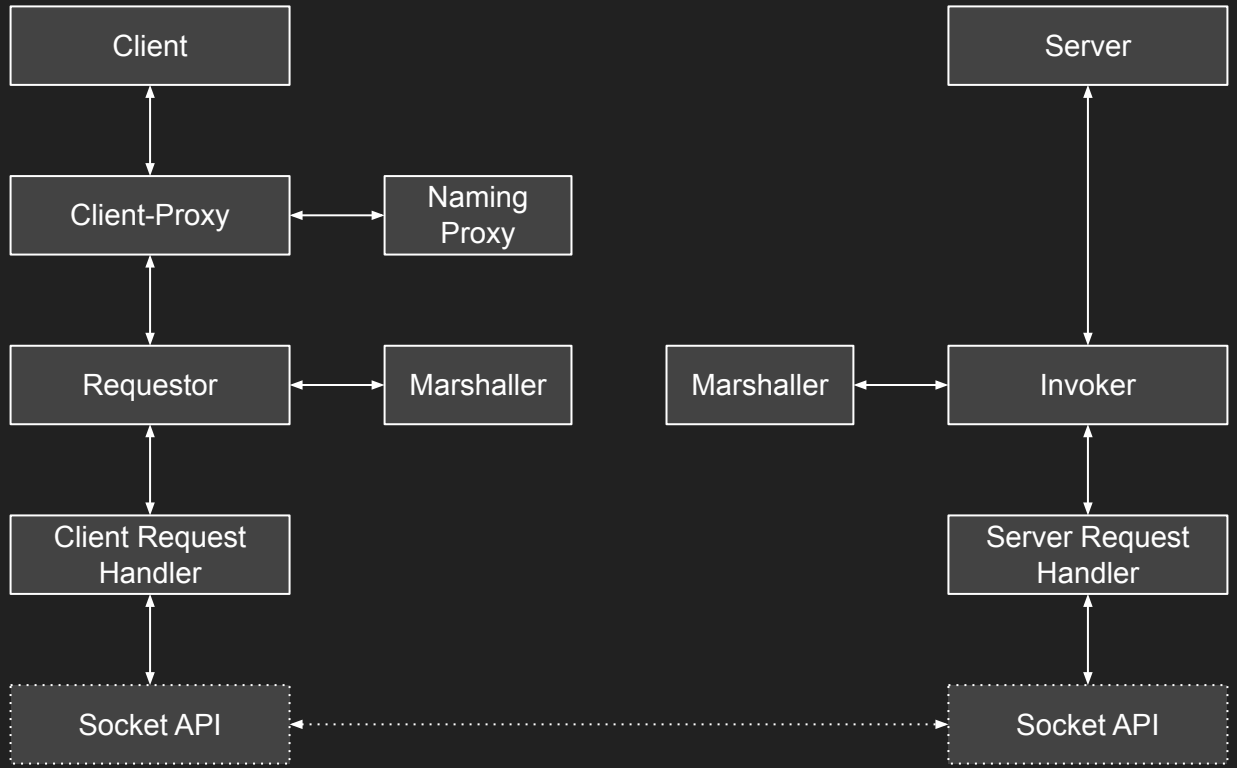
Aplicação Cliente/Servidor usando MyRPC em C


Client
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Client-Proxy
Naming Proxy
Requestor
Marshaller
Marshaller
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Client Request Handler
Server Request Handler
Socket API
Socket API

Client

```
1  static void send_request(uint_16 a, uint_16 b) {
2     int_32 result = 0;
3
4     if (calc.add(a, b, &result)) {
5         /* ... */
6     } else
7         die(EXIT_FAILURE, errno, "Calc failed");
8  }
```

Client Proxy

```
1   static bool calc_invoke(const char *method, const uint_16 a, const uint_16 b, int_32 *const result) {
2      struct data *request, *reply = NULL;
3      struct value reply_value;
4
5      if (requestor != NULL && !requestor_is_active(requestor)) {
6          requestor_destroy(requestor);
7          requestor = NULL;
8      }
9
10     if (requestor == NULL && (host_addr != NULL || np_lookup("calc", &host_addr)))
11         requestor = requestor_new(host_addr);
12
13     if (requestor != NULL) {
14         request = data_new(2);
15         data_push(request, UINT, sizeof(uint_16), &a);
16         data_push(request, UINT, sizeof(uint_16), &b);
17
18         if (requestor_invoke(requestor, method, request, &reply)) {
19             data_pop(reply, &reply_value);
20
21             if (reply_value.value != NULL && reply_value.type == INT && reply_value.size == sizeof(int_32)) {
22                 *result = *((int_32 *) reply_value.value);
23
24                 data_destroy(request);
25                 data_destroy(reply);
26
27                 return true;
28             } else
29                 errno = ENOMSG;
30
31             data_destroy(reply);
32         }
33
34         data_destroy(request);
35     } else
36         errno = EHOSTUNREACH;
37
38     return false;
39  }
```

