00026     new_node->children = NULL;
00027     if (amount > 0) {
00028         new_node->children = (struct Node **)malloc(sizeof(struct Node *) * amount);
00029         // LCOV_EXCL_START
00030         if (!new_node->children) {

```

```

00031     free(new_node);
00032     return NULL;
00033 }
00034 // LCOV_EXCL_STOP
00035 for (size_t i = 0; i < amount; ++i) {
00036     new_node->children[i] = (struct Node *)malloc(sizeof(struct Node));
00037
00038     // LCOV_EXCL_START
00039     if (!new_node->children[i]) {
00040         for (size_t j = 0; j < i; ++j) {
00041             free(new_node->children[j]);
00042         }
00043         free(new_node);
00044         return NULL;
00045     }
00046 }
00047 // LCOV_EXCL_STOP
00048 for (size_t i = 0; i < amount; ++i) {
00049     new_node->children[i]->size = 0;
00050     new_node->children[i]->next = NULL;
00051     new_node->children[i]->ptr = children[i];
00052     new_node->children[i]->children = NULL;
00053 }
00054 }
00055 new_node->next = NULL;
00056 return new_node;
00057 }
00058
00059 int list_insert(struct Node **head, void *ptr, size_t amount, void **children) {
00060     struct Node *new_node = create_node(ptr, amount, children);
00061     // LCOV_EXCL_START
00062     if (!new_node) {
00063         return 1;
00064     }
00065     // LCOV_EXCL_STOP
00066     pthread_mutex_lock(&list_mutex);
00067     if (!*head) {
00068         *head = new_node;
00069         pthread_mutex_unlock(&list_mutex);
00070         return 0;
00071     }
00072     struct Node *temp = *head;
00073     while (temp->next) {
00074         temp = temp->next;
00075     }
00076     temp->next = new_node;
00077     pthread_mutex_unlock(&list_mutex);
00078     return 0;
00079 }
00080
00081 void free_node(struct Node *current) {
00082     if (current->size > 0) {
00083         for (size_t i = 0; i < current->size; ++i) {
00084             free(current->children[i]->ptr);
00085             free(current->children[i]);
00086         }
00087         free(current->children);
00088     }
00089     free(current->ptr);
00090     free(current);
00091 }
00092
00093 void list_delete_node(struct Node **head, void *ptr) {
00094     pthread_mutex_lock(&list_mutex);
00095     struct Node *current = *head;
00096     struct Node *prev = NULL;
00097
00098     // Si el nodo a eliminar es el nodo cabeza
00099     if (current && current->ptr == ptr) {
00100         *head = current->next;
00101         free_node(current);
00102         pthread_mutex_unlock(&list_mutex);
00103         return;
00104     }
00105
00106     // Buscar el nodo a eliminar
00107     while (current && current->ptr != ptr) {
00108         prev = current;
00109         current = current->next;
00110     }
00111
00112     // Si el dato no se encuentra en la lista
00113     if (!current) {
00114         pthread_mutex_unlock(&list_mutex);
00115         return;
00116     }
00117

```

```

00118 // Desenlazar el nodo y liberarlo
00119 prev->next = current->next;
00120 free_node(current);
00121 pthread_mutex_unlock(&list_mutex);
00122 }
00123
00124 void list_free(struct Node **head) {
00125     pthread_mutex_lock(&list_mutex);
00126     struct Node *current = *head;
00127     struct Node *next;
00128
00129     while (current) {
00130         next = current->next;
00131         free_node(current);
00132         current = next;
00133     }
00134
00135     *head = NULL;
00136     pthread_mutex_unlock(&list_mutex);
00137 }

```

7.17 /__w/saurion/saurion/src/low_saurion.c File Reference

```

#include "low_saurion.h"
#include <netinet/in.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/eventfd.h>

```

Include dependency graph for low_saurion.c:

Classes

- struct [request](#)
- struct [saurion_wrapper](#)

Macros

- #define [EVENT_TYPE_ACCEPT](#) 0
- #define [EVENT_TYPE_READ](#) 1
- #define [EVENT_TYPE_WRITE](#) 2
- #define [EVENT_TYPE_WAIT](#) 3
- #define [EVENT_TYPE_ERROR](#) 4
- #define [MIN](#)(a, b) ((a) < (b) ? (a) : (b))
- #define [MAX](#)(a, b) ((a) > (b) ? (a) : (b))

Functions

- static uint32_t [next](#) (struct [saurion](#) *s)
- static uint64_t [htonll](#) (uint64_t value)
- static uint64_t [ntohll](#) (uint64_t value)
- void [free_request](#) (struct [request](#) *req, void **children_ptr, size_t amount)
- int [initialize_iovec](#) (struct iovec *iov, size_t amount, size_t pos, const void *msg, size_t size, uint8_t h)
Initializes a specified iovec structure with a message fragment.
- int [allocate_iovec](#) (struct iovec *iov, size_t amount, size_t pos, size_t size, void **chd_ptr)
- int [set_request](#) (struct [request](#) **r, struct [Node](#) **l, size_t s, const void *m, uint8_t h)
Sets up a request and allocates iovec structures for data handling in liburing.

- static void [add_accept](#) (struct [saurion](#) *const s, const struct sockaddr_in *const ca, socklen_t *const cal)
- static void [add_efd](#) (struct [saurion](#) *const s, const int client_socket, int sel)
- static void [add_read](#) (struct [saurion](#) *const s, const int client_socket)
- static void [add_read_continue](#) (struct [saurion](#) *const s, struct [request](#) *oreq, const int sel)
- static void [add_write](#) (struct [saurion](#) *const s, int fd, const char *const str, const int sel)
- static void [handle_accept](#) (const struct [saurion](#) *const s, const int fd)
- int [read_chunk](#) (void **dest, size_t *len, struct [request](#) *const req)
Reads a message chunk from the request's iovec buffers, handling messages that may span multiple iovec entries.
- static void [handle_read](#) (struct [saurion](#) *const s, struct [request](#) *const req)
- static void [handle_write](#) (const struct [saurion](#) *const s, const int fd)
- static void [handle_error](#) (const struct [saurion](#) *const s, const struct [request](#) *const req)
- static void [handle_close](#) (const struct [saurion](#) *const s, const struct [request](#) *const req)
- int [EXTERNAL_set_socket](#) (const int p)
- struct [saurion](#) * [saurion_create](#) (uint32_t n_threads)
Creates an instance of the saurion structure.
- void [saurion_worker_master](#) (void *arg)
- void [saurion_worker_slave](#) (void *arg)
- int [saurion_start](#) (struct [saurion](#) *const s)
Starts event processing in the saurion structure.
- void [saurion_stop](#) (const struct [saurion](#) *const s)
Stops event processing in the saurion structure.
- void [saurion_destroy](#) (struct [saurion](#) *const s)
Destroys the saurion structure and frees all associated resources.
- void [saurion_send](#) (struct [saurion](#) *const s, const int fd, const char *const msg)
Sends a message through a socket using io_uring.

Variables

- pthread_mutex_t [print_mutex](#)

7.17.1 Macro Definition Documentation

7.17.1.1 EVENT_TYPE_ACCEPT

```
#define EVENT_TYPE_ACCEPT 0
```

Definition at line 9 of file [low_saurion.c](#).

7.17.1.2 EVENT_TYPE_ERROR

```
#define EVENT_TYPE_ERROR 4
```

Definition at line 13 of file [low_saurion.c](#).

7.17.1.3 EVENT_TYPE_READ

```
#define EVENT_TYPE_READ 1
```

Definition at line 10 of file [low_saurion.c](#).

7.17.1.4 EVENT_TYPE_WAIT

```
#define EVENT_TYPE_WAIT 3
```

Definition at line 12 of file [low_saurion.c](#).

7.17.1.5 EVENT_TYPE_WRITE

```
#define EVENT_TYPE_WRITE 2
```

Definition at line 11 of file [low_saurion.c](#).

7.17.1.6 MAX

```
#define MAX(  
    a,  
    b ) ((a) > (b) ? (a) : (b))
```

Definition at line 28 of file [low_saurion.c](#).

7.17.1.7 MIN

```
#define MIN(  
    a,  
    b ) ((a) < (b) ? (a) : (b))
```

Definition at line 27 of file [low_saurion.c](#).

7.17.2 Function Documentation

7.17.2.1 add_accept()

```
static void add_accept (
    struct saurion *const s,
    const struct sockaddr_in *const ca,
    socklen_t *const cal ) [static]
```

Definition at line 186 of file [low_saurion.c](#).

