



*Department of Electronics Engineering, NTU*

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# Network Traffic Generator

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Date: 20180507



# Outline

- ❖ Ostinato
  - ❖ 安裝
  - ❖ 使用教學
- ❖ Lab 3-1: Ostinato simple test
- ❖ Lab 3-2: Multiple interface



# Ostinato

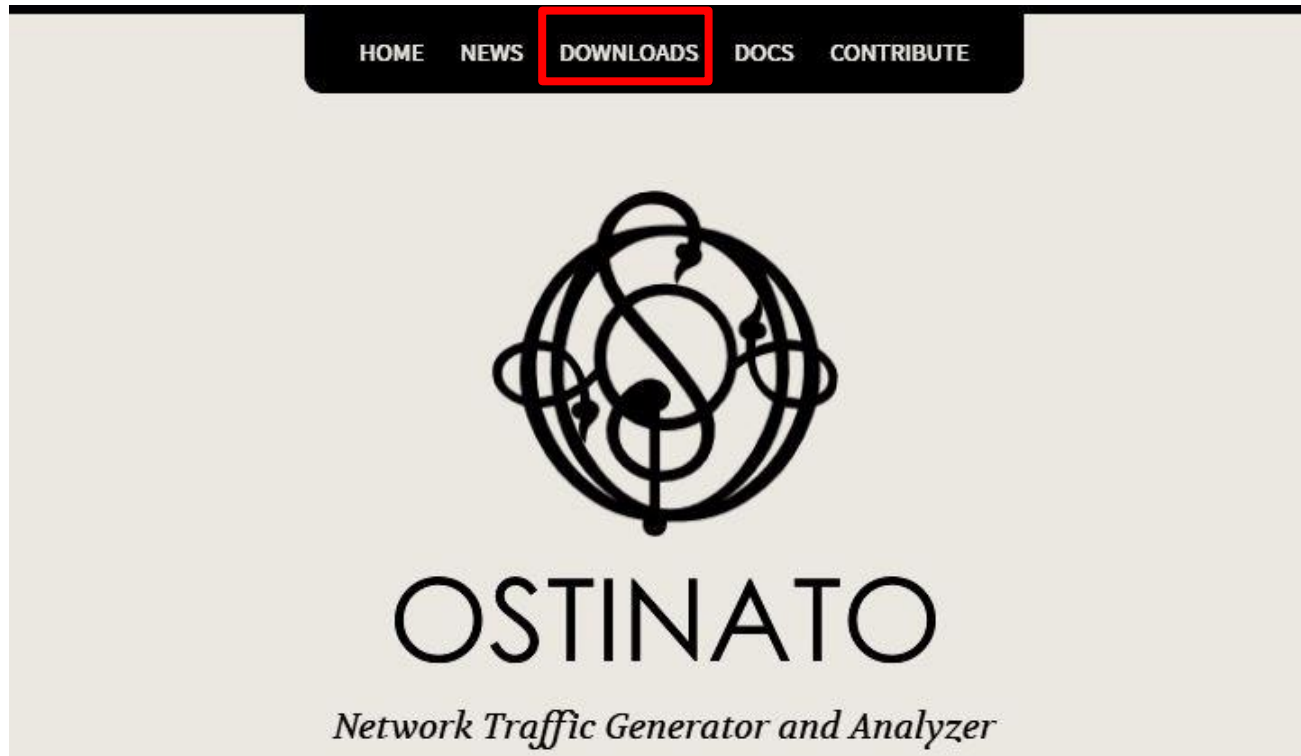
- ❖ Open Source
- ❖ 跨平台 - Windows, Linux, BSD, and Mac OS X
  - ❖ Friendly GUI
  - ❖ Python API for network test automation
- ❖ Network traffic generator & analyzer
  - ❖ 擷取網路封包
  - ❖ 製作和修改pcap檔
- ❖ 支援標準協定
  - ❖ Ethernet/802.3/LLC SNAP
  - ❖ VLAN
  - ❖ ARP, ICMP, IPv4, IPv6
  - ❖ TCP, UDP, ICMPv4, ICMPv6, IGMP





# Ostinato安裝

❖ 官方網站:<http://ostinato.org/>



❖ Ubuntu作業系統

❖ 使用指令安裝: `sudo apt-get install ostinato`



# Ostinato使用教學

- ❖ 官方網站教學
  - ❖ [User Guide](#)
  - ❖ [Developer Guide](#)
- ❖ `sudo apt-get install ostinato`





# Ostinato使用教學

- ❖ 開啟終端機，輸入指令: `sudo ostinato`

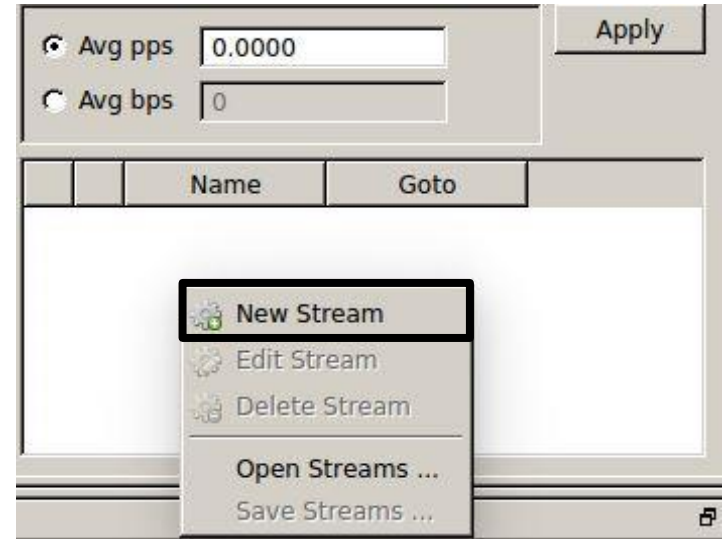
The screenshot shows the Ostinato application window. The 'Ports and Streams' panel is divided into two sections: 'Port List' and 'Streams List'. The 'Port List' section shows a tree view with 'Port Group 0: [127.0.0.1:7878] (3)' expanded, showing 'Port 0: eth0 [0.0.0.0] ()', 'Port 1: any [0.0.0.0] (Pseudo-device that ...)', and 'Port 2: lo [0.0.0.0] ()'. The 'Streams List' section is empty. The 'Statistics' panel at the bottom shows a table of statistics for three ports (Port 0-0, Port 0-1, Port 0-2). The 'Controls' panel is also visible, showing a set of icons for controlling the application.

	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	34	0	1740
Frames Sent	129	0	1740
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3

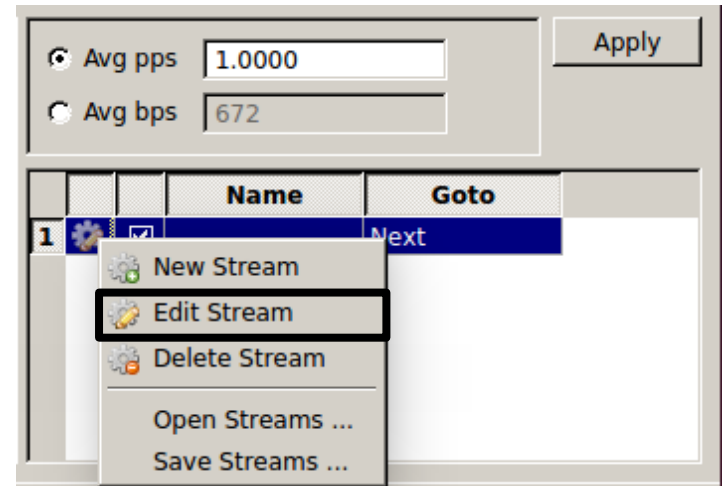


# Ostinato使用教學

- ❖ 新增一個Stream
  - ❖ 空白處點選右鍵
  - ❖ 選擇New Stream



- ❖ 編輯Stream
  - ❖ 在新增的Stream點選右鍵
  - ❖ 選擇Edit Stream





# Ostinato使用教學

## ❖ 設定封包

The image shows the 'Edit Stream' dialog box in Ostinato, with the 'Protocol Selection' tab selected. The dialog is divided into 'Simple' and 'Advanced' sections. In the 'Simple' section, the following settings are highlighted with black boxes:

- L1:** ☒ Mac
- L2:** ☒ Ethernet II
- L3:** ☒ IPv4
- L4:** ☒ None
- L5:** ☒ None
- Payload:** ☒ Pattern
- VLAN:** ☒ Untagged

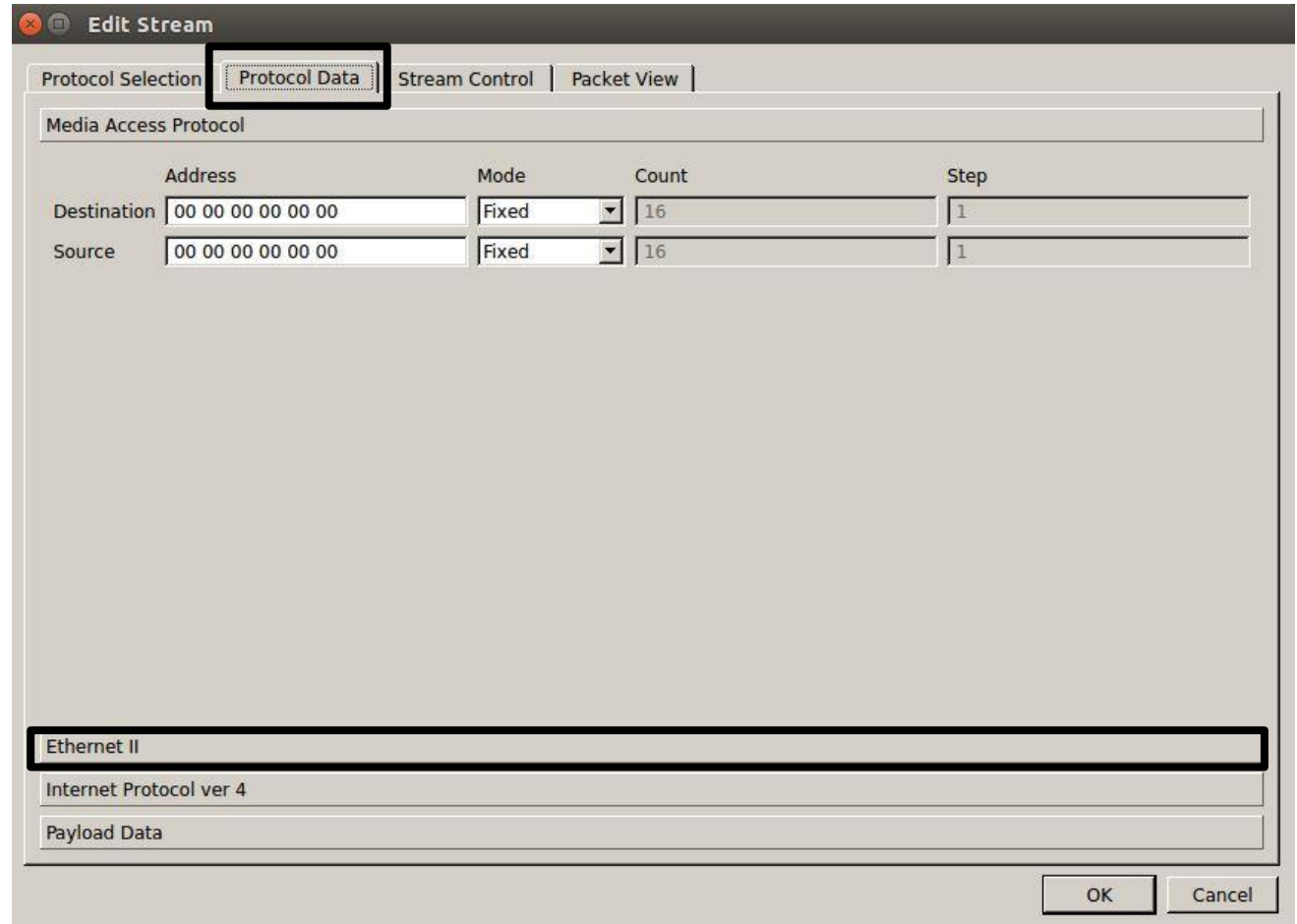
The 'Frame Length (including FCS)' section shows 'Fixed' selected with a value of 64. The 'Advanced' section is currently collapsed. At the bottom right, there are 'OK' and 'Cancel' buttons.