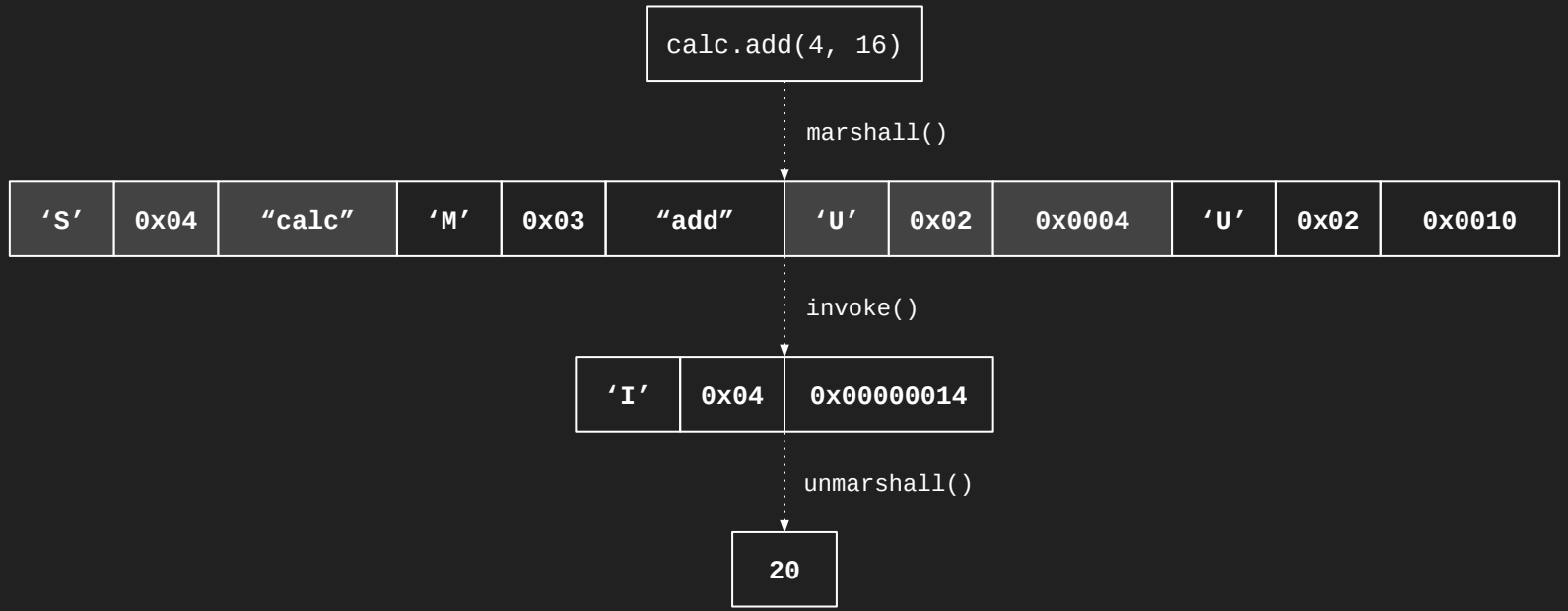
Requestor

```
bool requestor_invoke(struct requestor *requestor, const char *const method, const struct data *const request, struct data **const reply) {
   struct value bytes_value = {0};
   rh_server_msg *msg;

   marshall(request, requestor->host_addr->service_name, method, &bytes_value);

   if (bytes_value.size > 0 && rh_send_to_server(requestor->conn_ctx, bytes_value.value, bytes_value.size)) {
       free(bytes_value.value);

       log_print(NOISY, "Sent message with %ld bytes to server", bytes_value.size);

       if (NULL != (msg = rh_receive_from_server(requestor->conn_ctx))) {
           log_print(NOISY, "Received message with %ld bytes from server", msg->data_size);

           bytes_value.type = BYTES;
           bytes_value.size = msg->data_size;
           bytes_value.value = msg->data;

           unmarshall(&bytes_value, NULL, NULL, reply);

           rh_server_msg_destroy(msg);

           if (*reply)
               return true;
           else
               errno = ENOMSG;
       } else {
           requestor->closed = true;
           log_debug(DEBUG, errno, "Failed to receive message from server");
       }
   } else {
       requestor->closed = true;
       free(bytes_value.value);

       log_debug(DEBUG, errno, "Failed to send message to server");
   }

   return false;
}
```

Marshaller


<field_type>
1 byte
<field_size>
1 byte
<field_value>
<field_size> bytes
...