```
00187 {
00188     int res = ERROR_CODE;
00189     pthread_mutex_lock(&s->m_rings[0]);
00190     while (res != SUCCESS_CODE) {
00191         struct io_uring_sqe *sqe = io_uring_get_sqe(&s->rings[0]);
00192         while (!sqe) {
00193             sqe = io_uring_get_sqe(&s->rings[0]);
00194             usleep(TIMEOUT_RETRY);
00195         }
00196         struct request *req = NULL;
00197         if (!set_request(&req, &s->list, 0, NULL, 0)) {
00198             free(sqe);
00199             usleep(TIMEOUT_RETRY);
00200             res = ERROR_CODE;
00201             continue;
00202         }
00203         req->client_socket = 0;
00204         req->event_type = EVENT_TYPE_ACCEPT;
00205         io_uring_prep_accept(sqe, s->ss, (struct sockaddr *)ca, cal, 0);
00206         io_uring_sqe_set_data(sqe, req);
00207         if (io_uring_submit(&s->rings[0]) < 0) {
00208             free(sqe);
00209             list_delete_node(&s->list, req);
00210             usleep(TIMEOUT_RETRY);
00211             res = ERROR_CODE;
00212             continue;
00213         }
00214         res = SUCCESS_CODE;
00215     }
00216     pthread_mutex_unlock(&s->m_rings[0]);
00217 }
```

7.17.2.2 add_efd()

```
static void add_efd (
    struct saurion *const s,
    const int client_socket,
    int sel ) [static]
```

Definition at line 219 of file [low_saurion.c](#).

```
00219 {
00220     pthread_mutex_lock(&s->m_rings[sel]);
00221     int res = ERROR_CODE;
00222     while (res != SUCCESS_CODE) {
00223         struct io_uring *ring = &s->rings[sel];
00224         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);
00225         while (!sqe) {
00226             sqe = io_uring_get_sqe(ring);
00227             usleep(TIMEOUT_RETRY);
00228         }
00229         struct request *req = NULL;
00230         if (!set_request(&req, &s->list, CHUNK_SZ, NULL, 0)) {
00231             free(sqe);
00232             res = ERROR_CODE;
00233             continue;
00234         }
00235         req->event_type = EVENT_TYPE_READ;
00236         req->client_socket = client_socket;
00237         io_uring_prep_readv(sqe, client_socket, &req->iov[0], req->iovec_count, 0);
00238         io_uring_sqe_set_data(sqe, req);
00239         if (io_uring_submit(ring) < 0) {
00240             free(sqe);
00241             list_delete_node(&s->list, req);
00242             res = ERROR_CODE;
00243             continue;
00244         }
00245     }
```

```

00244     }
00245     res = SUCCESS_CODE;
00246 }
00247 pthread_mutex_unlock(&s->m_rings[sel]);
00248 }

```

7.17.2.3 add_read()

```

static void add_read (
    struct saurion *const s,
    const int client_socket ) [static]

```

Definition at line 250 of file [low_saurion.c](#).

```

00250                                     {
00251     int sel = next(s);
00252     int res = ERROR_CODE;
00253     pthread_mutex_lock(&s->m_rings[sel]);
00254     while (res != SUCCESS_CODE) {
00255         struct io_uring *ring = &s->rings[sel];
00256         struct io_uring_sq *sqe = io_uring_get_sqe(ring);
00257         while (!sqe) {
00258             sqe = io_uring_get_sqe(ring);
00259             usleep(TIMEOUT_RETRY);
00260         }
00261         struct request *req = NULL;
00262         if (!set_request(&req, &s->list, CHUNK_SZ, NULL, 0)) {
00263             free(sqe);
00264             res = ERROR_CODE;
00265             continue;
00266         }
00267         req->event_type = EVENT_TYPE_READ;
00268         req->client_socket = client_socket;
00269         io_uring_prep_readv(sqe, client_socket, &req->iov[0], req->iovec_count, 0);
00270         io_uring_sqe_set_data(sqe, req);
00271         if (io_uring_submit(ring) < 0) {
00272             free(sqe);
00273             list_delete_node(&s->list, req);
00274             res = ERROR_CODE;
00275             continue;
00276         }
00277         res = SUCCESS_CODE;
00278     }
00279     pthread_mutex_unlock(&s->m_rings[sel]);
00280 }

```

7.17.2.4 add_read_continue()

```

static void add_read_continue (
    struct saurion *const s,
    struct request *oreq,
    const int sel ) [static]

```

Definition at line 282 of file [low_saurion.c](#).

```

00282                                     {
00283     pthread_mutex_lock(&s->m_rings[sel]);
00284     int res = ERROR_CODE;
00285     while (res != SUCCESS_CODE) {
00286         struct io_uring *ring = &s->rings[sel];
00287         struct io_uring_sq *sqe = io_uring_get_sqe(ring);
00288         while (!sqe) {
00289             sqe = io_uring_get_sqe(ring);
00290             usleep(TIMEOUT_RETRY);
00291         }
00292         if (!set_request(&oreq, &s->list, oreq->prev_remain, NULL, 0)) {
00293             free(sqe);
00294             res = ERROR_CODE;
00295             continue;
00296         }

```

```

00297     io_uring_prep_readv(sqe, oreq->client_socket, &oreq->iov[0], oreq->iovec_count, 0);
00298     io_uring_sqe_set_data(sqe, oreq);
00299     if (io_uring_submit(ring) < 0) {
00300         free(sqe);
00301         list_delete_node(&s->list, oreq);
00302         res = ERROR_CODE;
00303         continue;
00304     }
00305     res = SUCCESS_CODE;
00306 }
00307 pthread_mutex_unlock(&s->m_rings[sel]);
00308 }

```

7.17.2.5 add_write()

```

static void add_write (
    struct saurion *const s,
    int fd,
    const char *const str,
    const int sel ) [static]

```

Definition at line 310 of file [low_saurion.c](#).

```

00310 {
00311     int res = ERROR_CODE;
00312     pthread_mutex_lock(&s->m_rings[sel]);
00313     while (res != SUCCESS_CODE) {
00314         struct io_uring *ring = &s->rings[sel];
00315         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);
00316         while (!sqe) {
00317             sqe = io_uring_get_sqe(ring);
00318             usleep(TIMEOUT_RETRY);
00319         }
00320         struct request *req = NULL;
00321         if (!set_request(&req, &s->list, strlen(str), (void *)str, 1)) {
00322             free(sqe);
00323             res = ERROR_CODE;
00324             continue;
00325         }
00326         req->event_type = EVENT_TYPE_WRITE;
00327         req->client_socket = fd;
00328         io_uring_prep_writev(sqe, req->client_socket, req->iov, req->iovec_count, 0);
00329         io_uring_sqe_set_data(sqe, req);
00330         if (io_uring_submit(ring) < 0) {
00331             free(sqe);
00332             list_delete_node(&s->list, req);
00333             res = ERROR_CODE;
00334             usleep(TIMEOUT_RETRY);
00335             continue;
00336         }
00337         res = SUCCESS_CODE;
00338     }
00339     pthread_mutex_unlock(&s->m_rings[sel]);
00340 }

```

7.17.2.6 handle_accept()

```

static void handle_accept (
    const struct saurion *const s,
    const int fd ) [static]

```

Definition at line 343 of file [low_saurion.c](#).

```

00343 {
00344     if (s->cb.on_connected) {
00345         s->cb.on_connected(fd, s->cb.on_connected_arg);
00346     }
00347 }

```

7.17.2.7 handle_close()

```
static void handle_close (
    const struct saurion *const s,
    const struct request *const req ) [static]
```

Definition at line 540 of file [low_saurion.c](#).

```
00540
00541     if (s->cb.on_closed) {
00542         s->cb.on_closed(req->client_socket, s->cb.on_closed_arg);
00543     }
00544     close(req->client_socket);
00545 }
```

7.17.2.8 handle_error()

```
static void handle_error (
    const struct saurion *const s,
    const struct request *const req ) [static]
```

Definition at line 533 of file [low_saurion.c](#).

```
00533
00534     if (s->cb.on_error) {
00535         const char *resp = "ERROR";
00536         s->cb.on_error(req->client_socket, resp, (ssize_t)strlen(resp), s->cb.on_error_arg);
00537     }
00538 }
```

7.17.2.9 handle_read()

```
static void handle_read (
    struct saurion *const s,
    struct request *const req ) [static]
```

Definition at line 495 of file [low_saurion.c](#).

```
00495
00496     void *msg = NULL;
00497     size_t len = 0;
00498     while (1) {
00499         if (!read_chunk(&msg, &len, req)) {
00500             break;
00501         }
00502         // Hay siguiente
00503         if (req->next_iov || req->next_offset) {
00504             if (s->cb.on_readed && msg) {
00505                 s->cb.on_readed(req->client_socket, msg, len, s->cb.on_readed_arg);
00506             }
00507             free(msg);
00508             msg = NULL;
00509             continue;
00510         }
00511         // Hay previo pero no se ha completado
00512         if (req->prev && req->prev_size && req->prev_remain) {
00513             add_read_continue(s, req, next(s));
00514             return;
00515         }
00516         // Hay un único mensaje y se ha completado
00517         if (s->cb.on_readed && msg) {
00518             s->cb.on_readed(req->client_socket, msg, len, s->cb.on_readed_arg);
00519         }
00520         free(msg);
00521         msg = NULL;
00522         break;
00523     }
00524     add_read(s, req->client_socket);
00525 }
```

7.17.2.10 handle_write()

```
static void handle_write (
    const struct saurion *const s,
    const int fd ) [static]
```

Definition at line 527 of file [low_saurion.c](#).

