

Task 1

```
#include "ns3/object.h"
#include "ns3/simulator.h"
#include "ns3/trace-source-accessor.h"
#include "ns3/traced-value.h"
#include "ns3/uinteger.h"

#include <iostream>

using namespace ns3;

class MyObject : public Object
{
public:
    /**
     * Register this type.
     * \return The TypeId.
     */
    static TypeId GetTypeId()
    {
        static TypeId tid = TypeId("MyObject")
            .SetParent<Object>()
            .SetGroupName("Tutorial")
            .AddConstructor<MyObject>()
            .AddTraceSource("MyInteger",
                "An integer value to trace.",
                MakeTraceSourceAccessor(&MyObject::m_pakOk),
                "ns3::TracedValueCallback::Int32")
            .AddTraceSource("MyIntegerError",
                "An integer value to trace.",
                MakeTraceSourceAccessor(&MyObject::m_pakError),
                "ns3::TracedValueCallback::Int32");

        return tid;
    }

    MyObject()
    {
    }

    TracedValue<int32_t> m_pakOk;
    TracedValue<int32_t> m_pakError;
};

void PacketsOK(int32_t oldValue, int32_t newValue)
{
    std::cout << "Packets Received Correctly " << oldValue << " to " << newValue << std::endl;
}

void PacketError(int32_t oldValue, int32_t newValue)
{
    std::cout << "Packets Received with error " << oldValue << " to " << newValue << std::endl;
}

int main(int argc, char* argv[])
{
    Ptr<MyObject> Node1 = CreateObject<MyObject>();
    Node1->TraceConnectWithoutContext("MyInteger", MakeCallback(&PacketsOK));
    Node1->TraceConnectWithoutContext("MyIntegerError", MakeCallback(&PacketError));

    Ptr<MyObject> Node2 = CreateObject<MyObject>();
    Node2->TraceConnectWithoutContext("MyInteger", MakeCallback(&PacketsOK));
    Node2->TraceConnectWithoutContext("MyIntegerError", MakeCallback(&PacketError));
}
```

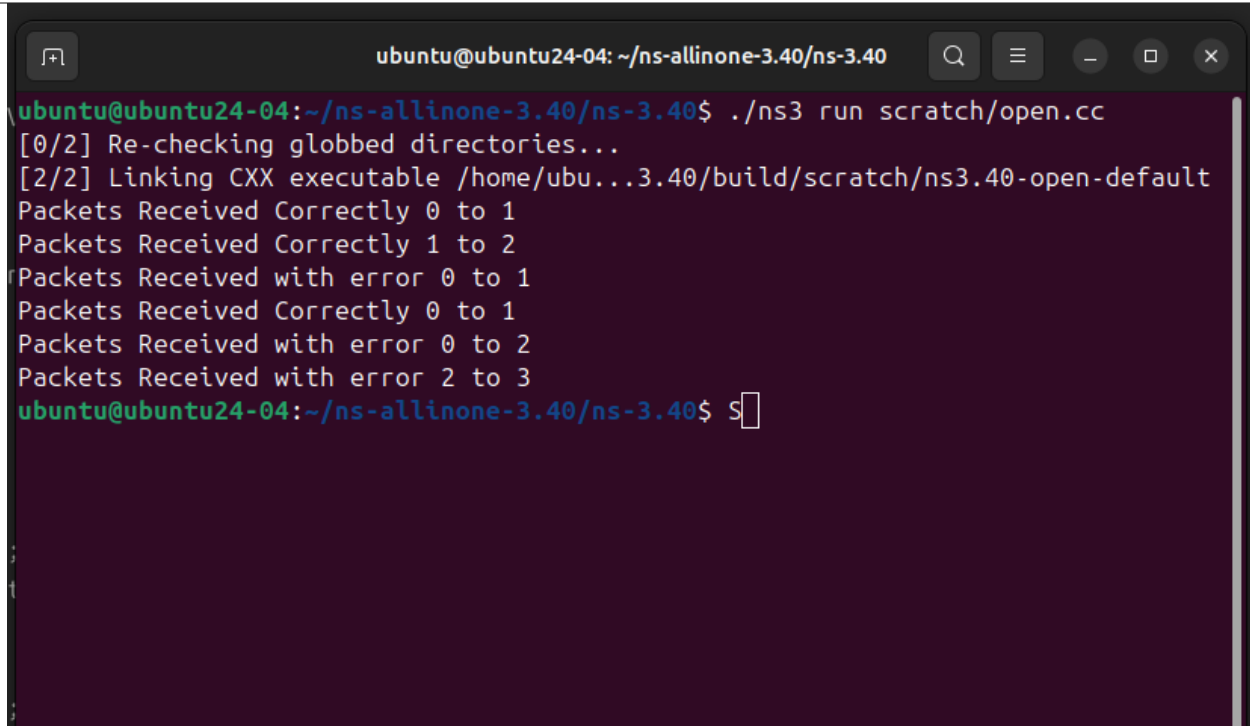
```

        Node1->m_pakOk = 1;
        Node1->m_pakOk = 2;
        Node1->m_pakError = 1;

        Node2->m_pakOk = 1;
        Node2->m_pakError = 2;
        Node2->m_pakError = 3;

    return 0;
}

