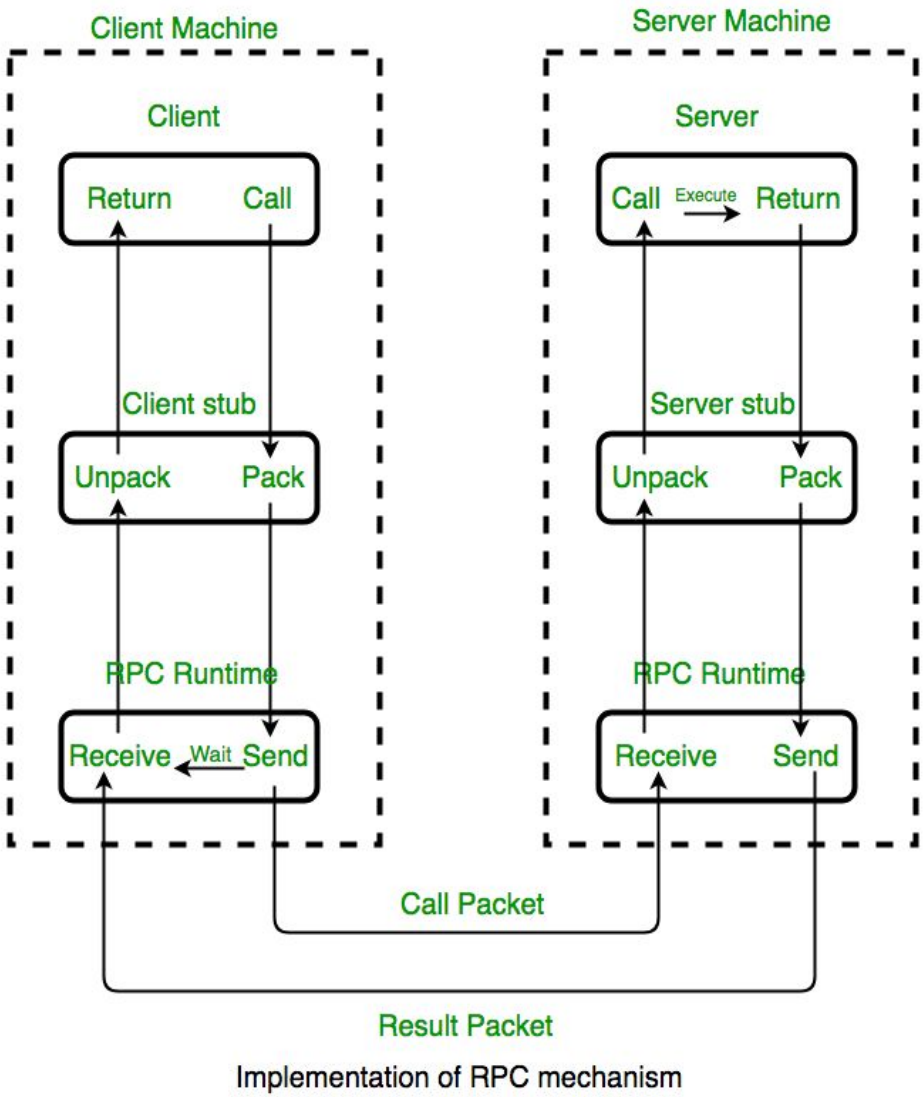
Remote Procedure Call

Remote Procedure Call

- A remote procedure call is an interprocess communication technique that is used for client-server based applications.
- It is also known as a subroutine call or a function call.

Implementing RPC Mechanism

- Client procedure **calls** the client stub in a normal way.
- Client stub **builds a message** and **traps** to the kernel.
- Kernel **sends** the message to remote kernel.
- Remote kernel **gives** the message to server stub.
- Server stub **unpacks** parameters and **calls** the server.
- Server **computes** results and **returns** it to server stub.
- Server stub **packs** results in a message to client and **traps** to kernel.
- Remote kernel **sends** message to client kernel.
- Client kernel **gives** message to client stub.
- Client stub **unpacks** results and **returns** to client.