Marshaller


calc.add(4, 16)
marshall()
‘S’
0x04
“calc”
‘M’
0x03
“add”
‘U’
0x02
0x0004
‘U’
0x02
0x0010
invoke()
‘I’
0x04
0x00000014
unmarshall()
20

Marshaller

```
1  void marshall(const struct data *const data, const char *const service, const char *const method, struct value *const value) {
2     uint_8 i;
3     const struct value *d_value;
4
5     if (service)
6         add_bytes(value, service, 'S', strlen(service));
7
8     if (method)
9         add_bytes(value, method, 'M', strlen(method));
10
11    for (i = 0; (d_value = data_get_value(data, i)) != NULL; ++i) {
12        if (d_value->size > 255) {
13            value->size = 0;
14            errno = EINVAL;
15            return;
16        }
17
18 #if __BYTE_ORDER == __BIG_ENDIAN
19        ...
20 #endif
21
22        add_bytes(value, d_value->value, d_value->type == BYTES ? 'B' : (d_value->type == INT ? 'I' : 'U'), d_value->size);
23    }
24 }
25
```

Marshaller

```
1   void unmarshall(const struct value *const value, char **const service, char **const method, struct data **const data) {
2      uint_8 i; void *bytes = NULL; byte marker; uint_8 size = 0; enum type type;
3
4      if (value->size > 0)
5          *data = data_new(1);
6
7      for (i = 0; i < value->size; i += (2 + size)) {
8          get_bytes(((byte *) value->value) + i, &bytes, &marker, &size);
9
10         switch (marker) {
11             case 'S':
12                 if (service != NULL) {
13                     *service = malloc(size + 1);
14                     memcpy(*service, bytes, size);
15                     (*service)[size] = '\0';
16                 }
17                 continue;
18             case 'M':
19                 if (method != NULL) {
20                     *method = malloc(size + 1);
21                     memcpy(*method, bytes, size);
22                     (*method)[size] = '\0';
23                 }
24                 continue;
25             case 'B':
26                 type = BYTES;
27                 break;
28             case 'I':
29                 type = INT;
30                 break;
31             case 'U':
32                 type = UINT;
33                 break;
34             default:
35                 data_destroy(*data);
36                 *data = NULL;
37                 free(bytes);
38                 errno = EINVAL;
39                 return;
40         }
41
42  #if __BYTE_ORDER == __BIG_ENDIAN
43         ...
44  #endif
45
46         data_push(*data, type, size, bytes);
47     }
48
49     free(bytes);
50  }
```

