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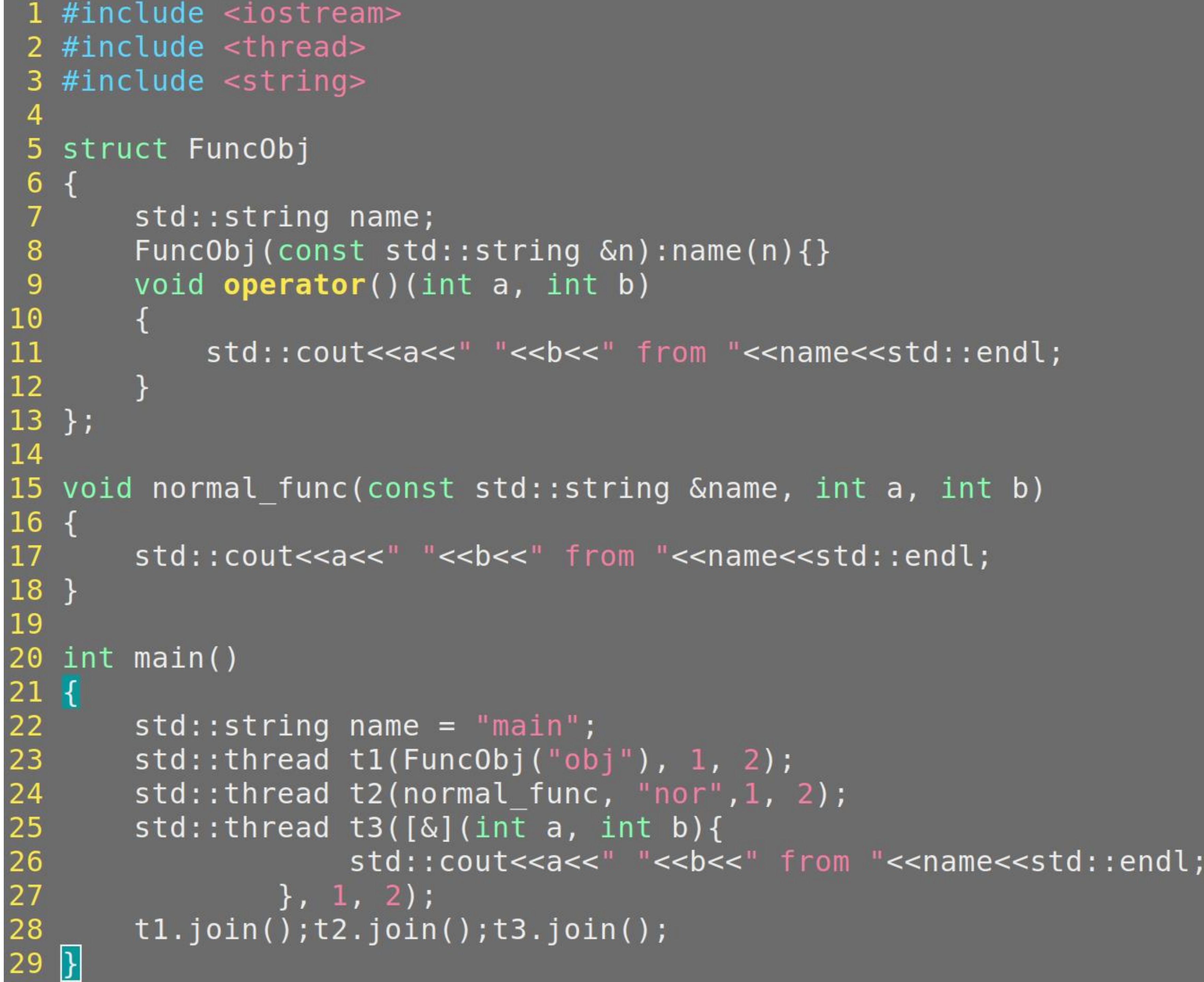
Contents

- Lab related

std::thread

- std::thread is easier to use than pthread
  - Pthread job is limited to "void *job(void*) which is not easy to use"
  - However, you can pass any "callable" object to contstruct a std::thread object
- Usage:
  - std::thread my_t(funcname, param1, param2...)
  - my_t.detach() or my_t.join()
- Need to add "-lpthread" flag when compiling
  - Both pthread and std::thread requires the flag

Example



```cpp
#include <iostream>
#include <thread>
#include <string>

struct FuncObj
{
    std::string name;
    FuncObj(const std::string &n):name(n){}
    void operator()(int a, int b)
    {
        std::cout<<a<<" "<<b<<" from "<<name<<std::endl;
    }
};

void normal_func(const std::string &name, int a, int b)
{
    std::cout<<a<<" "<<b<<" from "<<name<<std::endl;
}

int main()
{
    std::string name = "main";
    std::thread t1(FuncObj("obj"), 1, 2);
    std::thread t2(normal_func, "nor",1, 2);
    std::thread t3([&](int a, int b){
                std::cout<<a<<" "<<b<<" from "<<name<<std::endl;
            }, 1, 2);
    t1.join();t2.join();t3.join();
}
```