Implementation of RPC mechanism

RPCGEN

- **RPCGEN** is an interface generator pre-compiler for Sun Microsystems ONC RPC (Open Network Computing RPC).
- It creates client and server stubs in C based on information contained within a file called IDL (interface definition file) file. This file is written in a language called RPCL – remote procedure call language.
- **Client side program** to get numbers from the user, to call the relevant method in the server side and to send those numbers to that method in the server side.
- **Server side program** to do the addition and to send back the result to the client side. Let the server procedure run as the localhost for this example.

IDL

- An IDL is a file (suffixed with .x) which optionally begins with a bunch of type definitions and then defines the remote procedures.
- A set of remote procedures are grouped into a *version*.
- One or more versions are grouped into a *program*.

STEPS

- Install **rpcbind** in your machine

sudo apt-get install rpcbind

```
psg@psg-OptiPlex-3060:~$ rpcinfo

Command 'rpcinfo' not found, but can be installed with:

sudo apt install rpcbind

psg@psg-OptiPlex-3060:~$ sudo apt-get install rpcbind
[sudo] password for psg:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libtirpc1
The following NEW packages will be installed:
  libtirpc1 rpcbind
0 upgraded, 2 newly installed, 0 to remove and 323 not upgraded.
Need to get 118 kB of archives.
After this operation, 364 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu bionic-updates/main amd64 libtirpc1 amd64 0.2.5-1.2ubuntu0.1 [75.7 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu bionic-updates/main amd64 rpcbind amd64 0.2.3-0.6ubuntu0.18.04.4 [42.1 kB]
Fetched 118 kB in 1s (161 kB/s)
Selecting previously unselected package libtirpc1:amd64.
(Reading database ... 172438 files and directories currently installed.)
Preparing to unpack .../libtirpc1_0.2.5-1.2ubuntu0.1_amd64.deb ...
Unpacking libtirpc1:amd64 (0.2.5-1.2ubuntu0.1) ...
Selecting previously unselected package rpcbind.
Preparing to unpack .../rpcbind_0.2.3-0.6ubuntu0.18.04.4_amd64.deb ...
Unpacking rpcbind (0.2.3-0.6ubuntu0.18.04.4) ...
Processing triggers for ureadahead (0.100.0-20) ...
ureadahead will be reprofiled on next reboot
Processing triggers for libc-bin (2.27-3ubuntu1.2) ...
Setting up libtirpc1:amd64 (0.2.5-1.2ubuntu0.1) ...
Processing triggers for systemd (237-3ubuntu10.50) ...
Processing triggers for man-db (2.8.3-2) ...
Setting up rpcbind (0.2.3-0.6ubuntu0.18.04.4) ...
Created symlink /etc/systemd/system/multi-user.target.wants/rpcbind.service → /lib/systemd/system/rpcbind.service.
Created symlink /etc/systemd/system/sockets.target.wants/rpcbind.socket → /lib/systemd/system/rpcbind.socket.
Processing triggers for libc-bin (2.27-3ubuntu1.2) ...
Processing triggers for systemd (237-3ubuntu10.50) ...
Processing triggers for ureadahead (0.100.0-20) ...
```

STEPS

- rpcinfo

```
psg@psg-OptiPlex-3060:~$ rpcinfo
   program version netid     address                service    owner
    100000    4    tcp6      ::.0.111               portmapper superuser
    100000    3    tcp6      ::.0.111               portmapper superuser
    100000    4    udp6      ::.0.111               portmapper superuser
    100000    3    udp6      ::.0.111               portmapper superuser
    100000    4    tcp       0.0.0.0.0.111          portmapper superuser
    100000    3    tcp       0.0.0.0.0.111          portmapper superuser
    100000    2    tcp       0.0.0.0.0.111          portmapper superuser
    100000    4    udp       0.0.0.0.0.111          portmapper superuser
    100000    3    udp       0.0.0.0.0.111          portmapper superuser
    100000    2    udp       0.0.0.0.0.111          portmapper superuser
    100000    4    local     /run/rpcbind.sock      portmapper superuser
    100000    3    local     /run/rpcbind.sock      portmapper superuser
```