Server

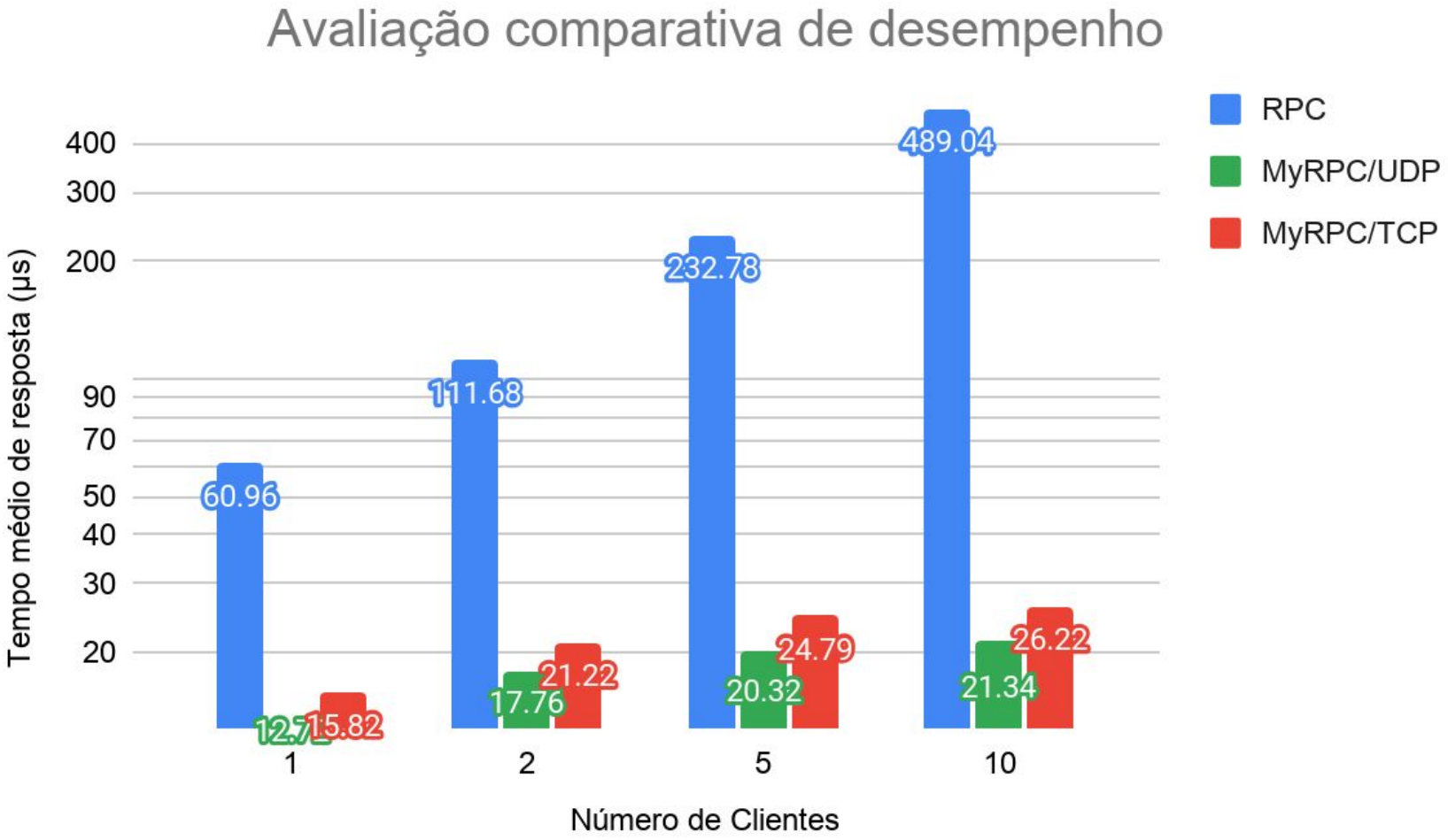
```
1  void run_server(const enum protocol protocol, const uint_16 port, const uint_8 thread_num) {
2     struct service *service = service_new("calc", methods_capacity: 4);
3     struct invoker *invoker = invoker_new(protocol, port, thread_num);
4
5     service_add_method(service, "add", calc_add);
6     service_add_method(service, "sub", calc_sub);
7     service_add_method(service, "mul", calc_mul);
8     service_add_method(service, "div", calc_div);
9
10    invoker_run(invoker, service);
11 }
```

Invoker

```
1  void invoker_run(struct invoker *const invoker, const struct service *const service) {
2     invoker->service = service;
3
4     for (uint_8 i = 0; i < invoker->threads_num; ++i)
5         thpool_add_work(invoker->thpool, (void (*)(void *)) run_server, invoker);
6
7     thpool_wait(invoker->thpool);
8
9     die(EXIT_FAILURE, NOERR, "Server died");
10 }
```

Invoker

```
1  static __attribute__((noreturn)) void run_server(const struct invoker *const invoker) {
2     rh_server_ctx *server_ctx;
3     rh_client_msg *msg;
4     struct req *req = NULL;
5
6     if (NULL == (server_ctx = rh_server_new(invoker->protocol, invoker->port)))
7         die(EXIT_FAILURE, errno, "Failed to start server");
8     else
9         log_print(INFO, "Server is running");
10
11    for (;; errno = 0) {
12        if (req == NULL)
13            req = malloc(sizeof(struct req));
14
15        if (NULL != (msg = rh_receive_from_client(server_ctx))) {
16            req->msg = msg;
17            req->invoker = invoker;
18
19            thpool_add_work(invoker->thpool, (void (*)(void *)) process_req, req);
20            req = NULL;
21        }
22    }
23 }
```


Avaliação comparativa de desempenho
RPC
MyRPC/UDP
MyRPC/TCP
Tempo médio de resposta (µs)
400
300
200
90
70
50
40
30
20
60.96
12.7
15.82
111.68
17.76
21.22
232.78
20.32
24.79
489.04
21.34
26.22
1
2
5
10
Número de Clientes