# Ostinato使用教學

## ❖ 輸入協定資訊



The image shows the 'Edit Stream' dialog box in Ostinato. The 'Protocol Data' tab is selected and highlighted with a red box. The 'Media Access Protocol' section is visible, showing 'Destination' and 'Source' addresses set to '00 00 00 00 00 00', both with 'Fixed' mode and a 'Count' of 16 and 'Step' of 1. At the bottom, the protocol stack is listed: 'Ethernet II' (highlighted with a red box), 'Internet Protocol ver 4', and 'Payload Data'. The 'OK' and 'Cancel' buttons are at the bottom right.

	Address	Mode	Count	Step
Destination	00 00 00 00 00 00	Fixed	16	1
Source	00 00 00 00 00 00	Fixed	16	1

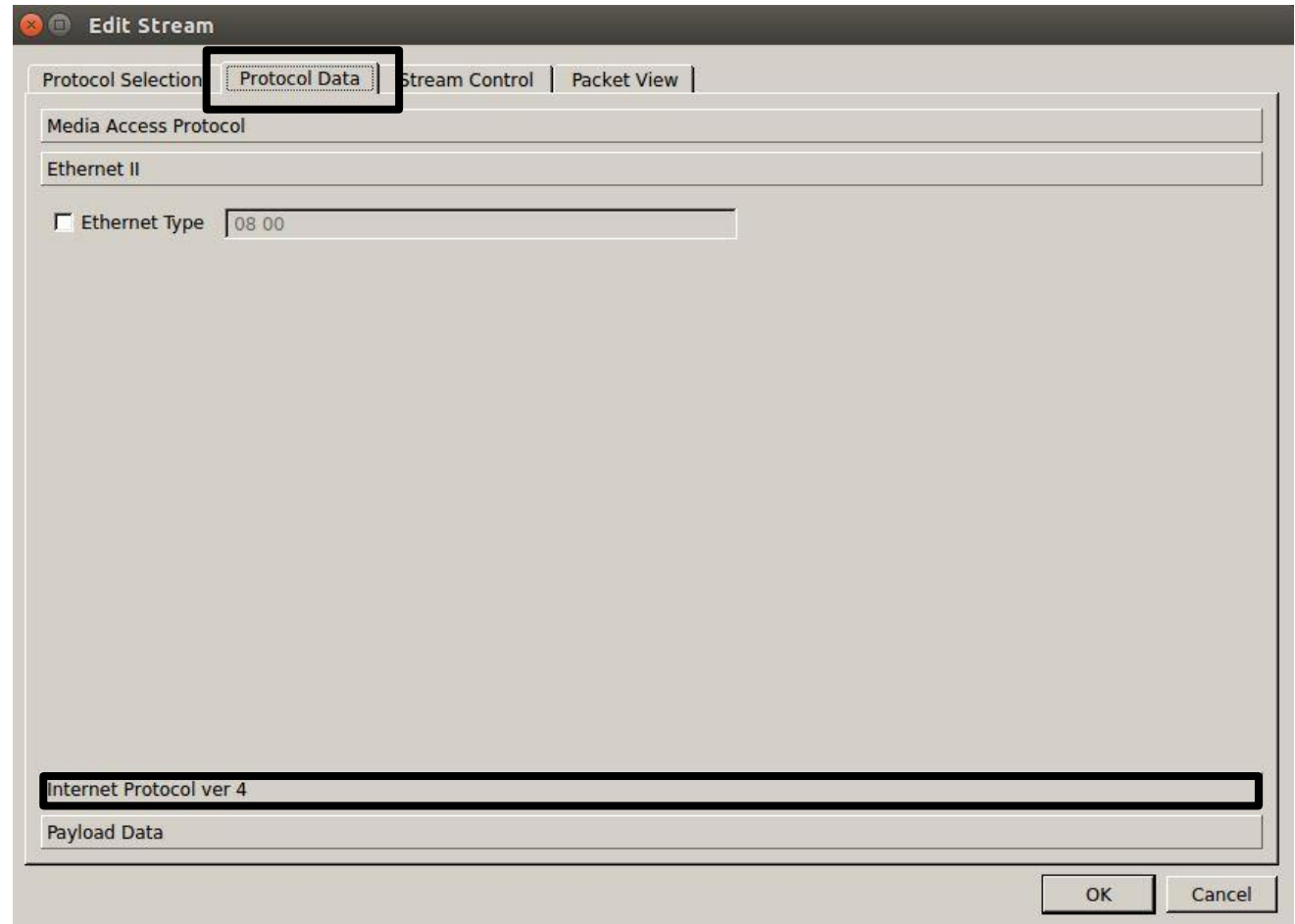
Ethernet II  
Internet Protocol ver 4  
Payload Data

OK Cancel



# Ostinato使用教學

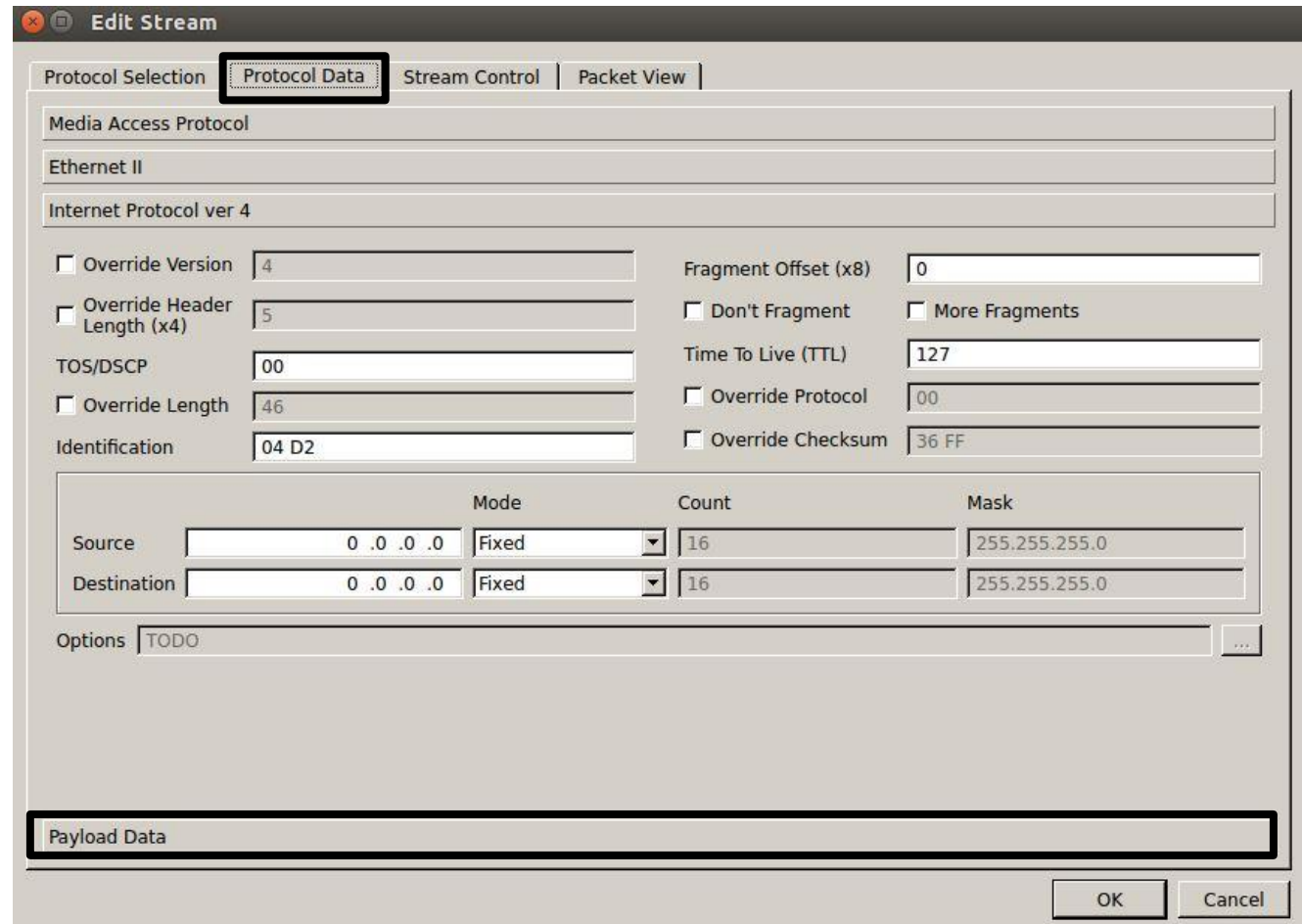
## ❖ 輸入協定資訊





# Ostinato使用教學

## ❖ 輸入協定資訊



The image shows the 'Edit Stream' dialog box in Ostinato. The 'Protocol Data' tab is selected and highlighted with a red box. The dialog is configured for Media Access Protocol, Ethernet II, and Internet Protocol ver 4. The 'Protocol Data' tab contains the following fields:

- ☐ Override Version: 4
- ☐ Override Header Length (x4): 5
- TOS/DSCP: 00
- ☐ Override Length: 46
- Identification: 04 D2
- Fragment Offset (x8): 0
- ☐ Don't Fragment
- ☐ More Fragments
- Time To Live (TTL): 127
- ☐ Override Protocol: 00
- ☐ Override Checksum: 36 FF

Below these fields is a table for Source and Destination IP addresses:

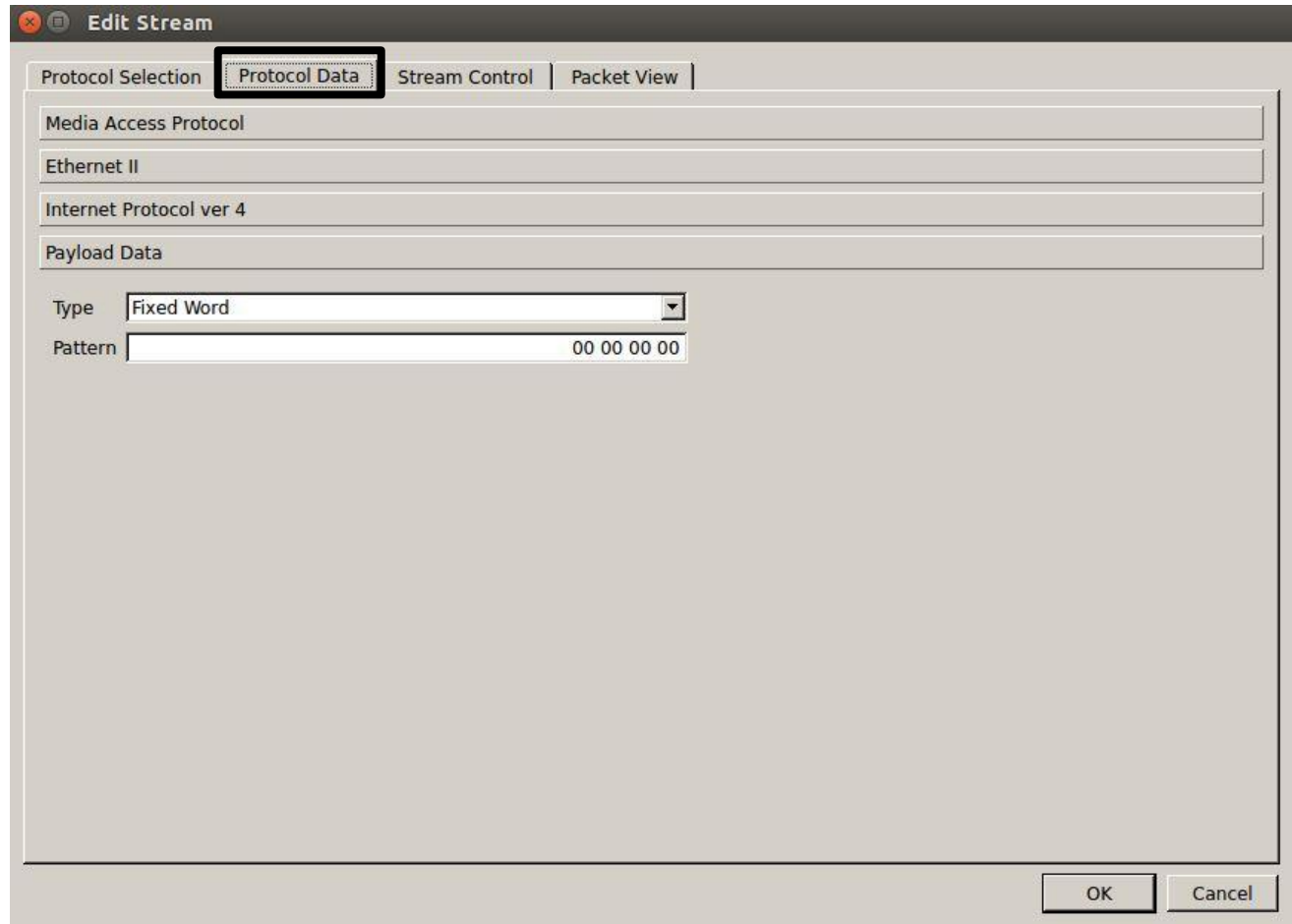
	Mode	Count	Mask
Source	Fixed	16	255.255.255.0
Destination	Fixed	16	255.255.255.0

At the bottom, there is an 'Options' field with the value 'TODO' and a 'Payload Data' field. The 'OK' and 'Cancel' buttons are at the bottom right.



# Ostinato使用教學

## ❖ 輸入協定資訊

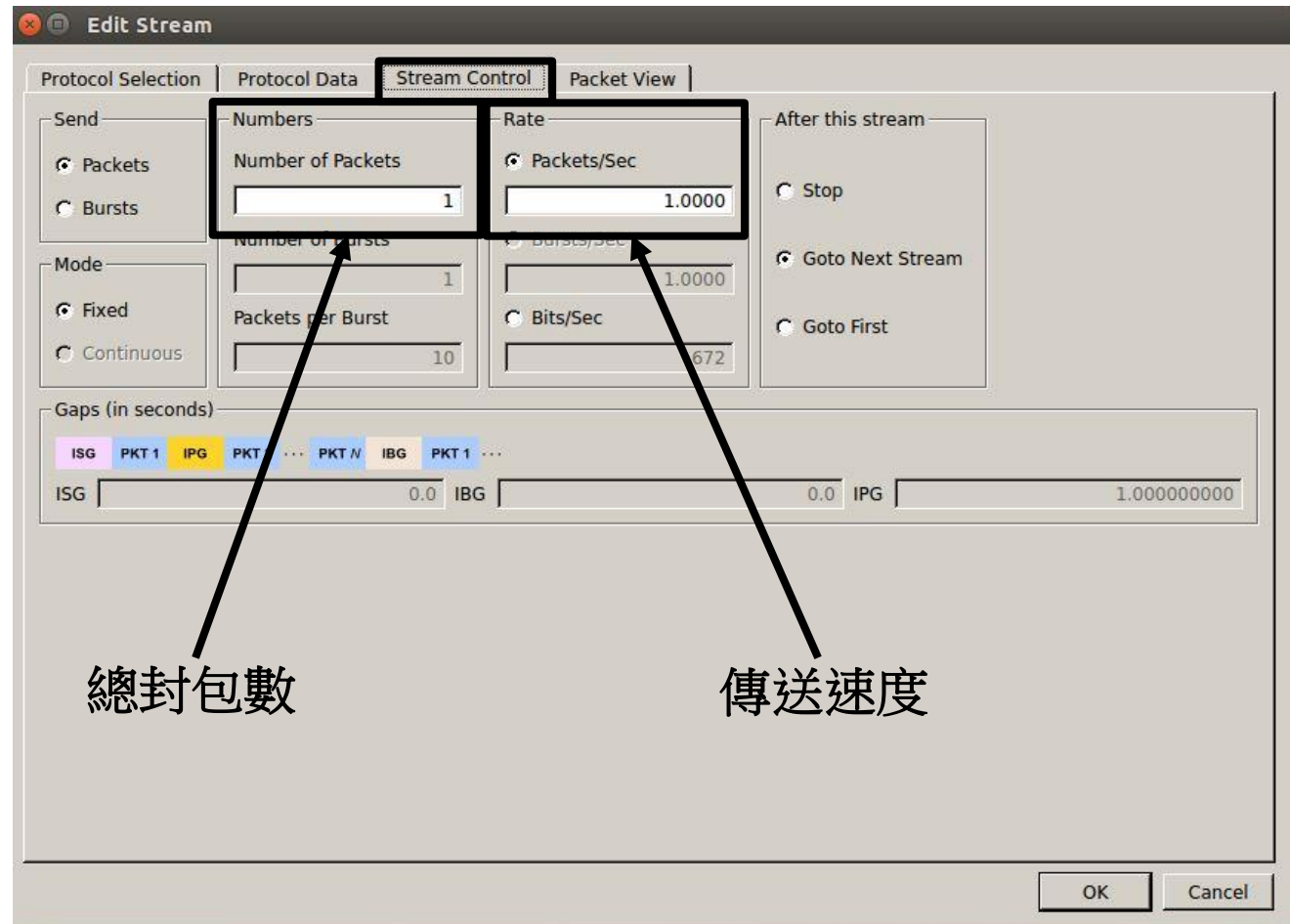


The image shows the 'Edit Stream' dialog box in Ostinato. The 'Protocol Data' tab is selected and highlighted with a black box. The dialog has four tabs: 'Protocol Selection', 'Protocol Data', 'Stream Control', and 'Packet View'. Under 'Protocol Data', there are four stacked input fields: 'Media Access Protocol', 'Ethernet II', 'Internet Protocol ver 4', and 'Payload Data'. The 'Payload Data' section is expanded, showing a 'Type' dropdown menu set to 'Fixed Word' and a 'Pattern' text field containing '00 00 00 00'. At the bottom right, there are 'OK' and 'Cancel' buttons.