add.x

This is the IDL file

```
/*combine the arguments to be passed to the server side in a structure*/
struct numbers{
        int a;
        int b;
};
program ADD_PROG{
version ADD_VERS{
        int add(numbers)=1;
 }=1;
}=0x4562877;
```

add.x

- numbers -> name of the structure which sends the parameters to the server
- ADD_PROG -> name of the program
- ADD_VERS -> name of the program version
- add(numbers) -> method that we are going to call remotely. We pass the numbers structure as the parameter to this method.

- Compile this IDL file by using the following command.

rpcgen -a -C add.x

- Should execute this command in the directory where the idl file resides.
- '-C ' in the command is for C language
- '-a' is to generate all the files including samples.

It will generate the following files.

add.h -> header file

add_client.c -> client program

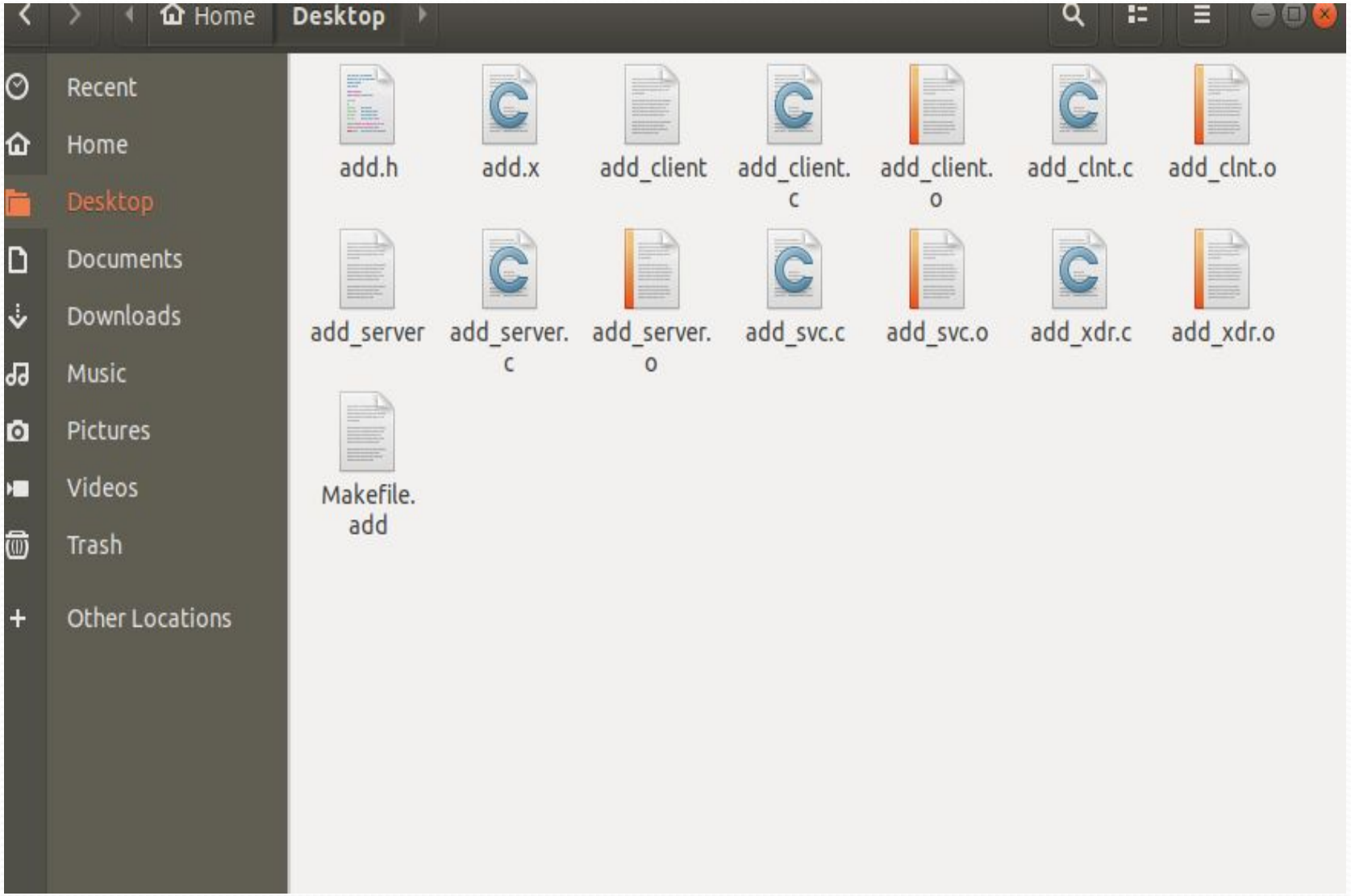
add_clnt.c -> client stub

add_server.c -> server program

add_svc.c -> server skeleton

add_xdr.c -> XDR routines used by both the client and the server

Makefile.add -> Makefile


Home
Desktop
Recent
Home
Desktop
Documents
Downloads
Music
Pictures
Videos
Trash
Other Locations
add.h
add.x
add_client
add_client.c
add_client.o
add_clnt.c
add_clnt.o
add_server
add_server.c
add_server.o
add_svc.c
add_svc.o
add_xdr.c
add_xdr.o
Makefile.add

Edit add_server.c

```
#include "add.h“
 int *
add_1_svc(numbers *argp, struct svc_req *rqstp)
 {
 static int result;
printf("add(%d,%d) is called\n", argp->a,argp->b);
result = argp->a + argp->b;
return &result;
}
```

Edit add_client.c

```
#include "add.h“
void
add_prog_1(char *host,int x,int y)
 {
CLIENT *clnt;
 int *result_1;