```
00527
00528     if (s->cb.on_wrote) {
00529         s->cb.on_wrote(fd, s->cb.on_wrote_arg);
00530     }
00531 }
```

7.17.2.11 htonll()

```
static uint64_t htonll (
    uint64_t value ) [static]
```

Definition at line 41 of file [low_saurion.c](#).

```
00041
00042     int num = 42;
00043     if (*(char *)&num == 42) { // Little endian check
00044         uint32_t high_part = htonl((uint32_t)(value >> 32));
00045         uint32_t low_part = htonl((uint32_t)(value & 0xFFFFFFFFLL));
00046         return ((uint64_t)low_part << 32) | high_part;
00047     }
00048     return value;
00049 }
```

7.17.2.12 next()

```
static uint32_t next (
    struct saurion * s ) [static]
```

Definition at line 36 of file [low_saurion.c](#).

```
00036
00037     s->next = (s->next + 1) % s->n_threads;
00038     return s->next;
00039 }
```

7.17.2.13 ntohll()

```
static uint64_t ntohll (
    uint64_t value ) [static]
```

Definition at line 51 of file [low_saurion.c](#).

```
00051
00052     int num = 42;
00053     if (*(char *)&num == 42) { // Little endian check
00054         uint32_t high_part = ntohl((uint32_t)(value >> 32));
00055         uint32_t low_part = ntohl((uint32_t)(value & 0xFFFFFFFFLL));
00056         return ((uint64_t)low_part << 32) | high_part;
00057     }
00058     return value;
00059 }
```

7.17.2.14 saurion_worker_master()

```
void saurion_worker_master (
    void * arg )
```

Definition at line 677 of file [low_saurion.c](#).

```
00677 {
00678     struct saurion *const s = (struct saurion *)arg;
00679     struct io_uring ring = s->rings[0];
00680     struct io_uring_cqe *cqe = NULL;
00681     struct sockaddr_in client_addr;
00682     socklen_t client_addr_len = sizeof(client_addr);
00683
00684     add_efd(s, s->efds[0], 0);
00685     add_accept(s, &client_addr, &client_addr_len);
00686
00687     pthread_mutex_lock(&s->status_m);
00688     s->status = 1;
00689     pthread_cond_signal(&s->status_c);
00690     pthread_mutex_unlock(&s->status_m);
00691     while (1) {
00692         int ret = io_uring_wait_cqe(&ring, &cqe);
00693         if (ret < 0) {
00694             free(cqe);
00695             return;
00696         }
00697         struct request *req = (struct request *)cqe->user_data;
00698         if (!req) {
00699             io_uring_cqe_seen(&s->rings[0], cqe);
00700             continue;
00701         }
00702         if (cqe->res < 0) {
00703             list_delete_node(&s->list, req);
00704             return;
00705         }
00706         if (req->client_socket == s->efds[0]) {
00707             io_uring_cqe_seen(&s->rings[0], cqe);
00708             list_delete_node(&s->list, req);
00709             break;
00710         }
00711         /* Mark this request as processed */
00712         io_uring_cqe_seen(&s->rings[0], cqe);
00713         switch (req->event_type) {
00714             case EVENT_TYPE_ACCEPT:
00715                 handle_accept(s, cqe->res);
00716                 add_accept(s, &client_addr, &client_addr_len);
00717                 add_read(s, cqe->res);
00718                 list_delete_node(&s->list, req);
00719                 break;
00720             case EVENT_TYPE_READ:
00721                 if (cqe->res < 0) {
00722                     handle_error(s, req);
00723                 }
00724                 if (cqe->res < 1) {
00725                     handle_close(s, req);
00726                 }
00727                 if (cqe->res > 0) {
00728                     handle_read(s, req);
00729                 }
00730                 list_delete_node(&s->list, req);
00731                 break;
00732             case EVENT_TYPE_WRITE:
00733                 handle_write(s, req->client_socket);
00734                 list_delete_node(&s->list, req);
00735                 break;
00736         }
00737     }
00738     pthread_mutex_lock(&s->status_m);
00739     s->status = 2;
00740     pthread_cond_signal(&s->status_c);
00741     pthread_mutex_unlock(&s->status_m);
00742     return;
00743 }
```

7.17.2.15 saurion_worker_slave()

```
void saurion_worker_slave (
    void * arg )
```


Definition at line 745 of file [low_saurion.c](#).

```

00745 {
00746     struct saurion_wrapper *const ss = (struct saurion_wrapper *)arg;
00747     struct saurion *s = ss->s;
00748     const int sel = ss->sel;
00749     free(ss);
00750     struct io_uring ring = s->rings[sel];
00751     struct io_uring_cqe *cqe = NULL;
00752
00753     add_efd(s, s->efds[sel], sel);
00754
00755     pthread_mutex_lock(&s->status_m);
00756     s->status = 1;
00757     pthread_cond_signal(&s->status_c);
00758     pthread_mutex_unlock(&s->status_m);
00759     while (1) {
00760         int ret = io_uring_wait_cqe(&ring, &cqe);
00761         if (ret < 0) {
00762             free(cqe);
00763             return;
00764         }
00765         struct request *req = (struct request *)cqe->user_data;
00766         if (!req) {
00767             io_uring_cqe_seen(&ring, cqe);
00768             continue;
00769         }
00770         if (cqe->res < 0) {
00771             list_delete_node(&s->list, req);
00772             return;
00773         }
00774         if (req->client_socket == s->efds[sel]) {
00775             io_uring_cqe_seen(&ring, cqe);
00776             list_delete_node(&s->list, req);
00777             break;
00778         }
00779         /* Mark this request as processed */
00780         io_uring_cqe_seen(&ring, cqe);
00781         switch (req->event_type) {
00782             case EVENT_TYPE_READ:
00783                 if (cqe->res < 0) {
00784                     handle_error(s, req);
00785                 }
00786                 if (cqe->res < 1) {
00787                     handle_close(s, req);
00788                 }
00789                 if (cqe->res > 0) {
00790                     handle_read(s, req);
00791                 }
00792                 list_delete_node(&s->list, req);
00793                 break;
00794             case EVENT_TYPE_WRITE:
00795                 handle_write(s, req->client_socket);
00796                 list_delete_node(&s->list, req);
00797                 break;
00798         }
00799     }
00800     pthread_mutex_lock(&s->status_m);
00801     s->status = 2;
00802     pthread_cond_signal(&s->status_c);
00803     pthread_mutex_unlock(&s->status_m);
00804     return;
00805 }

```

7.17.3 Variable Documentation

7.17.3.1 print_mutex

pthread_mutex_t print_mutex

Definition at line 29 of file [low_saurion.c](#).

7.18 low_saurion.c

[Go to the documentation of this file.](#)

```

00001 #include "low_saurion.h"
00002
00003 #include <netinet/in.h>
00004 #include <stdio.h>
00005 #include <stdlib.h>
00006 #include <string.h>
00007 #include <sys/eventfd.h>
00008
00009 #define EVENT_TYPE_ACCEPT 0
00010 #define EVENT_TYPE_READ 1
00011 #define EVENT_TYPE_WRITE 2
00012 #define EVENT_TYPE_WAIT 3
00013 #define EVENT_TYPE_ERROR 4
00014
00015 struct request {
00016     void *prev;
00017     size_t prev_size;
00018     size_t prev_remain;
00019     size_t next_iov;
00020     size_t next_offset;
00021     int event_type;
00022     size_t iovec_count;
00023     int client_socket;
00024     struct iovec iov[];
00025 };
00026
00027 #define MIN(a, b) ((a) < (b) ? (a) : (b))
00028 #define MAX(a, b) ((a) > (b) ? (a) : (b))
00029 pthread_mutex_t print_mutex;
00030
00031 struct saurion_wrapper {
00032     struct saurion *s;
00033     uint32_t sel;
00034 };
00035
00036 static uint32_t next(struct saurion *s) {
00037     s->next = (s->next + 1) % s->n_threads;
00038     return s->next;
00039 }
00040
00041 static uint64_t htonll(uint64_t value) {
00042     int num = 42;
00043     if (*(char *)&num == 42) { // Little endian check
00044         uint32_t high_part = htonl((uint32_t)(value >> 32));
00045         uint32_t low_part = htonl((uint32_t)(value & 0xFFFFFFFFLL));
00046         return ((uint64_t)low_part << 32) | high_part;
00047     }
00048     return value;
00049 }
00050
00051 static uint64_t ntohll(uint64_t value) {
00052     int num = 42;
00053     if (*(char *)&num == 42) { // Little endian check
00054         uint32_t high_part = ntohl((uint32_t)(value >> 32));
00055         uint32_t low_part = ntohl((uint32_t)(value & 0xFFFFFFFFLL));
00056         return ((uint64_t)low_part << 32) | high_part;
00057     }
00058     return value;
00059 }
00060
00061 void free_request(struct request *req, void **children_ptr, size_t amount) {
00062     if (children_ptr) {
00063         free(children_ptr);
00064         children_ptr = NULL;
00065     }
00066     for (size_t i = 0; i < amount; ++i) {
00067         free(req->iov[i].iov_base);
00068         req->iov[i].iov_base = NULL;
00069     }
00070     free(req);
00071     req = NULL;
00072     free(children_ptr);
00073     children_ptr = NULL;
00074 }
00075
00076 [[nodiscard]]
00077 int initialize_iovec(struct iovec *iov, size_t amount, size_t pos, const void *msg, size_t size,
00078                     uint8_t h) {
00079     if (!iov || !iov->iov_base) {
00080         return ERROR_CODE;
00081     }
00082     if (msg) {

```