# Ostinato使用教學

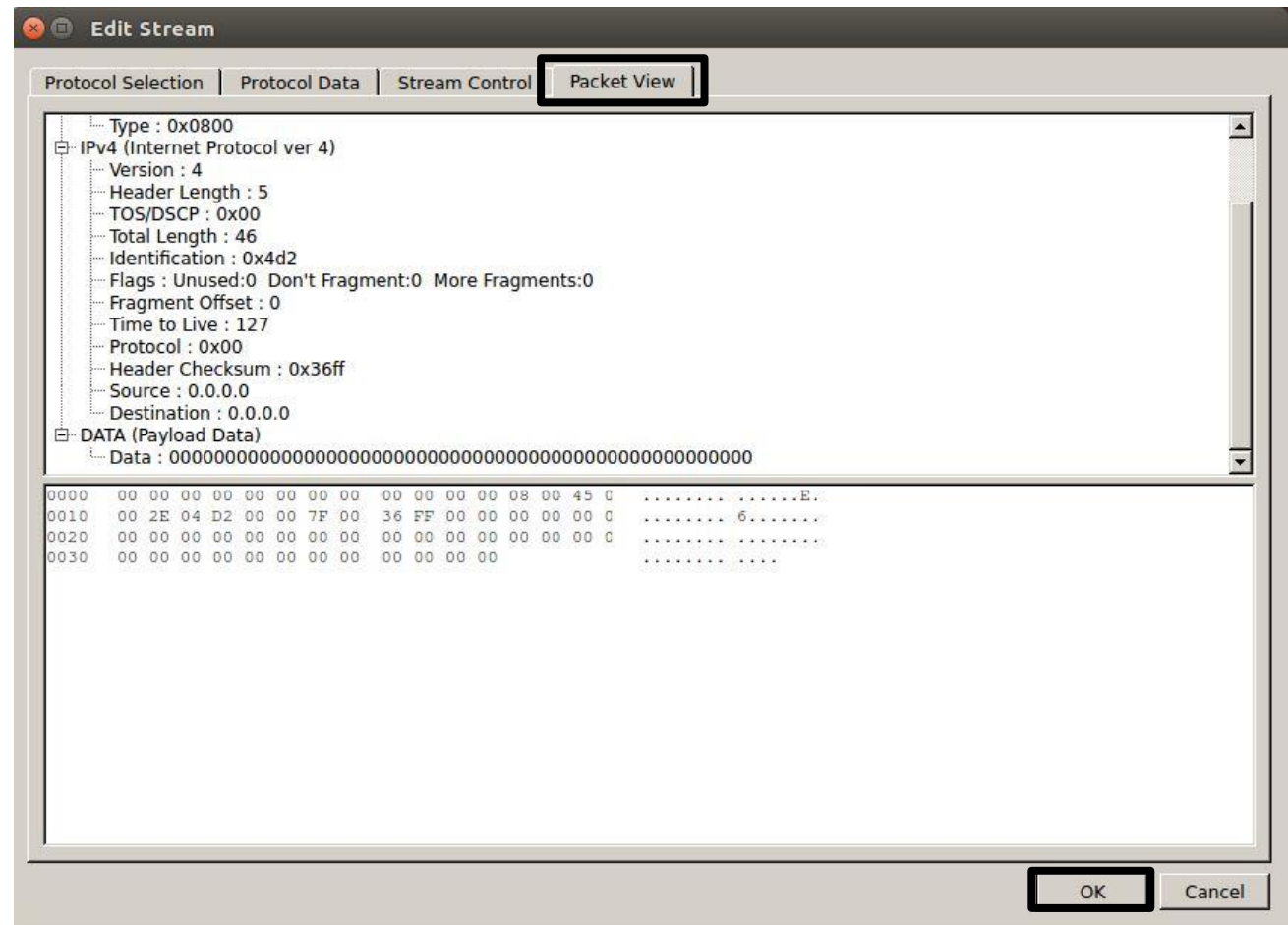
## ❖ 設定封包個數





# Ostinato使用教學

## ❖ 封包內容





# Ostinato使用教學

## ❖ 發送封包

2. 按下Apply

3. 按下Transmit button

1. 點選Port

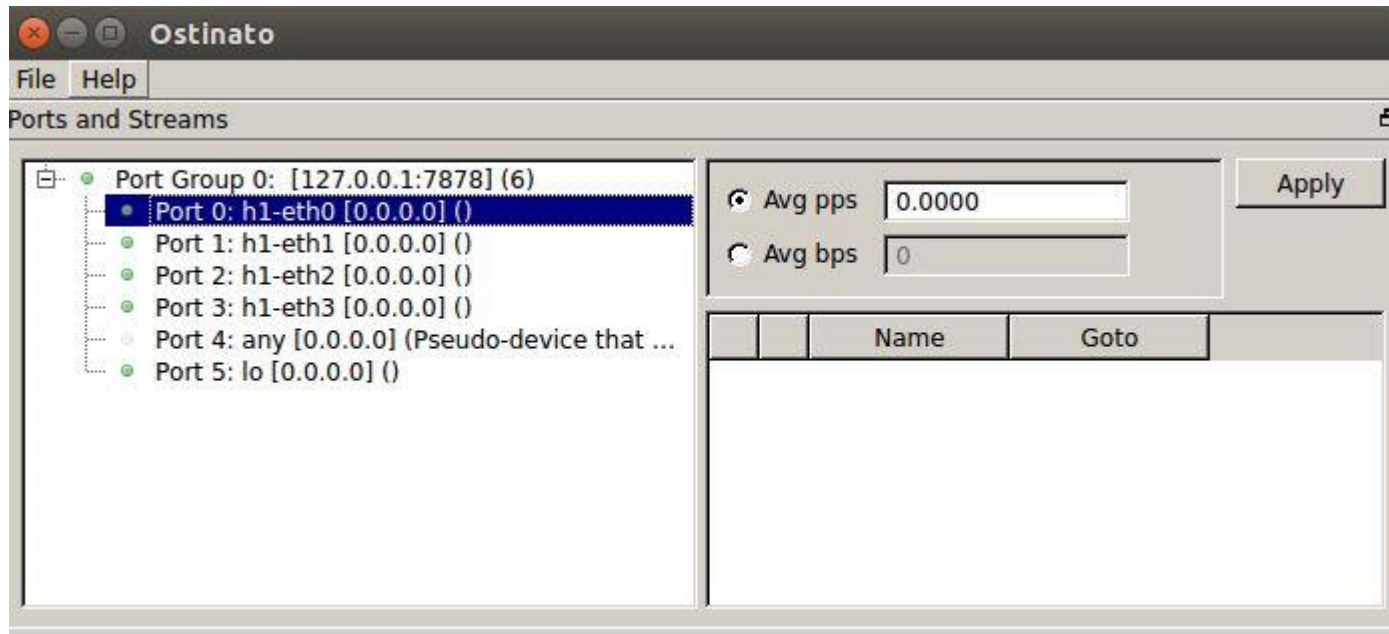
The screenshot shows the Ostinato application window. The 'Ports and Streams' section on the left lists 'Port Group 0: [127.0.0.1:7878] (3)' with sub-items 'Port 0: eth0 [0.0.0.0] ()', 'Port 1: any [0.0.0.0] (Pseudo-device that ...)', and 'Port 2: lo [0.0.0.0] ()'. The 'Port 0' item is selected. On the right, 'Avg pps' is set to 1.0000 and 'Avg bps' to 672. The 'Apply' button is highlighted. Below this, a table shows stream configuration with 'Stream1' set to 'Next'. At the bottom, the 'Statistics' section shows a table of metrics for 'Port 0-0', 'Port 0-1', and 'Port 0-2'. The 'Port 0-0' column is highlighted. A toolbar at the bottom left contains a 'Transmit' button (a play icon) which is also highlighted.

	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	5049	0	9303
Frames Sent	781	0	9303
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3



# Ostinato使用教學

- ❖ 同時多個介面發送封包
  - ❖ 每一個port都必須匯入一個pcap檔案



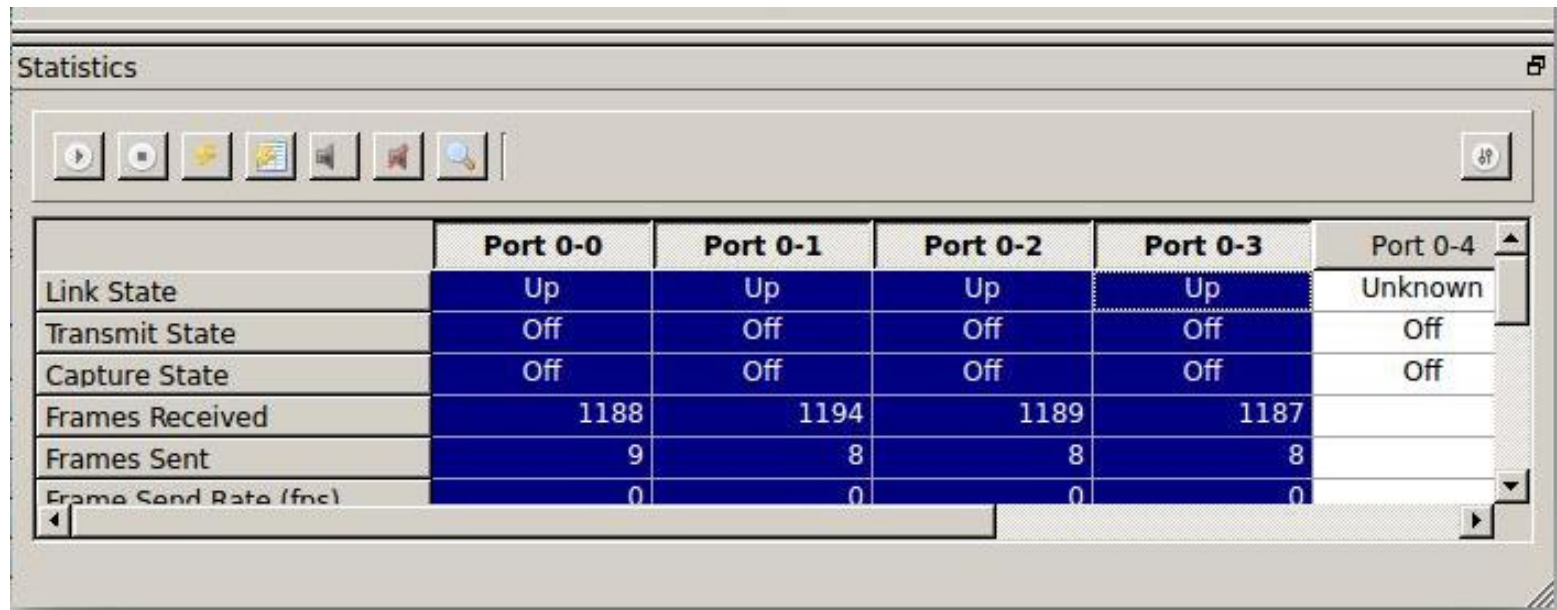




# Ostinato使用教學

## ❖ 同時多個介面發送封包

1. 在Statistics列按住Ctrl並選擇需要發送的Port
2. 按下Apply
3. 按下Transmit button



The screenshot shows the 'Statistics' window in Ostinato. It contains a table with 6 rows and 6 columns. The columns are labeled 'Port 0-0', 'Port 0-1', 'Port 0-2', 'Port 0-3', and 'Port 0-4'. The rows are labeled 'Link State', 'Transmit State', 'Capture State', 'Frames Received', 'Frames Sent', and 'Frame Send Rate (fnc)'. The 'Port 0-3' column is highlighted with a blue background.

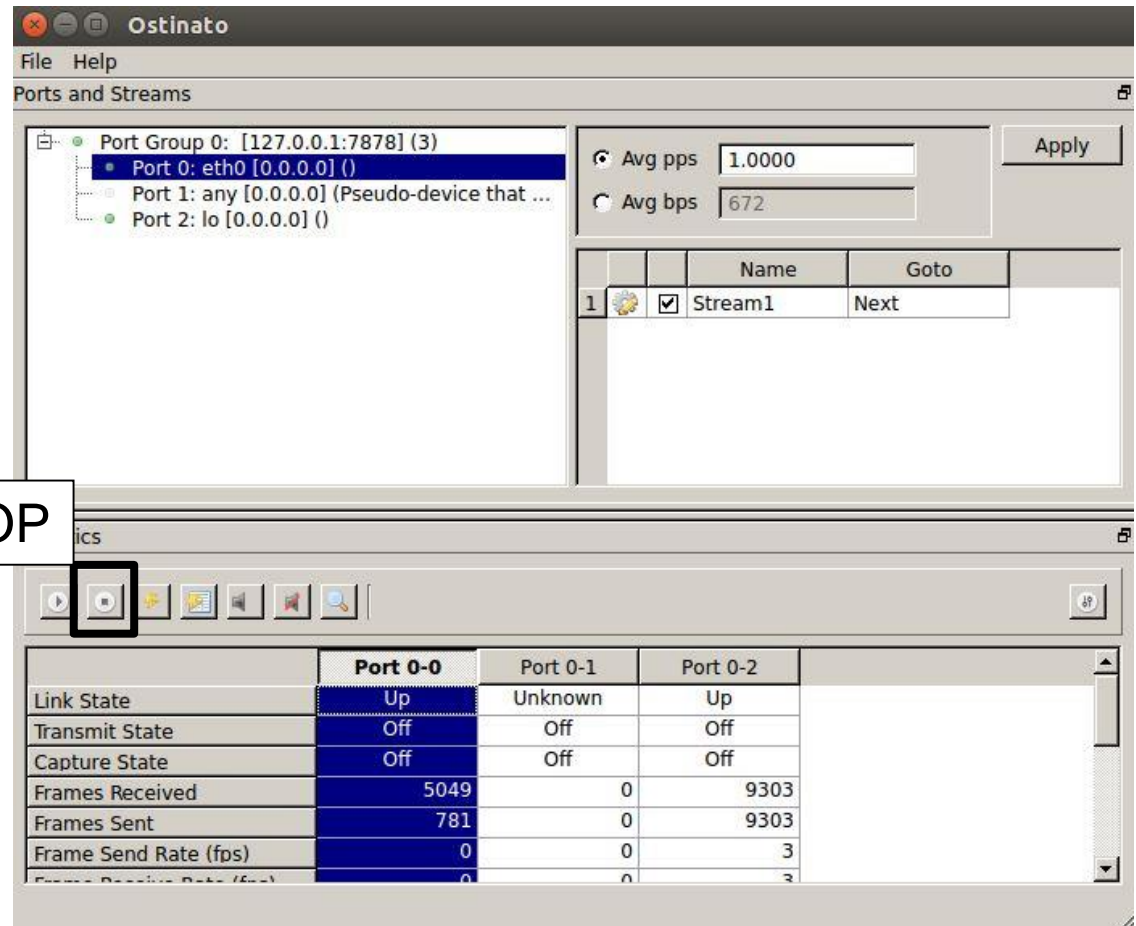
	Port 0-0	Port 0-1	Port 0-2	Port 0-3	Port 0-4
Link State	Up	Up	Up	Up	Unknown
Transmit State	Off	Off	Off	Off	Off
Capture State	Off	Off	Off	Off	Off
Frames Received	1188	1194	1189	1187	
Frames Sent	9	8	8	8	
Frame Send Rate (fnc)	0	0	0	0	