```



A terminal window titled 'ubuntu@ubuntu24-04: ~/ns-allinone-3.40/ns-3.40' showing the execution of a program. The command './ns3 run scratch/open.cc' has been run. The output shows the program checking directories, linking the CXX executable, and then displaying packet reception statistics for two nodes. The statistics show that Node 1 received 2 packets correctly and 1 packet with error, while Node 2 received 1 packet correctly and 2 packets with error. The terminal prompt is currently at the end of the command line, waiting for input.

```

ubuntu@ubuntu24-04:~/ns-allinone-3.40/ns-3.40$ ./ns3 run scratch/open.cc
[0/2] Re-checking globbed directories...
[2/2] Linking CXX executable /home/ubu...3.40/build/scratch/ns3.40-open-default
Packets Received Correctly 0 to 1
Packets Received Correctly 1 to 2
Packets Received with error 0 to 1
Packets Received Correctly 0 to 1
Packets Received with error 0 to 2
Packets Received with error 2 to 3
ubuntu@ubuntu24-04:~/ns-allinone-3.40/ns-3.40$ S

```

Task 2

```

#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"

#include <iostream>

using namespace ns3;
using namespace std;

static int32_t packetOk;
static int32_t packetError;

```

```

void pak_Ok(Ptr<const Packet>packet){
    packetOk++;
    cout << "Packets Received Correctly " << packet->GetSize() <<"bytes"<< endl;
}

void pak_Error(Ptr<const Packet>packet){
    packetError++;
    cout << "Packets Received Correctly " << packet->GetSize() <<"bytes"<< endl;
}

int main(int argc, char *argv[])
{
    LogComponentEnable("UdpEchoClientApplication", LOG_LEVEL_INFO);
    LogComponentEnable("UdpEchoServerApplication", LOG_LEVEL_INFO);

    NodeContainer nodes;
    nodes.Create(2);

    PointToPointHelper p2p;
    p2p.SetDeviceAttribute("DataRate", StringValue("5Mbps"));
    p2p.SetChannelAttribute("Delay", StringValue("2ms"));

    NetDeviceContainer devices = p2p.Install(nodes);

    // Install Internet stack
    InternetStackHelper stack;
    stack.Install(nodes);

    Ipv4AddressHelper address;
    address.SetBase("10.1.1.0", "255.255.255.0");
    Ipv4InterfaceContainer interfaces = address.Assign(devices);

    // Set up UDP Echo Server on Node 1
    UdpEchoServerHelper echoServer(9);
    ApplicationContainer serverApp = echoServer.Install(nodes.Get(1));
    serverApp.Start(Seconds(1.0));
    serverApp.Stop(Seconds(10.0));

    UdpEchoClientHelper echoClient(interfaces.GetAddress(1), 9);
    echoClient.SetAttribute("MaxPackets", UintegerValue(5));
    echoClient.SetAttribute("Interval", TimeValue(Seconds(1.0)));
    echoClient.SetAttribute("PacketSize", UintegerValue(1024));