```

00083     size_t len = iov->iov_len;
00084     char *dest = (char *)iov->iov_base;
00085     char *orig = (char *)msg + pos * CHUNK_SZ;
00086     size_t cpy_sz = 0;
00087     if (h) {
00088         if (pos == 0) {
00089             uint64_t send_size = htonll(size);
00090             memcpy(dest, &send_size, sizeof(uint64_t));
00091             dest += sizeof(uint64_t);
00092             len -= sizeof(uint64_t);
00093         } else {
00094             orig -= sizeof(uint64_t);
00095         }
00096         if ((pos + 1) == amount) {
00097             --len;
00098             cpy_sz = (len < size ? len : size);
00099             dest[cpy_sz] = 0;
00100         }
00101     }
00102     cpy_sz = (len < size ? len : size);
00103     memcpy(dest, orig, cpy_sz);
00104     dest += cpy_sz;
00105     size_t rem = CHUNK_SZ - (dest - (char *)iov->iov_base);
00106     memset(dest, 0, rem);
00107 } else {
00108     memset((char *)iov->iov_base, 0, CHUNK_SZ);
00109 }
00110 return SUCCESS_CODE;
00111 }
00112
00113 [[nodiscard]]
00114 int allocate_iovec(struct iovec *iov, size_t amount, size_t pos, size_t size, void **chd_ptr) {
00115     if (!iov || !chd_ptr) {
00116         return ERROR_CODE;
00117     }
00118     iov->iov_base = malloc(CHUNK_SZ);
00119     if (!iov->iov_base) {
00120         return ERROR_CODE;
00121     }
00122     iov->iov_len = (pos == (amount - 1) ? (size % CHUNK_SZ) : CHUNK_SZ);
00123     if (iov->iov_len == 0) {
00124         iov->iov_len = CHUNK_SZ;
00125     }
00126     chd_ptr[pos] = iov->iov_base;
00127     return SUCCESS_CODE;
00128 }
00129
00130 [[nodiscard]]
00131 int set_request(struct request **r, struct Node **l, size_t s, const void *m, uint8_t h) {
00132     uint64_t full_size = s;
00133     if (h) {
00134         full_size += (sizeof(uint64_t) + 1);
00135     }
00136     size_t amount = full_size / CHUNK_SZ;
00137     amount = amount + (full_size % CHUNK_SZ == 0 ? 0 : 1);
00138     struct request *temp =
00139         (struct request *)malloc(sizeof(struct request) + sizeof(struct iovec) * amount);
00140     if (!temp) {
00141         return ERROR_CODE;
00142     }
00143     if (!*r) {
00144         *r = temp;
00145         (*r)->prev = NULL;
00146         (*r)->prev_size = 0;
00147         (*r)->prev_remain = 0;
00148         (*r)->next_iov = 0;
00149         (*r)->next_offset = 0;
00150     } else {
00151         temp->client_socket = (*r)->client_socket;
00152         temp->event_type = (*r)->event_type;
00153         temp->prev = (*r)->prev;
00154         temp->prev_size = (*r)->prev_size;
00155         temp->prev_remain = (*r)->prev_remain;
00156         temp->next_iov = (*r)->next_iov;
00157         temp->next_offset = (*r)->next_offset;
00158         *r = temp;
00159     }
00160     struct request *req = *r;
00161     req->iovec_count = (int)amount;
00162     void **children_ptr = (void **)malloc(amount * sizeof(void *));
00163     if (!children_ptr) {
00164         free_request(req, children_ptr, 0);
00165         return ERROR_CODE;
00166     }
00167     for (size_t i = 0; i < amount; ++i) {
00168         if (!allocate_iovec(&req->iov[i], amount, i, full_size, children_ptr)) {
00169             free_request(req, children_ptr, amount);

```

```

00170         return ERROR_CODE;
00171     }
00172     if (!initialize_iovec(&req->iov[i], amount, i, m, s, h)) {
00173         free_request(req, children_ptr, amount);
00174         return ERROR_CODE;
00175     }
00176 }
00177 if (list_insert(l, req, amount, children_ptr)) {
00178     free_request(req, children_ptr, amount);
00179     return ERROR_CODE;
00180 }
00181 free(children_ptr);
00182 return SUCCESS_CODE;
00183 }
00184
00185 /***** ADDERS *****/
00186 static void add_accept(struct saurion *const s, const struct sockaddr_in *const ca,
00187                      socklen_t *const cal) {
00188     int res = ERROR_CODE;
00189     pthread_mutex_lock(&s->m_rings[0]);
00190     while (res != SUCCESS_CODE) {
00191         struct io_uring_sqe *sqe = io_uring_get_sqe(&s->rings[0]);
00192         while (!sqe) {
00193             sqe = io_uring_get_sqe(&s->rings[0]);
00194             usleep(TIMEOUT_RETRY);
00195         }
00196         struct request *req = NULL;
00197         if (!set_request(&req, &s->list, 0, NULL, 0)) {
00198             free(sqe);
00199             usleep(TIMEOUT_RETRY);
00200             res = ERROR_CODE;
00201             continue;
00202         }
00203         req->client_socket = 0;
00204         req->event_type = EVENT_TYPE_ACCEPT;
00205         io_uring_prep_accept(sqe, s->ss, (struct sockaddr *)ca, cal, 0);
00206         io_uring_sqe_set_data(sqe, req);
00207         if (io_uring_submit(&s->rings[0]) < 0) {
00208             free(sqe);
00209             list_delete_node(&s->list, req);
00210             usleep(TIMEOUT_RETRY);
00211             res = ERROR_CODE;
00212             continue;
00213         }
00214         res = SUCCESS_CODE;
00215     }
00216     pthread_mutex_unlock(&s->m_rings[0]);
00217 }
00218
00219 static void add_efd(struct saurion *const s, const int client_socket, int sel) {
00220     pthread_mutex_lock(&s->m_rings[sel]);
00221     int res = ERROR_CODE;
00222     while (res != SUCCESS_CODE) {
00223         struct io_uring *ring = &s->rings[sel];
00224         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);
00225         while (!sqe) {
00226             sqe = io_uring_get_sqe(ring);
00227             usleep(TIMEOUT_RETRY);
00228         }
00229         struct request *req = NULL;
00230         if (!set_request(&req, &s->list, CHUNK_SZ, NULL, 0)) {
00231             free(sqe);
00232             res = ERROR_CODE;
00233             continue;
00234         }
00235         req->event_type = EVENT_TYPE_READ;
00236         req->client_socket = client_socket;
00237         io_uring_prep_readv(sqe, client_socket, &req->iov[0], req->iovec_count, 0);
00238         io_uring_sqe_set_data(sqe, req);
00239         if (io_uring_submit(ring) < 0) {
00240             free(sqe);
00241             list_delete_node(&s->list, req);
00242             res = ERROR_CODE;
00243             continue;
00244         }
00245         res = SUCCESS_CODE;
00246     }
00247     pthread_mutex_unlock(&s->m_rings[sel]);
00248 }
00249
00250 static void add_read(struct saurion *const s, const int client_socket) {
00251     int sel = next(s);
00252     int res = ERROR_CODE;
00253     pthread_mutex_lock(&s->m_rings[sel]);
00254     while (res != SUCCESS_CODE) {
00255         struct io_uring *ring = &s->rings[sel];
00256         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);

```