Join and Detach

- There should be someone revoke the resource from a **terminated** thread
  - Two primitives: **Join** and **Detach**
    - **std::thread::join** and **std::thread::detach** in C++ thread support library
    - **pthread_join** and **pthread_detach** in pthread library
- Function *main* call ***A*.Join()**, then *main* will be blocked until ***A*** is terminated. The resource will be deallocated by *main* afterwards.
- Function *main* call ***A*.Detach()**, then object ***A*** will have no relationship with the detached thread. The system will do free the resource after the detached thread terminated, automatically.
- Manage threads carefully!

Notice

- In pthread library, threads are referenced by *pthread_t* variable
- In std::thread, threads are referenced by **std::thread** object
- After **Detach** and **Join**, the relationship between the thread and the "handle" is deleted.
- **C++ runtime will destruct object implictly**
    - Thread **t** is referenced by the object *obj_t*
    - When **t**'s destructor is called, **std::terminate** will be called **IF**:
        - **t** is neither detached nor joined

poll – wait an event on a descriptor

- **poll**() performs a similar task to **select**: it waits for one of a set of file descriptors to become ready to perform I/O.
- User pass an array of ***struct pollfd*** to the **poll** function.
    - No macro or bit mask operations.
- Easy to extend to C++.
- Support timeout.

- Example:

```
class PollMgr{
  public:
    void Insert(pollfd, callback, mode);
    void Stop();
    void Run();
  private:
    int timeout;
    … // pollfd list and callback
      // list
};
```

Easy to do I/O multiplexing

- Just use PollMgr in the previous silde.
- Set up the manager by insert pollfd and callback function into it.
  - The callback function will be called when the fd is readable/writeable.
- Can still insert new pollfd in to a running manager
  - Simple solution: Takes effect after next "timeout".
  - Other solution: use thread