# Ostinato使用教學

## ❖ 停止發送

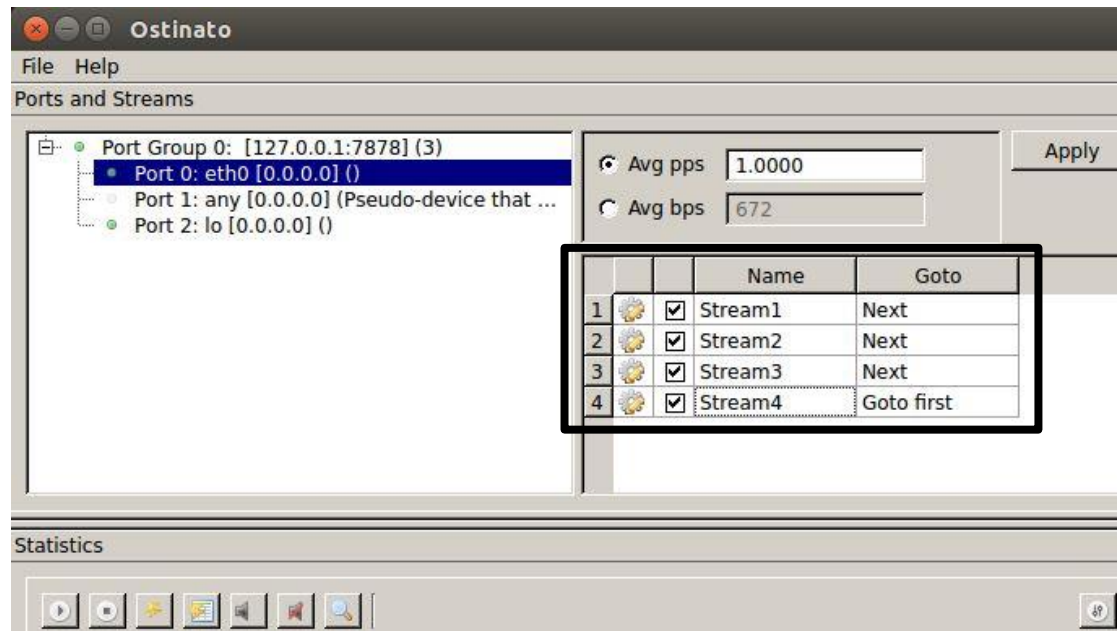
4. 停止按下STOP





# Ostinato使用教學

## ❖ 多個Stream



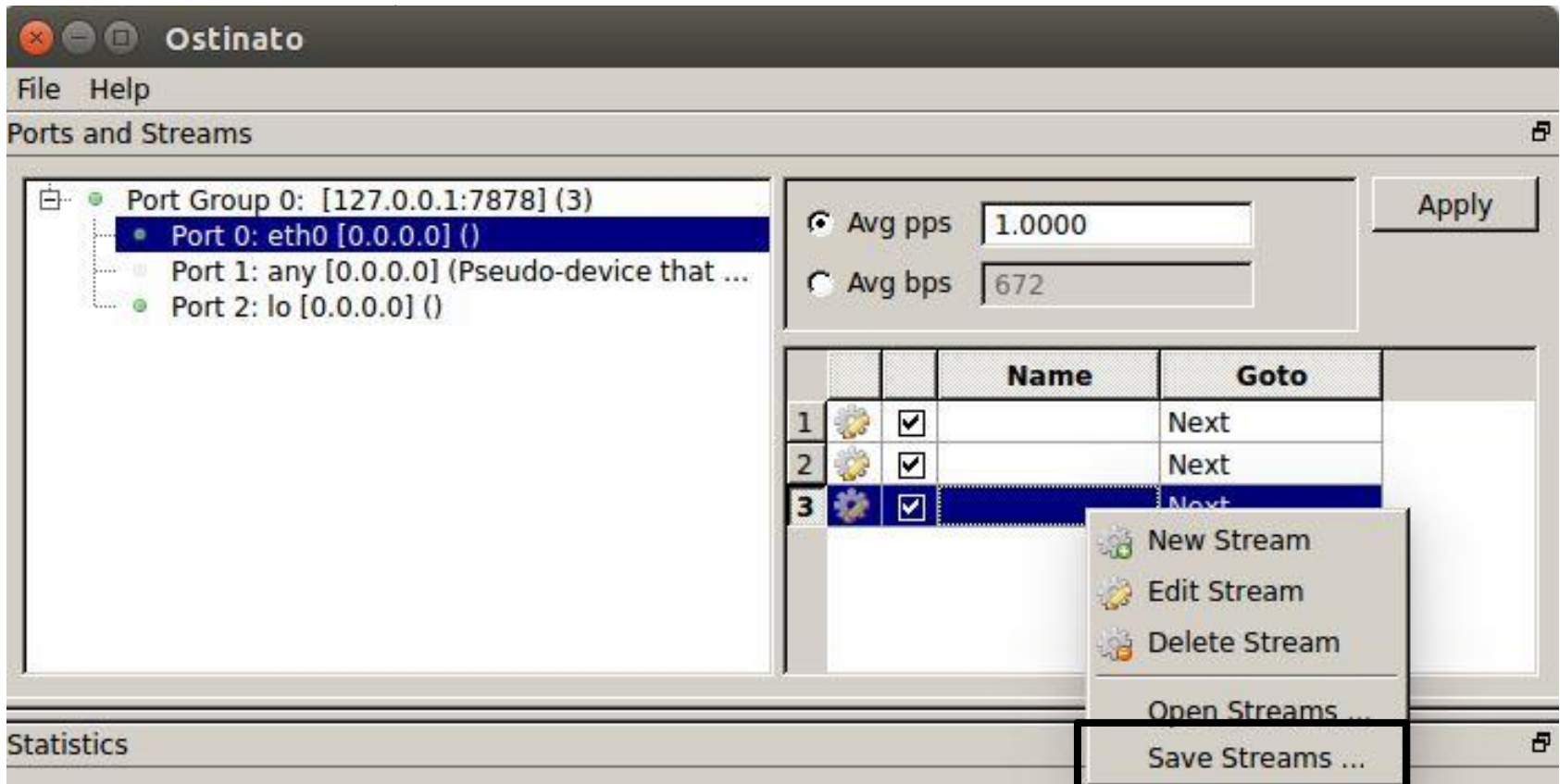
❖ 注意: 發送封包時，必須先按下停止才能調整參數

❖ 對Stream調整參數後，再按下Apply後方能生效



# Ostinato使用教學

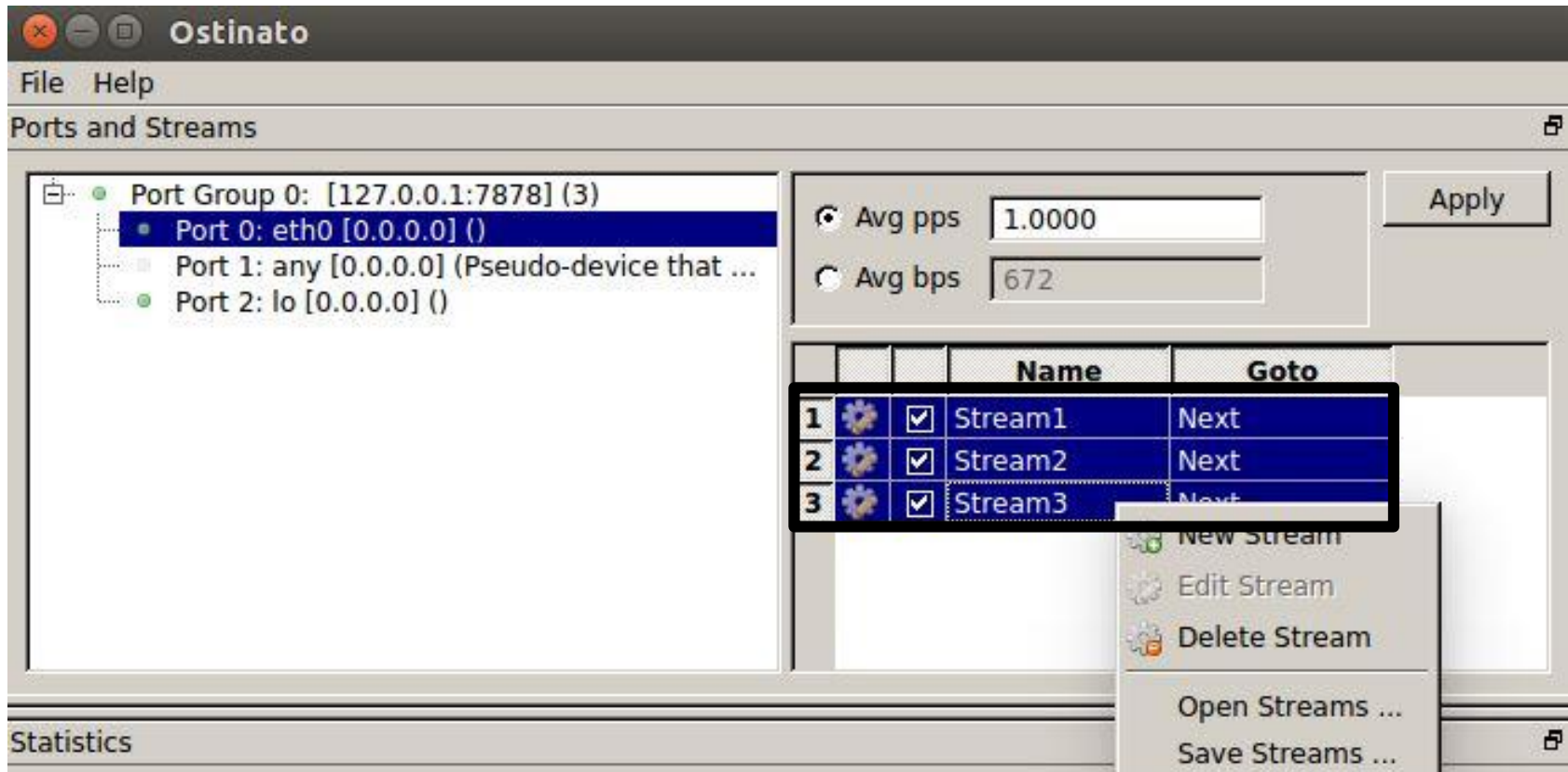
## ❖ 製作pcap檔





# Ostinato使用教學

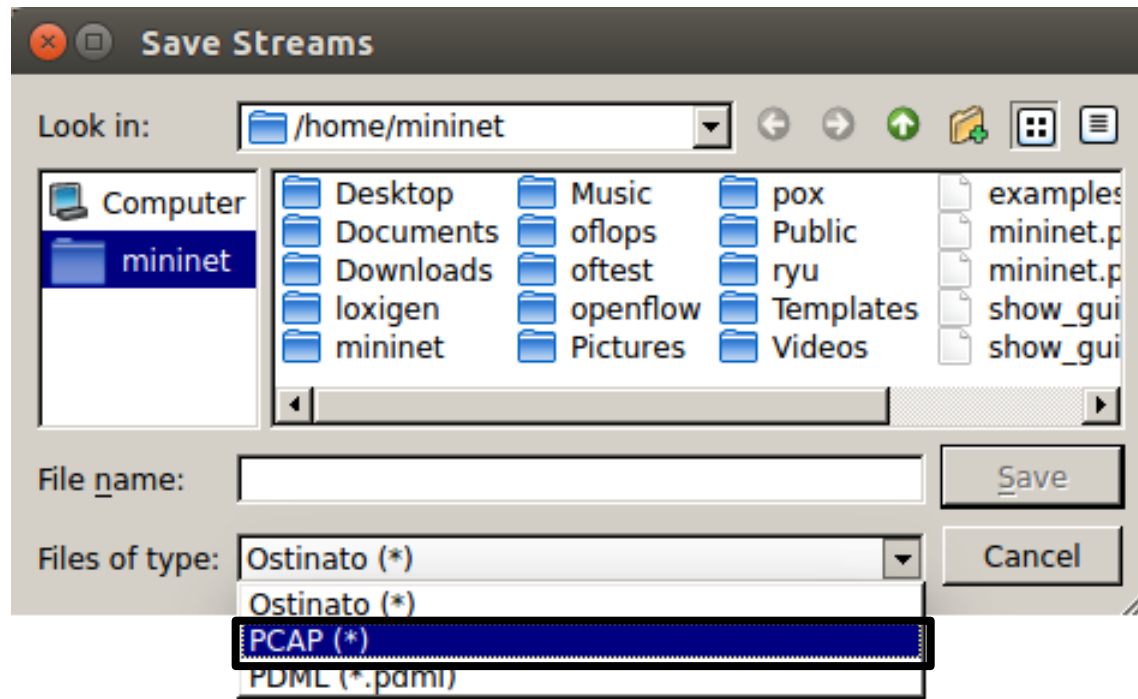
- ❖ 儲存多個Stream至一個pcap檔
  - ❖ 按Ctrl並選擇多個Stream