```

00257     while (!sqe) {
00258         sqe = io_uring_get_sqe(ring);
00259         usleep(TIMEOUT_RETRY);
00260     }
00261     struct request *req = NULL;
00262     if (!set_request(&req, &s->list, CHUNK_SZ, NULL, 0)) {
00263         free(sqe);
00264         res = ERROR_CODE;
00265         continue;
00266     }
00267     req->event_type = EVENT_TYPE_READ;
00268     req->client_socket = client_socket;
00269     io_uring_prep_readv(sqe, client_socket, &req->iov[0], req->iovec_count, 0);
00270     io_uring_sqe_set_data(sqe, req);
00271     if (io_uring_submit(ring) < 0) {
00272         free(sqe);
00273         list_delete_node(&s->list, req);
00274         res = ERROR_CODE;
00275         continue;
00276     }
00277     res = SUCCESS_CODE;
00278 }
00279 pthread_mutex_unlock(&s->m_rings[sel]);
00280 }
00281
00282 static void add_read_continue(struct saurion *const s, struct request *oreq, const int sel) {
00283     pthread_mutex_lock(&s->m_rings[sel]);
00284     int res = ERROR_CODE;
00285     while (res != SUCCESS_CODE) {
00286         struct io_uring *ring = &s->rings[sel];
00287         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);
00288         while (!sqe) {
00289             sqe = io_uring_get_sqe(ring);
00290             usleep(TIMEOUT_RETRY);
00291         }
00292         if (!set_request(&oreq, &s->list, oreq->prev_remain, NULL, 0)) {
00293             free(sqe);
00294             res = ERROR_CODE;
00295             continue;
00296         }
00297         io_uring_prep_readv(sqe, oreq->client_socket, &oreq->iov[0], oreq->iovec_count, 0);
00298         io_uring_sqe_set_data(sqe, oreq);
00299         if (io_uring_submit(ring) < 0) {
00300             free(sqe);
00301             list_delete_node(&s->list, oreq);
00302             res = ERROR_CODE;
00303             continue;
00304         }
00305         res = SUCCESS_CODE;
00306     }
00307     pthread_mutex_unlock(&s->m_rings[sel]);
00308 }
00309
00310 static void add_write(struct saurion *const s, int fd, const char *const str, const int sel) {
00311     int res = ERROR_CODE;
00312     pthread_mutex_lock(&s->m_rings[sel]);
00313     while (res != SUCCESS_CODE) {
00314         struct io_uring *ring = &s->rings[sel];
00315         struct io_uring_sqe *sqe = io_uring_get_sqe(ring);
00316         while (!sqe) {
00317             sqe = io_uring_get_sqe(ring);
00318             usleep(TIMEOUT_RETRY);
00319         }
00320         struct request *req = NULL;
00321         if (!set_request(&req, &s->list, strlen(str), (void *)str, 1)) {
00322             free(sqe);
00323             res = ERROR_CODE;
00324             continue;
00325         }
00326         req->event_type = EVENT_TYPE_WRITE;
00327         req->client_socket = fd;
00328         io_uring_prep_writev(sqe, req->client_socket, req->iov, req->iovec_count, 0);
00329         io_uring_sqe_set_data(sqe, req);
00330         if (io_uring_submit(ring) < 0) {
00331             free(sqe);
00332             list_delete_node(&s->list, req);
00333             res = ERROR_CODE;
00334             usleep(TIMEOUT_RETRY);
00335             continue;
00336         }
00337         res = SUCCESS_CODE;
00338     }
00339     pthread_mutex_unlock(&s->m_rings[sel]);
00340 }
00341
00342 /***** HANDLERS *****/
00343 static void handle_accept(const struct saurion *const s, const int fd) {

```

```

00344     if (s->cb.on_connected) {
00345         s->cb.on_connected(fd, s->cb.on_connected_arg);
00346     }
00347 }
00348
00349 [[nodiscard]]
00350 int read_chunk(void **dest, size_t *len, struct request *const req) {
00351     // Initial checks
00352     if (req->iovec_count == 0) {
00353         return ERROR_CODE;
00354     }
00355
00356     // Initialization
00357     size_t max_iov_cont = 0; //< Total size of request
00358     for (size_t i = 0; i < req->iovec_count; ++i) {
00359         max_iov_cont += req->iov[i].iov_len;
00360     }
00361     size_t cont_sz = 0; //< Message content size
00362     size_t cont_rem = 0; //< Remaining bytes of message content
00363     size_t curr_iov = 0; //< IOVEC num currently reading
00364     size_t curr_iov_off = 0; //< Offset in bytes of the current IOVEC
00365     size_t dest_off = 0; //< Write offset on the destiny array
00366     void *dest_ptr = NULL; //< Destiny pointer, could be dest or prev
00367     if (req->prev && req->prev_size && req->prev_remain) {
00368         // There's a previous unfinished message
00369         cont_sz = req->prev_size;
00370         cont_rem = req->prev_remain;
00371         curr_iov = 0;
00372         curr_iov_off = 0;
00373         dest_off = cont_sz - cont_rem;
00374         if (cont_rem <= max_iov_cont) {
00375             *dest = req->prev;
00376             dest_ptr = *dest;
00377             req->prev = NULL;
00378             req->prev_size = 0;
00379             req->prev_remain = 0;
00380         } else {
00381             dest_ptr = req->prev;
00382             *dest = NULL;
00383         }
00384     } else if (req->next_iov || req->next_offset) {
00385         // Reading the next message
00386         curr_iov = req->next_iov;
00387         curr_iov_off = req->next_offset;
00388         cont_sz = *((size_t *) (req->iov[curr_iov].iov_base + curr_iov_off));
00389         cont_sz = ntohll(cont_sz);
00390         curr_iov_off += sizeof(uint64_t);
00391         cont_rem = cont_sz;
00392         dest_off = cont_sz - cont_rem;
00393         if ((curr_iov_off + cont_rem + 1) <= max_iov_cont) {
00394             *dest = malloc(cont_sz);
00395             dest_ptr = *dest;
00396         } else {
00397             req->prev = malloc(cont_sz);
00398             dest_ptr = req->prev;
00399             *dest = NULL;
00400             *len = 0;
00401         }
00402     } else {
00403         // Reading the first message
00404         curr_iov = 0;
00405         curr_iov_off = 0;
00406         cont_sz = *((size_t *) (req->iov[curr_iov].iov_base + curr_iov_off));
00407         cont_sz = ntohll(cont_sz);
00408         curr_iov_off += sizeof(uint64_t);
00409         cont_rem = cont_sz;
00410         dest_off = cont_sz - cont_rem;
00411         if (cont_rem <= max_iov_cont) {
00412             *dest = malloc(cont_sz);
00413             dest_ptr = *dest;
00414         } else {
00415             req->prev = malloc(cont_sz);
00416             dest_ptr = req->prev;
00417             *dest = NULL;
00418         }
00419     }
00420     size_t curr_iov_msg_rem = 0;
00421
00422     // Copy loop
00423     uint8_t ok = 1UL;
00424     while (1) {
00425         curr_iov_msg_rem = MIN(cont_rem, (req->iov[curr_iov].iov_len - curr_iov_off));
00426         memcpy(dest_ptr + dest_off, req->iov[curr_iov].iov_base + curr_iov_off, curr_iov_msg_rem);
00427         dest_off += curr_iov_msg_rem;
00428         curr_iov_off += curr_iov_msg_rem;
00429         cont_rem -= curr_iov_msg_rem;
00430         if (cont_rem <= 0) {

```

```

00432     // Finish reading
00433     if (*(uint8_t *) (req->iiov[curr_iiov].iov_base + curr_iiov_off)) != 0) {
00434         ok = 0UL;
00435     }
00436     *len = cont_sz;
00437     ++curr_iiov_off;
00438     break;
00439 }
00440 if (curr_iiov_off >= (req->iiov[curr_iiov].iov_len)) {
00441     ++curr_iiov;
00442     if (curr_iiov == req->iiovec_count) {
00443         break;
00444     }
00445     curr_iiov_off = 0;
00446 }
00447 }
00448
00449 // Update status
00450 if (req->prev) {
00451     req->prev_size = cont_sz;
00452     req->prev_remain = cont_rem;
00453     *dest = NULL;
00454     len = 0;
00455 } else {
00456     req->prev_size = 0;
00457     req->prev_remain = 0;
00458 }
00459 if (curr_iiov < req->iiovec_count) {
00460     uint64_t next_sz = *(uint64_t *) (req->iiov[curr_iiov].iov_base + curr_iiov_off);
00461     if ((req->iiov[curr_iiov].iov_len > curr_iiov_off) && next_sz) {
00462         req->next_iiov = curr_iiov;
00463         req->next_offset = curr_iiov_off;
00464     } else {
00465         req->next_iiov = 0;
00466         req->next_offset = 0;
00467     }
00468 }
00469
00470 // Finish
00471 if (!ok) {
00472     // Esto solo es posible si no se encuentra un 0 al final del la lectura
00473     // buscar el siguiente 0 y ... probar fortuna
00474     free(dest_ptr);
00475     dest_ptr = NULL;
00476     *dest = NULL;
00477     *len = 0;
00478     req->next_iiov = 0;
00479     req->next_offset = 0;
00480     for (size_t i = curr_iiov; i < req->iiovec_count; ++i) {
00481         for (size_t j = curr_iiov_off; j < req->iiov[i].iov_len; ++j) {
00482             uint8_t foot = *(uint8_t *) (req->iiov[i].iov_base + j);
00483             if (foot == 0) {
00484                 req->next_iiov = i;
00485                 req->next_offset = (j + 1) % req->iiov[i].iov_len;
00486                 return ERROR_CODE;
00487             }
00488         }
00489     }
00490     return ERROR_CODE;
00491 }
00492 return SUCCESS_CODE;
00493 }
00494
00495 static void handle_read(struct saurion *const s, struct request *const req) {
00496     void *msg = NULL;
00497     size_t len = 0;
00498     while (1) {
00499         if (!read_chunk(&msg, &len, req)) {
00500             break;
00501         }
00502         // Hay siguiente
00503         if (req->next_iiov || req->next_offset) {
00504             if (s->cb.on_readed && msg) {
00505                 s->cb.on_readed(req->client_socket, msg, len, s->cb.on_readed_arg);
00506             }
00507             free(msg);
00508             msg = NULL;
00509             continue;
00510         }
00511         // Hay previo pero no se ha completado
00512         if (req->prev && req->prev_size && req->prev_remain) {
00513             add_read_continue(s, req, next(s));
00514             return;
00515         }
00516         // Hay un único mensaje y se ha completado
00517         if (s->cb.on_readed && msg) {
00518             s->cb.on_readed(req->client_socket, msg, len, s->cb.on_readed_arg);

```