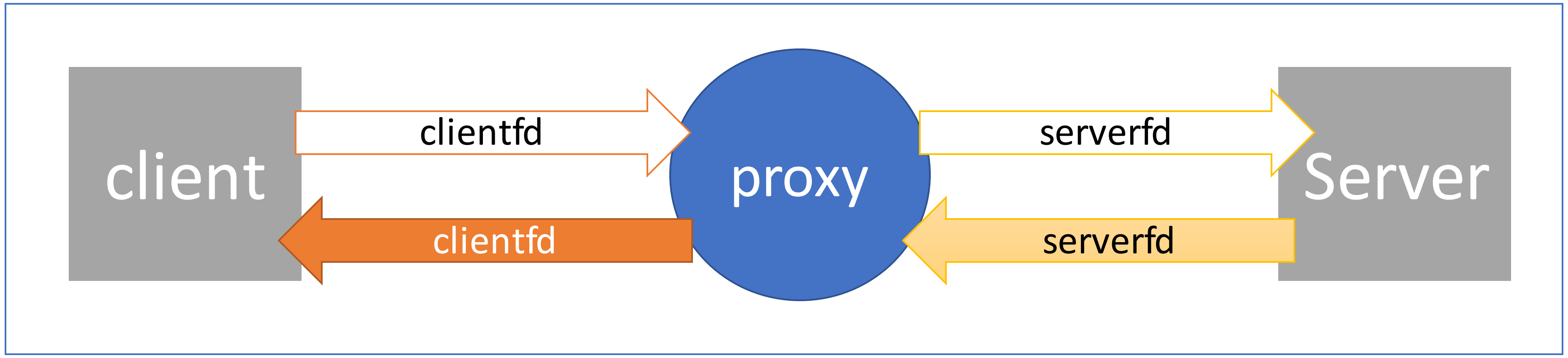
Wireshark

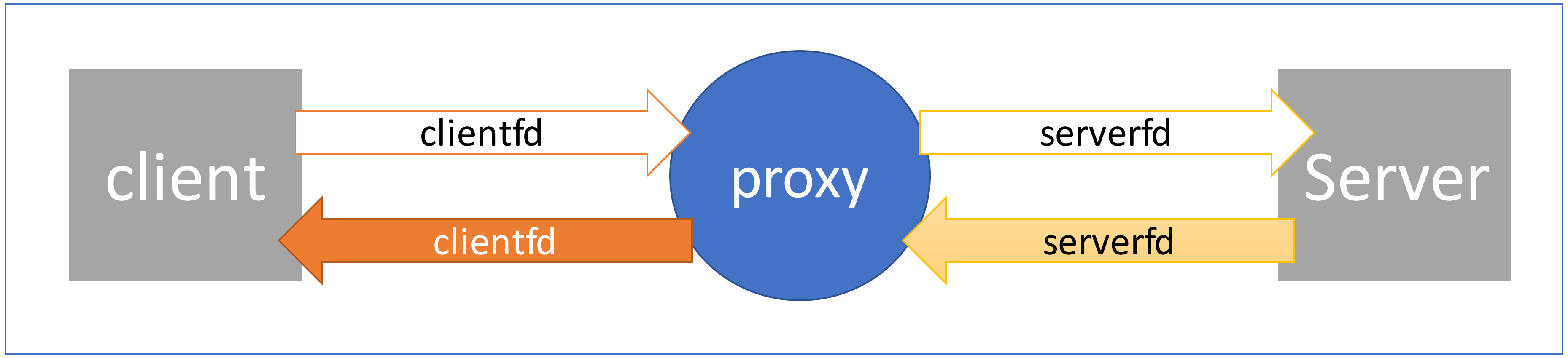
- A tool to capture packets
- Packet format sometimes is weird
    - GeT http://baidu.com/index.html HTTP/1.1
    - gEt baidu.com HTTP/1.1
- Use wireshark to see the content of the packet
    - Help you debug
- Installation: $ sudo apt install wireshark
- Usage: $ wireshark

Proxy architecture

- Only I/O multiplexing
- Proxy should be able to support multiple clients
  - Use I/O multiplexing
  - Need to know which server the client sends to. --> use a "map" to store
- Proxy should be able to forward packets between client and server
  - Need to block on both "clientfd" and "serverfd" and wait for input from each side.
  - Use I/O multiplexing.