# Ostinato使用教學

- ❖ 選擇pcap檔按下Save即可

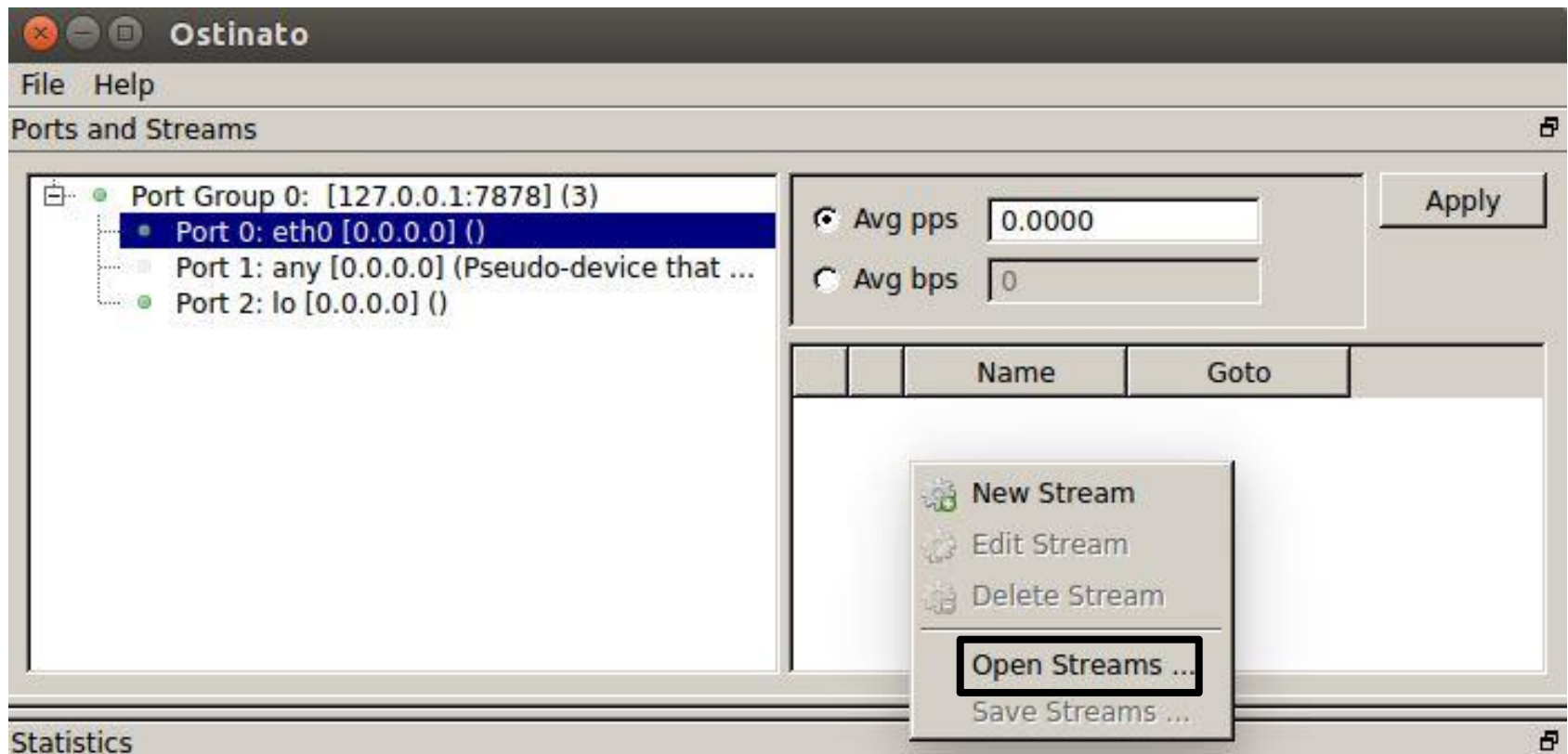






# Ostinato使用教學

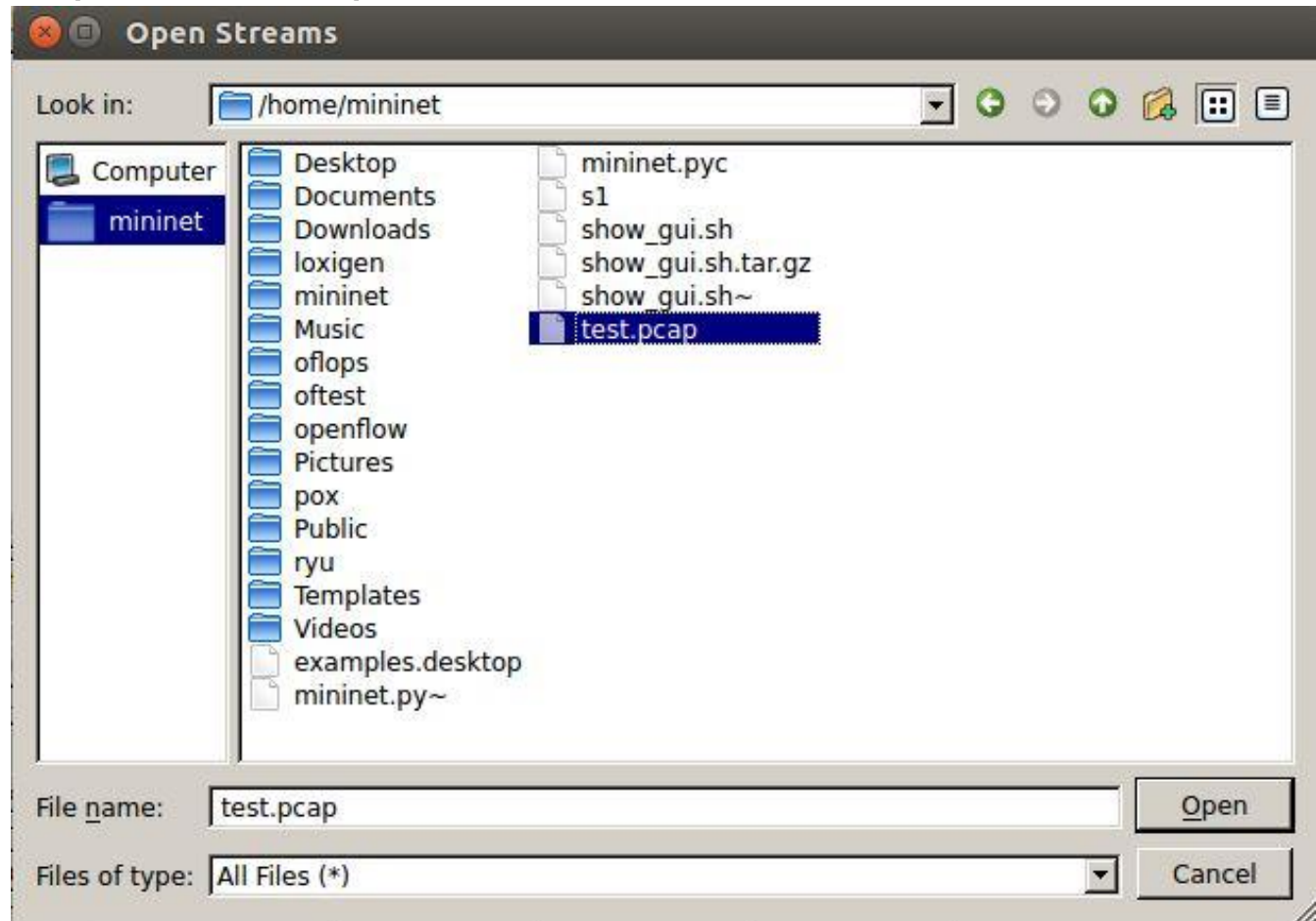
- ❖ 匯入pcap檔
- ❖ 點選Open Streams





# Ostinato使用教學

- ❖ 選擇要開啟的pcap檔，按下Open







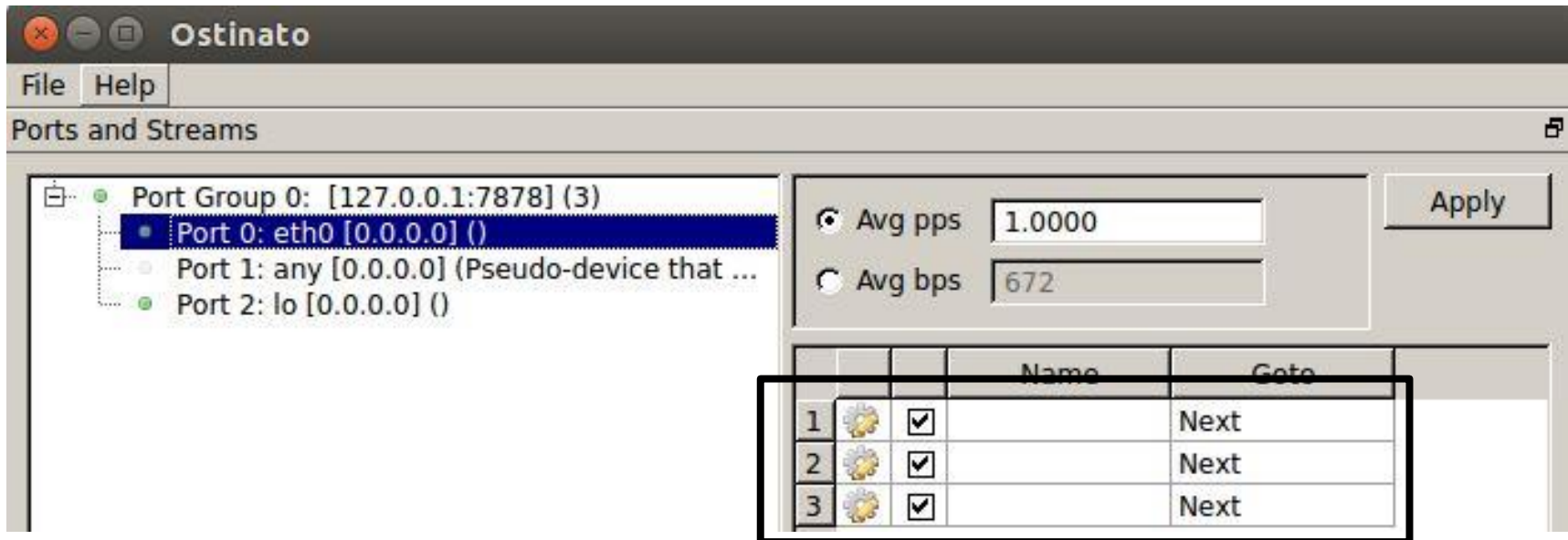
# Ostinato使用教學

❖ 詢問是否要自動轉換格式

❖ 點選OK



❖ 匯入完成





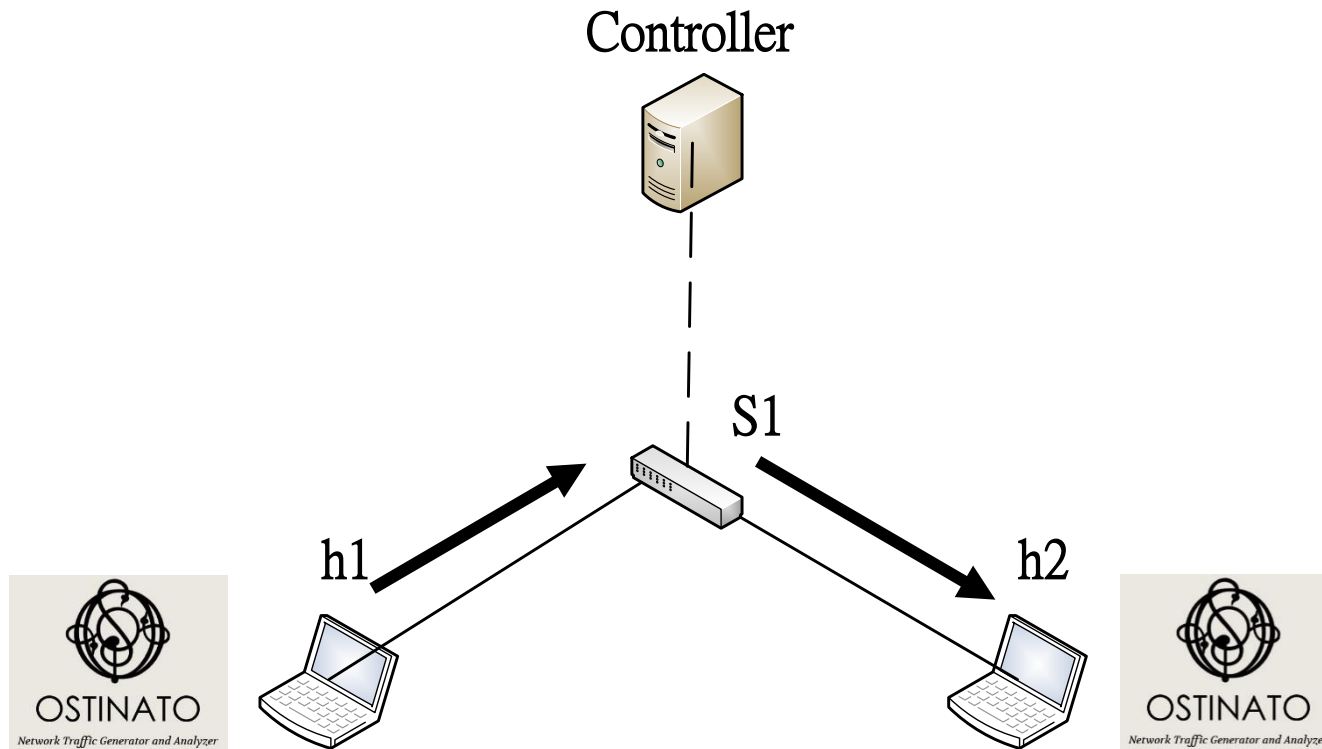
# Outline

- ❖ Ostinato
  - ❖ 安裝
  - ❖ 使用教學
- ❖ Lab 3-1: Ostinato simple test
- ❖ Lab 3-2: Multiple interface



# Lab 3-1: Ostinato simple test

- ❖ 使用mininet預設拓樸
  - ❖ 指令: `sudo mn --mac`
- ❖ 利用Ostinato將封包從h1送往h2