```

00519     }
00520     free(msg);
00521     msg = NULL;
00522     break;
00523 }
00524 add_read(s, req->client_socket);
00525 }
00526
00527 static void handle_write(const struct saurion *const s, const int fd) {
00528     if (s->cb.on_wrote) {
00529         s->cb.on_wrote(fd, s->cb.on_wrote_arg);
00530     }
00531 }
00532
00533 static void handle_error(const struct saurion *const s, const struct request *const req) {
00534     if (s->cb.on_error) {
00535         const char *resp = "ERROR";
00536         s->cb.on_error(req->client_socket, resp, (ssize_t)strlen(resp), s->cb.on_error_arg);
00537     }
00538 }
00539
00540 static void handle_close(const struct saurion *const s, const struct request *const req) {
00541     if (s->cb.on_closed) {
00542         s->cb.on_closed(req->client_socket, s->cb.on_closed_arg);
00543     }
00544     close(req->client_socket);
00545 }
00546
00547 /***** INTERFACE *****/
00548 int EXTERNAL_set_socket(const int p) {
00549     int sock = 0;
00550     struct sockaddr_in srv_addr;
00551
00552     sock = socket(PF_INET, SOCK_STREAM, 0);
00553     if (sock < 1) {
00554         return ERROR_CODE;
00555     }
00556
00557     int enable = 1;
00558     if (setsockopt(sock, SOL_SOCKET, SO_REUSEADDR, &enable, sizeof(int)) < 0) {
00559         return ERROR_CODE;
00560     }
00561     if (setsockopt(sock, SOL_SOCKET, SO_REUSEPORT, &enable, sizeof(int)) < 0) {
00562         return ERROR_CODE;
00563     }
00564
00565     memset(&srv_addr, 0, sizeof(srv_addr));
00566     srv_addr.sin_family = AF_INET;
00567     srv_addr.sin_port = htons(p);
00568     srv_addr.sin_addr.s_addr = htonl(INADDR_ANY);
00569
00570     /* We bind to a port and turn this socket into a listening
00571     * socket.
00572     */
00573     if (bind(sock, (const struct sockaddr *)&srv_addr, sizeof(srv_addr)) < 0) {
00574         return ERROR_CODE;
00575     }
00576
00577     if (listen(sock, ACCEPT_QUEUE) < 0) {
00578         return ERROR_CODE;
00579     }
00580
00581     return sock;
00582 }
00583
00584 [[nodiscard]]
00585 struct saurion *saurion_create(uint32_t n_threads) {
00586     // Asignar memoria
00587     struct saurion *p = (struct saurion *)malloc(sizeof(struct saurion));
00588     if (!p) {
00589         return NULL;
00590     }
00591     // Inicializar mutex
00592     int ret = 0;
00593     ret = pthread_mutex_init(&p->status_m, NULL);
00594     if (ret) {
00595         free(p);
00596         return NULL;
00597     }
00598     ret = pthread_cond_init(&p->status_c, NULL);
00599     if (ret) {
00600         free(p);
00601         return NULL;
00602     }
00603     p->m_rings = (pthread_mutex_t *)malloc(n_threads * sizeof(pthread_mutex_t));
00604     if (!p->m_rings) {
00605         free(p);

```



```

00606     return NULL;
00607 }
00608 for (uint32_t i = 0; i < n_threads; ++i) {
00609     pthread_mutex_init(&(p->m_rings[i]), NULL);
00610 }
00611 // Inicializar miembros
00612 p->ss = 0;
00613 n_threads = (n_threads < 2 ? 2 : n_threads);
00614 n_threads = (n_threads > NUM_CORES ? NUM_CORES : n_threads);
00615 p->n_threads = n_threads;
00616 p->status = 0;
00617 p->list = NULL;
00618 p->cb.on_connected = NULL;
00619 p->cb.on_connected_arg = NULL;
00620 p->cb.on_readed = NULL;
00621 p->cb.on_readed_arg = NULL;
00622 p->cb.on_wrote = NULL;
00623 p->cb.on_wrote_arg = NULL;
00624 p->cb.on_closed = NULL;
00625 p->cb.on_closed_arg = NULL;
00626 p->cb.on_error = NULL;
00627 p->cb.on_error_arg = NULL;
00628 p->next = 0;
00629 // Inicializar efds
00630 p->efds = (int *)malloc(sizeof(int) * p->n_threads);
00631 if (!p->efds) {
00632     free(p->m_rings);
00633     free(p);
00634     return NULL;
00635 }
00636 for (uint32_t i = 0; i < p->n_threads; ++i) {
00637     p->efds[i] = eventfd(0, EFD_NONBLOCK);
00638     if (p->efds[i] == ERROR_CODE) {
00639         for (uint32_t j = 0; j < i; ++j) {
00640             close(p->efds[j]);
00641         }
00642         free(p->efds);
00643         free(p->m_rings);
00644         free(p);
00645         return NULL;
00646     }
00647 }
00648 // Inicializar rings
00649 p->rings = (struct io_uring *)malloc(sizeof(struct io_uring) * p->n_threads);
00650 if (!p->rings) {
00651     for (uint32_t j = 0; j < p->n_threads; ++j) {
00652         close(p->efds[j]);
00653     }
00654     free(p->efds);
00655     free(p->m_rings);
00656     free(p);
00657     return NULL;
00658 }
00659 for (uint32_t i = 0; i < p->n_threads; ++i) {
00660     memset(&p->rings[i], 0, sizeof(struct io_uring));
00661     ret = io_uring_queue_init(SAURION_RING_SIZE, &p->rings[i], 0);
00662     if (ret) {
00663         for (uint32_t j = 0; j < p->n_threads; ++j) {
00664             close(p->efds[j]);
00665         }
00666         free(p->efds);
00667         free(p->rings);
00668         free(p->m_rings);
00669         free(p);
00670         return NULL;
00671     }
00672 }
00673 p->pool = ThreadPool_create(p->n_threads);
00674 return p;
00675 }
00676
00677 void saurion_worker_master(void *arg) {
00678     struct saurion *const s = (struct saurion *)arg;
00679     struct io_uring ring = s->rings[0];
00680     struct io_uring_cqe *cqe = NULL;
00681     struct sockaddr_in client_addr;
00682     socklen_t client_addr_len = sizeof(client_addr);
00683
00684     add_efd(s, s->efds[0], 0);
00685     add_accept(s, &client_addr, &client_addr_len);
00686
00687     pthread_mutex_lock(&s->status_m);
00688     s->status = 1;
00689     pthread_cond_signal(&s->status_c);
00690     pthread_mutex_unlock(&s->status_m);
00691     while (1) {
00692         int ret = io_uring_wait_cqe(&ring, &cqe);

```