Proxy architecture

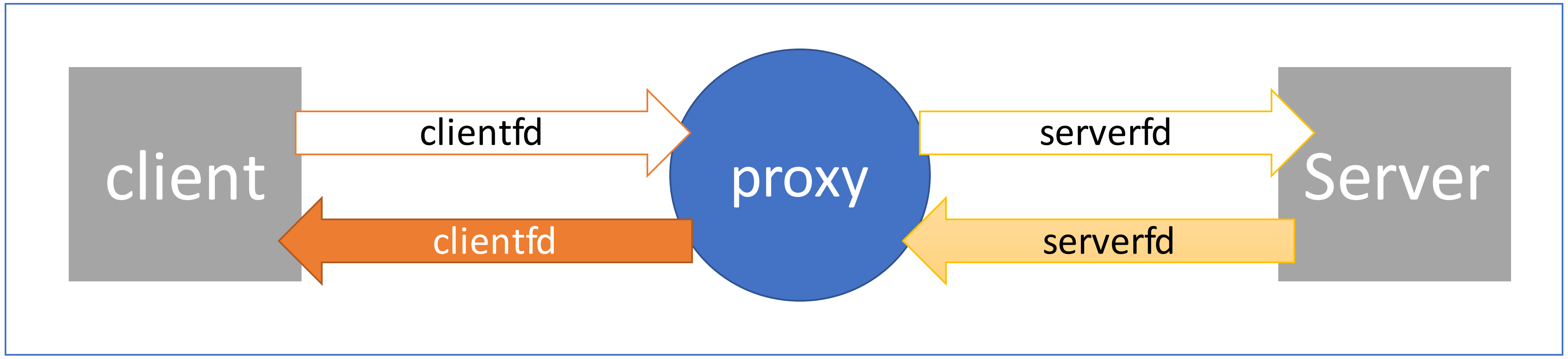


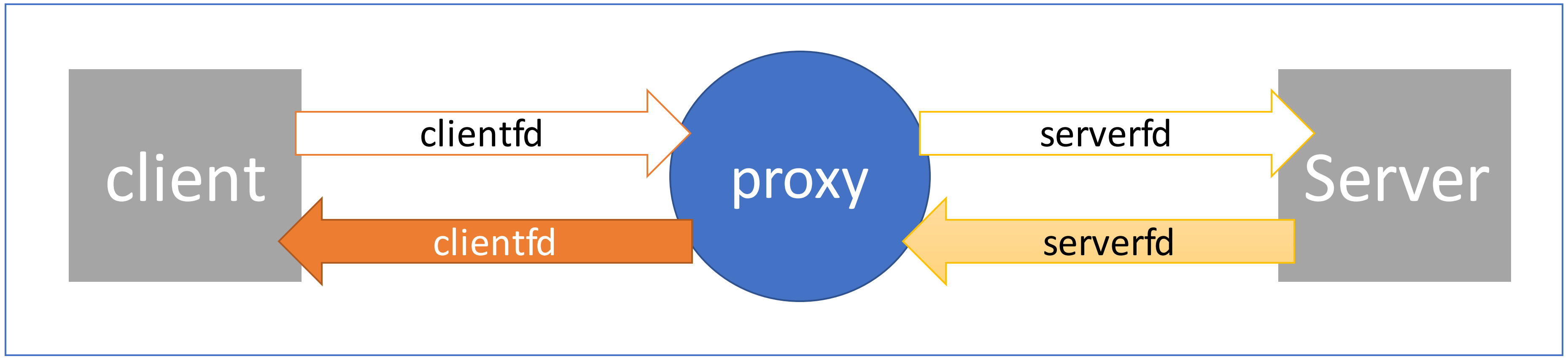


Proxy architecture

- Thread + Process
- Proxy should be able to support multiple clients
  - Use multiple child processes
- Proxy should be able to forward packets between client and server
  - Use two thread to manage clientfd and serverfd.
- Problem: Hard to implement global cache
  - But each client can have its own local cache, it still works

Proxy architecture

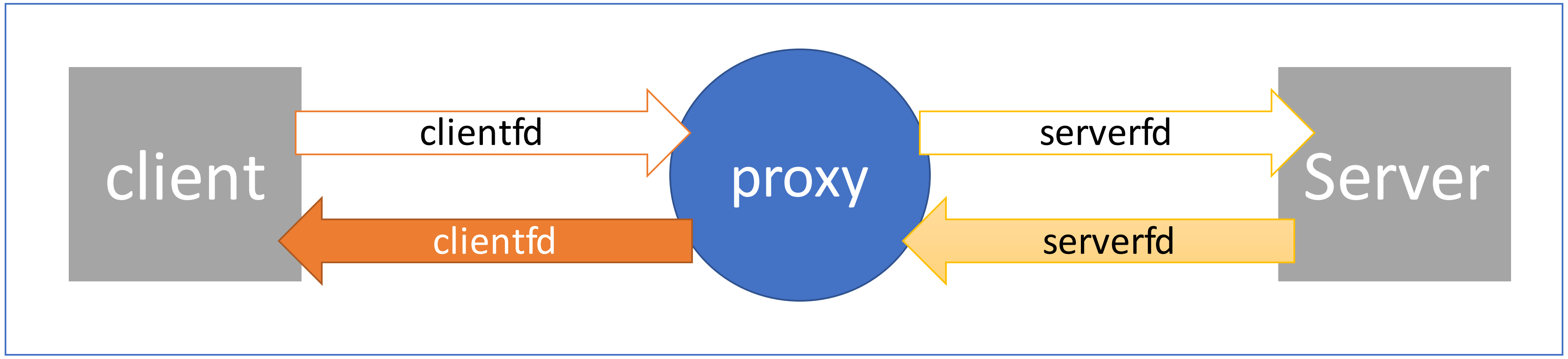


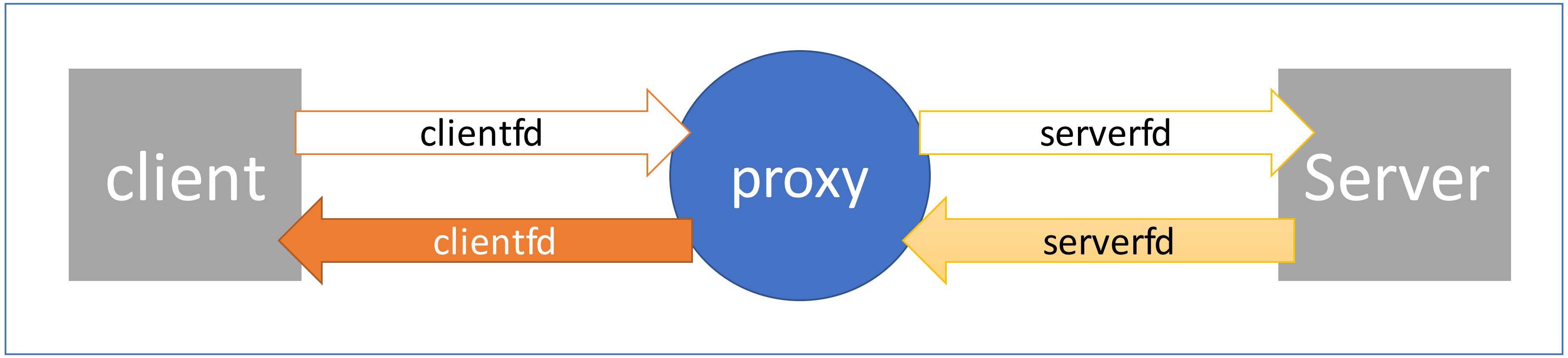


Proxy architecture

- Thread + I/O multiplexing
- Proxy should be able to support multiple clients
  - Use threads
- Proxy should be able to forward packets between client and server
  - Need to block on both "clientfd" and "serverfd" and wait for input from each side.
  - Use I/O multiplexing.

Proxy architecture


client
clientfd
clientfd
proxy
serverfd
serverfd
Server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