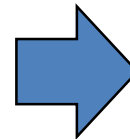


# Lab 3-1: Ostinato simple test

## ❖ Step1: h1發送封包

❖ 在mininet中使用指令xterm h1 進入h1命令列模式

```
mininet@mininet-VirtualBox: ~  
mininet@mininet-VirtualBox:~$ sudo mn  
[sudo] password for mininet:  
*** Creating network  
*** Adding controller  
*** Adding hosts:  
h1 h2  
*** Adding switches:  
s1  
*** Adding links:  
(h1, s1) (h2, s1)  
*** Configuring hosts  
h1 h2  
*** Starting controller  
c0  
*** Starting 1 switches  
s1 ...  
*** Starting CLI:  
mininet> xterm h1
```

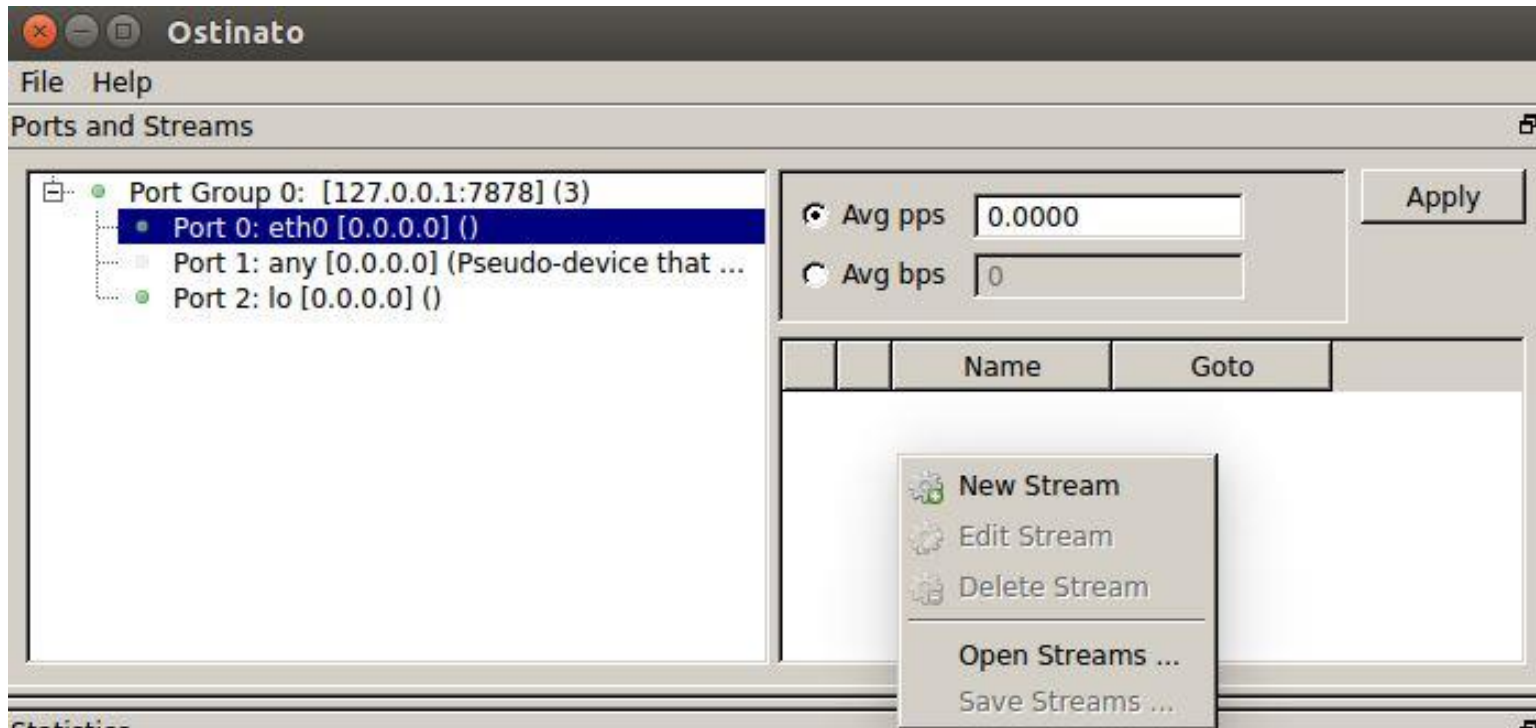


```
"Node: h1"  
root@mininet-VirtualBox:~#
```