```

00693     if (ret < 0) {
00694         free(cqe);
00695         return;
00696     }
00697     struct request *req = (struct request *)cqe->user_data;
00698     if (!req) {
00699         io_uring_cqe_seen(&s->rings[0], cqe);
00700         continue;
00701     }
00702     if (cqe->res < 0) {
00703         list_delete_node(&s->list, req);
00704         return;
00705     }
00706     if (req->client_socket == s->efds[0]) {
00707         io_uring_cqe_seen(&s->rings[0], cqe);
00708         list_delete_node(&s->list, req);
00709         break;
00710     }
00711     /* Mark this request as processed */
00712     io_uring_cqe_seen(&s->rings[0], cqe);
00713     switch (req->event_type) {
00714         case EVENT_TYPE_ACCEPT:
00715             handle_accept(s, cqe->res);
00716             add_accept(s, &client_addr, &client_addr_len);
00717             add_read(s, cqe->res);
00718             list_delete_node(&s->list, req);
00719             break;
00720         case EVENT_TYPE_READ:
00721             if (cqe->res < 0) {
00722                 handle_error(s, req);
00723             }
00724             if (cqe->res < 1) {
00725                 handle_close(s, req);
00726             }
00727             if (cqe->res > 0) {
00728                 handle_read(s, req);
00729             }
00730             list_delete_node(&s->list, req);
00731             break;
00732         case EVENT_TYPE_WRITE:
00733             handle_write(s, req->client_socket);
00734             list_delete_node(&s->list, req);
00735             break;
00736     }
00737 }
00738 pthread_mutex_lock(&s->status_m);
00739 s->status = 2;
00740 pthread_cond_signal(&s->status_c);
00741 pthread_mutex_unlock(&s->status_m);
00742 return;
00743 }
00744
00745 void saurion_worker_slave(void *arg) {
00746     struct saurion_wrapper *const ss = (struct saurion_wrapper *)arg;
00747     struct saurion *s = ss->s;
00748     const int sel = ss->sel;
00749     free(ss);
00750     struct io_uring ring = s->rings[sel];
00751     struct io_uring_cqe *cqe = NULL;
00752
00753     add_efd(s, s->efds[sel], sel);
00754
00755     pthread_mutex_lock(&s->status_m);
00756     s->status = 1;
00757     pthread_cond_signal(&s->status_c);
00758     pthread_mutex_unlock(&s->status_m);
00759     while (1) {
00760         int ret = io_uring_wait_cqe(&ring, &cqe);
00761         if (ret < 0) {
00762             free(cqe);
00763             return;
00764         }
00765         struct request *req = (struct request *)cqe->user_data;
00766         if (!req) {
00767             io_uring_cqe_seen(&ring, cqe);
00768             continue;
00769         }
00770         if (cqe->res < 0) {
00771             list_delete_node(&s->list, req);
00772             return;
00773         }
00774         if (req->client_socket == s->efds[sel]) {
00775             io_uring_cqe_seen(&ring, cqe);
00776             list_delete_node(&s->list, req);
00777             break;
00778         }
00779         /* Mark this request as processed */

```

```

00780     io_uring_cqe_seen(&ring, cqe);
00781     switch (req->event_type) {
00782     case EVENT_TYPE_READ:
00783         if (cqe->res < 0) {
00784             handle_error(s, req);
00785         }
00786         if (cqe->res < 1) {
00787             handle_close(s, req);
00788         }
00789         if (cqe->res > 0) {
00790             handle_read(s, req);
00791         }
00792         list_delete_node(&s->list, req);
00793         break;
00794     case EVENT_TYPE_WRITE:
00795         handle_write(s, req->client_socket);
00796         list_delete_node(&s->list, req);
00797         break;
00798     }
00799 }
00800 pthread_mutex_lock(&s->status_m);
00801 s->status = 2;
00802 pthread_cond_signal(&s->status_c);
00803 pthread_mutex_unlock(&s->status_m);
00804 return;
00805 }
00806
00807 [[nodiscard]]
00808 int saurion_start(struct saurion *const s) {
00809     pthread_mutex_init(&print_mutex, NULL);
00810     ThreadPool_init(s->pool);
00811     ThreadPool_add_default(s->pool, saurion_worker_master, s);
00812     struct saurion_wrapper *ss = NULL;
00813     for (uint32_t i = 1; i < s->n_threads; ++i) {
00814         ss = (struct saurion_wrapper *)malloc(sizeof(struct saurion_wrapper));
00815         ss->s = s;
00816         ss->sel = i;
00817         ThreadPool_add_default(s->pool, saurion_worker_slave, ss);
00818     }
00819     return SUCCESS_CODE;
00820 }
00821
00822 void saurion_stop(const struct saurion *const s) {
00823     uint64_t u = 1;
00824     for (uint32_t i = 0; i < s->n_threads; ++i) {
00825         while (write(s->efds[i], &u, sizeof(u)) < 0) {
00826             usleep(TIMEOUT_RETRY);
00827         }
00828     }
00829     ThreadPool_wait_empty(s->pool);
00830 }
00831
00832 void saurion_destroy(struct saurion *const s) {
00833     pthread_mutex_lock(&s->status_m);
00834     while (s->status == 1) {
00835         pthread_cond_wait(&s->status_c, &s->status_m);
00836     }
00837     pthread_mutex_unlock(&s->status_m);
00838     ThreadPool_destroy(s->pool);
00839     for (uint32_t i = 0; i < s->n_threads; ++i) {
00840         io_uring_queue_exit(&s->rings[i]);
00841         pthread_mutex_destroy(&s->m_rings[i]);
00842     }
00843     free(s->m_rings);
00844     list_free(&s->list);
00845     for (uint32_t i = 0; i < s->n_threads; ++i) {
00846         close(s->efds[i]);
00847     }
00848     free(s->efds);
00849     if (!s->ss) {
00850         close(s->ss);
00851     }
00852     free(s->rings);
00853     pthread_mutex_destroy(&s->status_m);
00854     pthread_cond_destroy(&s->status_c);
00855     free(s);
00856 }
00857
00858 void saurion_send(struct saurion *const s, const int fd, const char *const msg) {
00859     add_write(s, fd, msg, next(s));
00860 }

```

7.19 /__w/saurion/saurion/src/saurion.cpp File Reference

```
#include "saurion.hpp"
#include <cstdint>
#include "low_saurion.h"
Include dependency graph for saurion.cpp:
```

7.20 saurion.cpp

[Go to the documentation of this file.](#)

```
00001 #include "saurion.hpp"
00002
00003 #include <cstdint>
00004
00005 #include "low_saurion.h"
00006
00007 Saurion::Saurion(const uint32_t thds, const int sck) noexcept {
00008     this->s = saurion_create(thds);
00009     if (!this->s) {
00010         return;
00011     }
00012     this->s->ss = sck;
00013 }
00014
00015 Saurion::~Saurion() { saurion_destroy(this->s); }
00016
00017 void Saurion::init() noexcept {
00018     if (!saurion_start(this->s)) {
00019         return;
00020     }
00021 }
00022
00023 void Saurion::stop() noexcept { saurion_stop(this->s); }
00024
00025 Saurion *Saurion::on_connected(Saurion::ConnectedCb ncb, void *arg) noexcept {
00026     s->cb.on_connected = ncb;
00027     s->cb.on_connected_arg = arg;
00028     return this;
00029 }
00030
00031 Saurion *Saurion::on_readed(Saurion::ReadedCb ncb, void *arg) noexcept {
00032     s->cb.on_readed = ncb;
00033     s->cb.on_readed_arg = arg;
00034     return this;
00035 }
00036
00037 Saurion *Saurion::on_wrote(Saurion::WroteCb ncb, void *arg) noexcept {
00038     s->cb.on_wrote = ncb;
00039     s->cb.on_wrote_arg = arg;
00040     return this;
00041 }
00042
00043 Saurion *Saurion::on_closed(Saurion::ClosedCb ncb, void *arg) noexcept {
00044     s->cb.on_closed = ncb;
00045     s->cb.on_closed_arg = arg;
00046     return this;
00047 }
00048
00049 Saurion *Saurion::on_error(Saurion::ErrorCb ncb, void *arg) noexcept {
00050     s->cb.on_error = ncb;
00051     s->cb.on_error_arg = arg;
00052     return this;
00053 }
00054
00055 void Saurion::send(const int fd, const char *const msg) noexcept { saurion_send(this->s, fd, msg); }
```

7.21 /__w/saurion/saurion/src/threadpool.cpp File Reference

```
#include "threadpool.hpp"
#include <pthread.h>
#include <stdexcept>
Include dependency graph for threadpool.cpp:
```

Typedefs

- using `TP` = `ThreadPool`
- using `T` = `Task`

7.21.1 Typedef Documentation

7.21.1.1 T

```
using T = Task
```

Definition at line 12 of file [threadpool.cpp](#).

7.21.1.2 TP

```
using TP = ThreadPool
```

Definition at line 9 of file [threadpool.cpp](#).

7.22 threadpool.cpp

[Go to the documentation of this file.](#)

```
00001 // This is a personal academic project. Dear PVS-Studio, please check it.
00002 // PVS-Studio Static Code Analyzer for C, C++, C#, and Java: https://pvs-studio.com
00003 #include "threadpool.hpp"
00004
00005 #include <pthread.h>
00006
00007 #include <stdexcept>
00008
00009 using TP = ThreadPool;
00010
00011 //***** Task *****
00012 using T = Task;
00013 T::Task(void (*nfn)(void*), void* narg) : function(nfn), argument(narg) {}
00014
00015 //***** AsyncQueue *****
00016 TP::AsyncQueue::AsyncQueue(uint32_t cnt) : m_max(cnt), m_cnt(0) {}
00017
00018 TP::AsyncQueue::~AsyncQueue() { pthread_mutex_destroy(&m_mtx); }
00019
00020 void TP::AsyncQueue::push(Task* task) {
00021     pthread_mutex_lock(&m_mtx);
00022     m_queue.push(task);
00023     pthread_mutex_unlock(&m_mtx);
00024 }
00025 Task* TP::AsyncQueue::front() {
00026     pthread_mutex_lock(&m_mtx);
00027     if ((m_cnt >= m_max) && (m_max != 0)) {
00028         pthread_mutex_unlock(&m_mtx);
00029         throw std::out_of_range("reached max parallel tasks");
00030     }
00031     Task* task = m_queue.front();
00032     m_queue.pop();
00033     ++m_cnt;
00034     pthread_mutex_unlock(&m_mtx);
00035     return task;
00036 }
00037 void TP::AsyncQueue::pop() {
```