numbers add_1_arg;
#ifndef DEBUG
clnt = clnt_create (host, ADD_PROG, ADD_VERS, "udp");
if (clnt == NULL) {
clnt_pcreateerror (host);
exit (1);
} #endif /* DEBUG */
```

Edit add_client.c

```
add_1_arg.a=x;
add_1_arg.b=y;
result_1 = add_1(&add_1_arg, clnt);
if (result_1 == (int *) NULL) {
clnt_perror (clnt, "call failed");
} else{
printf("Result:%d\n", *result_1 );
}
#ifndef DEBUG
clnt_destroy (clnt);
#endif /* DEBUG */ }
```

Edit add_client.c

```
int
main (int argc, char *argv[])
 {
 char *host;
if (argc < 4) {
printf ("usage: %s server_host\n", argv[0]);
exit (1); }
host = argv[1];
add_prog_1 (host,atoi(argv[2]),atoi(argv[3]));
 exit (0);
}
```

- Since we've changed those two files now we have to compile all the files again. Use the following command to do that. It will generate all the object files.

make -f Makefile.add

- Now open up two terminals and run the server in a one and client in the other.
- To start server --> :-$ sudo ./add_server
- To start client --> :-$ sudo ./add_client localhost 5 8

```
psg@psg-OptiPlex-3060:~$ cd Desktop
psg@psg-OptiPlex-3060:~/Desktop$ rpcgen -a -C add.x
psg@psg-OptiPlex-3060:~/Desktop$ make -f Makefile.add
cc -g    -c -o add_clnt.o add_clnt.c
cc -g    -c -o add_client.o add_client.c
cc -g    -c -o add_xdr.o add_xdr.c
cc -g     -o add_client  add_clnt.o add_client.o add_xdr.o -lnsl
cc -g    -c -o add_svc.o add_svc.c
cc -g    -c -o add_server.o add_server.c
cc -g     -o add_server  add_svc.o add_server.o add_xdr.o -lnsl
psg@psg-OptiPlex-3060:~/Desktop$ sudo ./add_server
add(1,2) is called
```

```
psg@psg-OptiPlex-3060:~/Desktop$ sudo ./add_client localhost 1 2
[sudo] password for psg:
Result:3
psg@psg-OptiPlex-3060:~/Desktop$
```