    ApplicationContainer clientApp = echoClient.Install(nodes.Get(0));

    clientApp.Start(Seconds(2.0));
    clientApp.Stop(Seconds(10.0));

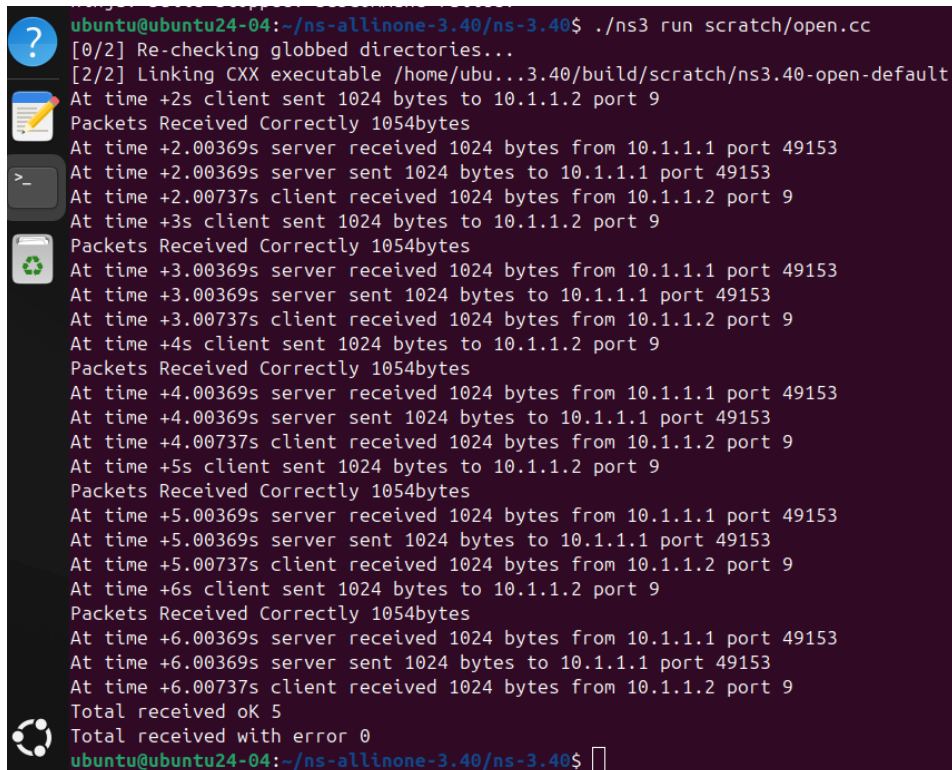
    devices.Get(1)->TraceConnectWithoutContext("PhyRxEnd", MakeCallback(&pak_Ok));
    evices.Get(1)->TraceConnectWithoutContext("PhyRxDrop", MakeCallback(&pak_Error));

    Simulator::Stop(Seconds(10.0));
    Simulator::Run();
    Simulator::Destroy();
}

```

```
cout<<"Total received OK " << packetOk << endl;
cout<<"Total received with error " << packetError << endl;

    return 0;
}
```

A terminal window with a dark purple background and white text. On the left side, there is a vertical toolbar with icons for help (question mark), a notepad, a terminal, and a refresh/clear button. The terminal output shows the execution of a script named 'scratch/open.cc' using 'ns3 run'. It displays a series of network simulation events over 6 seconds, including packet transmissions between a client and a server at various IP addresses and ports. The output concludes with 'Total received OK 5' and 'Total received with error 0'.

```
ubuntu@ubuntu24-04:~/ns-allinone-3.40/ns-3.40$ ./ns3 run scratch/open.cc
[0/2] Re-checking globbed directories...
[2/2] Linking CXX executable /home/ubu...3.40/build/scratch/ns3.40-open-default
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
Packets Received Correctly 1054bytes
At time +2.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.00737s client received 1024 bytes from 10.1.1.2 port 9
At time +3s client sent 1024 bytes to 10.1.1.2 port 9
Packets Received Correctly 1054bytes
At time +3.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +3.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +3.00737s client received 1024 bytes from 10.1.1.2 port 9
At time +4s client sent 1024 bytes to 10.1.1.2 port 9
Packets Received Correctly 1054bytes
At time +4.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +4.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +4.00737s client received 1024 bytes from 10.1.1.2 port 9
At time +5s client sent 1024 bytes to 10.1.1.2 port 9
Packets Received Correctly 1054bytes
At time +5.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +5.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +5.00737s client received 1024 bytes from 10.1.1.2 port 9
At time +6s client sent 1024 bytes to 10.1.1.2 port 9
Packets Received Correctly 1054bytes
At time +6.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +6.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +6.00737s client received 1024 bytes from 10.1.1.2 port 9
Total received OK 5
Total received with error 0
ubuntu@ubuntu24-04:~/ns-allinone-3.40/ns-3.40$
```