```

00038 pthread_mutex_lock(&m_mtx);
00039 --m_cnt;
00040 pthread_mutex_unlock(&m_mtx);
00041 }
00042
00043 bool TP::AsyncQueue::empty() {
00044     pthread_mutex_lock(&m_mtx);
00045     bool empty = m_queue.empty();
00046     pthread_mutex_unlock(&m_mtx);
00047     return empty;
00048 }
00049
00050 //***** AsyncMultiQueue *****
00051
00052 TP::AsyncMultiQueue::AsyncMultiQueue() {
00053     new_queue(0, 0);
00054     m_it = m_queues.begin();
00055 }
00056 TP::AsyncMultiQueue::~AsyncMultiQueue() {
00057     for (auto& queue : m_queues) {
00058         delete queue.second;
00059     }
00060 }
00061
00062 void TP::AsyncMultiQueue::new_queue(uint32_t qid, uint32_t cnt) {
00063     if (m_queues.find(qid) != m_queues.end()) {
00064         throw std::out_of_range("queue already exists");
00065     }
00066     m_queues.emplace(qid, new TP::AsyncQueue(cnt));
00067 }
00068 void TP::AsyncMultiQueue::remove_queue(uint32_t qid) {
00069     auto queue = m_queues.find(qid);
00070     if (queue == m_queues.end()) {
00071         throw std::out_of_range("queue not found");
00072     }
00073     delete queue->second;
00074     m_queues.erase(qid);
00075 }
00076
00077 void TP::AsyncMultiQueue::push(uint32_t qid, void (*nfn)(void*), void* arg) {
00078     m_queues.at(qid)->push(new Task{nfn, arg});
00079 }
00080 Task* TP::AsyncMultiQueue::front(uint32_t& qid) {
00081     if (empty()) {
00082         throw std::out_of_range("empty queue");
00083     }
00084     auto newit = m_it;
00085     ++newit;
00086     while (newit != m_it) {
00087         if (newit == m_queues.end()) {
00088             newit = m_queues.begin();
00089         }
00090         if (!newit->second->empty()) {
00091             break;
00092         }
00093         ++newit;
00094     }
00095     Task* task = newit->second->front();
00096     qid = newit->first;
00097     m_it = newit;
00098     return task;
00099 }
00100 void TP::AsyncMultiQueue::pop(uint32_t qid) { m_queues.at(qid)->pop(); }
00101 void TP::AsyncMultiQueue::clear() {
00102     if (empty()) {
00103         return;
00104     }
00105     auto newit = m_queues.begin();
00106     while (newit != m_queues.end()) {
00107         while (!newit->second->empty()) {
00108             delete newit->second->front();
00109             newit->second->pop();
00110         }
00111         ++newit;
00112     }
00113 }
00114
00115 bool TP::AsyncMultiQueue::empty() {
00116     for (auto& queue : m_queues) {
00117         if (!queue.second->empty()) {
00118             return false;
00119         }
00120     }
00121     return true;
00122 }
00123
00124 //***** ThreadPool *****

```

```

00125
00126 pthread_mutex_t TP::s_mtx = PTHREAD_MUTEX_INITIALIZER;
00127
00128 TP::ThreadPool() : ThreadPool(4) {}
00129
00130 TP::ThreadPool(size_t num_threads)
00131     : m_nth(num_threads < 2 ? 2 : num_threads),
00132       m_started(0),
00133       m_ths(new pthread_t[m_nth]{0}),
00134       m_fstop(0),
00135       m_faccept(0) {}
00136
00137 void TP::init() {
00138     if (m_started != 0) {
00139         return;
00140     }
00141     m_faccept = 1;
00142     m_fstop = 0;
00143     pthread_mutex_lock(&s_mtx);
00144     for (size_t i = 0; i < m_nth; ++i) {
00145         pthread_create(&m_ths[i], nullptr, thread_entry, this);
00146         ++m_started;
00147     }
00148     pthread_mutex_unlock(&s_mtx);
00149 }
00150 void TP::stop() {
00151     if (m_started == 0) {
00152         return;
00153     }
00154     m_fstop = 0;
00155     m_faccept = 0;
00156     wait_empty();
00157
00158     pthread_mutex_lock(&m_q_mtx);
00159     m_fstop = 1;
00160     pthread_cond_broadcast(&m_q_cond);
00161     pthread_mutex_unlock(&m_q_mtx);
00162     // Detener los hilos
00163     for (size_t i = 0; i < m_started; ++i) {
00164         pthread_join(m_ths[i], nullptr);
00165     }
00166     m_started = 0;
00167     m_nth = 0;
00168 }
00169 void TP::add(uint32_t qid, void (*nfn)(void*), void* arg) {
00170     if (m_faccept == 0) {
00171         throw std::logic_error("threadpool already closed");
00172     }
00173     if (nfn == nullptr) {
00174         throw std::logic_error("function pointer cannot be null");
00175     }
00176     bool failed = false;
00177     pthread_mutex_lock(&m_q_mtx);
00178     try {
00179         m_queues.push(qid, nfn, arg);
00180     } catch (const std::out_of_range& e) {
00181         failed = true;
00182     }
00183     pthread_cond_signal(&m_q_cond);
00184     pthread_mutex_unlock(&m_q_mtx);
00185     if (failed) {
00186         throw std::out_of_range("queue not found");
00187     }
00188 }
00189 void TP::add(void (*nfn)(void*), void* arg) {
00190     add(0, nfn, arg); // Agregar a la cola por defecto
00191 }
00192 void TP::new_queue(uint32_t qid, uint32_t cnt) {
00193     pthread_mutex_lock(&m_q_mtx);
00194     try {
00195         m_queues.new_queue(qid, cnt);
00196     } catch (const std::out_of_range& e) {
00197         pthread_mutex_unlock(&m_q_mtx);
00198         throw e;
00199     }
00200     pthread_mutex_unlock(&m_q_mtx);
00201 }
00202 void TP::remove_queue(uint32_t qid) {
00203     if (qid != 0) {
00204         bool failed = false;
00205         pthread_mutex_lock(&m_q_mtx);
00206         try {
00207             m_queues.remove_queue(qid);
00208         } catch (const std::out_of_range& e) {
00209             failed = true;
00210         }
00211         pthread_cond_signal(&m_q_cond);

```

```

00212     pthread_mutex_unlock(&m_q_mtx);
00213     if (failed) {
00214         throw std::out_of_range("queue not found");
00215     }
00216 }
00217 }
00218 bool TP::empty() { return m_queues.empty(); }
00219 void TP::wait_closeable() {
00220     pthread_mutex_lock(&m_q_mtx);
00221     while (empty() && m_fstop == 0) {
00222         pthread_cond_wait(&m_q_cond, &m_q_mtx);
00223     }
00224     pthread_mutex_unlock(&m_q_mtx);
00225 }
00226 void TP::wait_empty() {
00227     pthread_mutex_lock(&m_q_mtx);
00228     while (!m_queues.empty()) {
00229         pthread_cond_wait(&m_q_cond, &m_q_mtx);
00230     }
00231     pthread_mutex_unlock(&m_q_mtx);
00232 }
00233 TP::~ThreadPool() {
00234     stop();
00235     m_queues.clear();
00236     delete[] m_ths;
00237     pthread_mutex_destroy(&s_mtx);
00238 }
00239
00240 void TP::thread_worker() {
00241     // Lógica del trabajador del hilo
00242     uint32_t qid = 0;
00243     while (m_fstop == 0) {
00244         // Buscar una tarea para ejecutar
00245         try {
00246             pthread_mutex_lock(&m_q_mtx);
00247             Task* task = m_queues.front(qid);
00248             pthread_cond_signal(&m_q_cond);
00249             pthread_mutex_unlock(&m_q_mtx);
00250             try {
00251                 task->function(task->argument);
00252             } catch (...) {
00253             }
00254             delete task; // TODO delete task
00255             pthread_mutex_lock(&m_q_mtx);
00256             m_queues.pop(qid);
00257             pthread_cond_broadcast(&m_q_cond);
00258             pthread_mutex_unlock(&m_q_mtx);
00259         } catch (const std::out_of_range& e) {
00260             pthread_mutex_unlock(&m_q_mtx);
00261             wait_closeable();
00262         }
00263     }
00264 }
00265 void* TP::thread_entry(void* arg) {
00266     auto* pool = static_cast<TP*>(arg);
00267     pool->thread_worker();
00268     return nullptr;
00269 }

```


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