# Lab 3-1: Ostinato simple test

- ❖ 使用h1的命令列打開Ostinato
  - ❖ `sudo ostinato &`
  - ❖ `&` 可以讓你在同一終端機裡, 繼續輸入指令
- ❖ 在Ostinato裡, 新增Stream





# Lab 3-1: Ostinato simple test

❖ 設定從h1之Port0:h1-eth0發送封包

❖ Protocol Selection配置如下

The image shows the 'Protocol Selection' tab of the Ostinato application. The configuration is set to 'Simple' mode. The 'Frame Length (including FCS)' is set to 'Fixed' with a minimum of 64 and a maximum of 1518. The protocol stack is configured as follows:

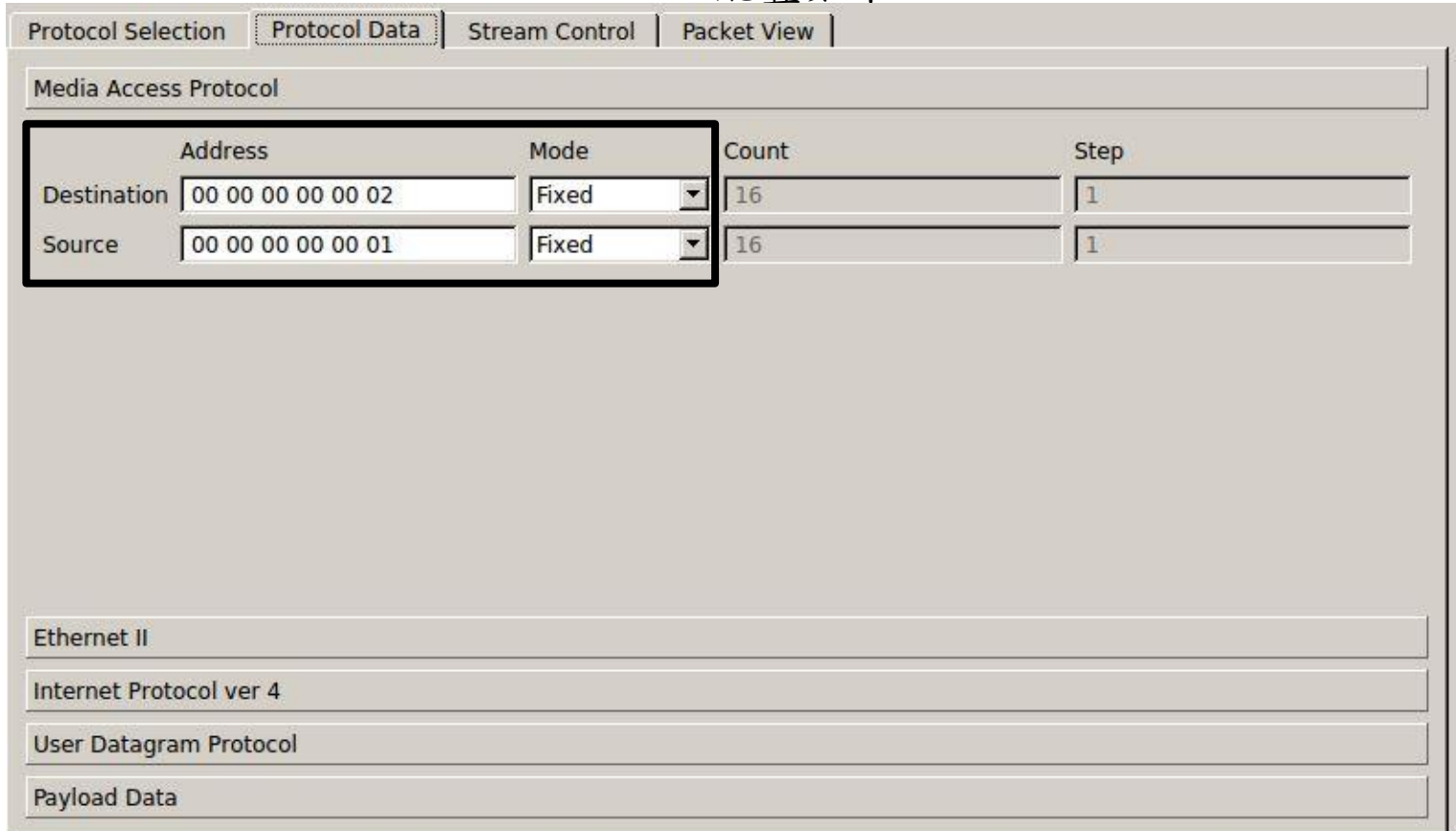
- L1:** ☒ Mac
- L2:** ☒ Ethernet II
- L3:** ☒ IPv4
- L4:** ☒ UDP
- L5:** ☒ None
- VLAN:** ☒ Untagged
- Payload:** ☒ Pattern

The 'Advanced' tab is also visible at the bottom.



# Lab 3-1: Ostinato simple test

- ❖ 設定從h1之Port0:h1-eth0發送封包
- ❖ Protocol Data – Media Access Protocol配置如下



The image shows the 'Protocol Data' configuration window in Ostinato. The 'Media Access Protocol' tab is selected. The configuration is as follows:

	Address	Mode	Count	Step
Destination	00 00 00 00 00 02	Fixed	16	1
Source	00 00 00 00 00 01	Fixed	16	1

Below the MAC configuration, the protocol stack is shown:

- Ethernet II
- Internet Protocol ver 4
- User Datagram Protocol
- Payload Data





# Lab 3-1: Ostinato simple test

- ❖ 設定從h1之Port0:h1-eth0發送封包
- ❖ Protocol Data – Internet Protocol Ver 4配置如下

The screenshot shows the 'Edit Stream' window with the 'Protocol Data' tab selected. The 'Internet Protocol ver 4' section is expanded, showing the following configuration:

Field	Value
Override Version	4
Override Header Length (x4)	5
TOS/DSCP	00
Override Length	46
Identification	04 D2
Fragment Offset (x8)	0
Don't Fragment	<input type="checkbox"/>
More Fragments	<input type="checkbox"/>
Time To Live (TTL)	127
Override Protocol	11
Override Checksum	22 EB

The 'Source' and 'Destination' fields are highlighted with a black box:

Field	IP Address	Mode	Count	Mask
Source	10.0.0.1	Fixed	16	255.255.255.0
Destination	10.0.0.2	Fixed	16	255.255.255.0

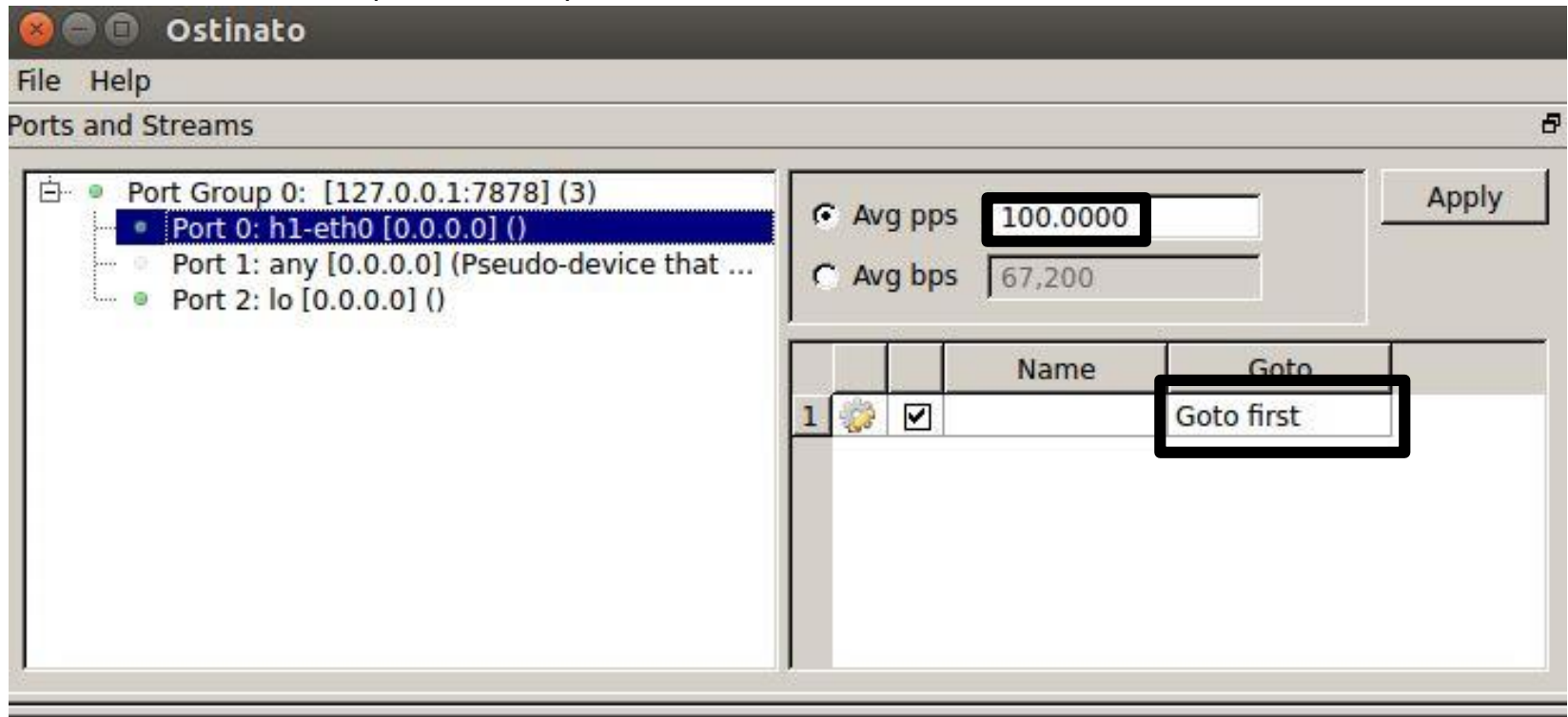
The 'User Datagram Protocol' and 'Payload Data' sections are also visible at the bottom of the window.





## Lab 3-1: Ostinato simple test

- ❖ 設定從h1之Port0:h1-eth0發送封包
  - ❖ 每秒送100個封包
  - ❖ 重複發送封包 (Goto first)





# Lab 3-1: Ostinato simple test

❖ 按下OK回到主畫面

The screenshot shows the Ostinato application window with the following components and annotations:

- Ports and Streams:**
  - Port Group 0: [127.0.0.1:7878] (3)
    - Port 0: h1-eth0 () (Selected)
    - Port 1: any (Pseudo-device that captures ...)
    - Port 2: lo ()
- Statistics:**
  - Avg pps: 100.0000
  - Avg bps: 67,200
  - Buttons: Apply, Goto first
- Stream List:**
  - 1 [Stream icon] [x] stream1 [Goto first]
- Statistics Table:**

	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	14	0	24150
Frames Sent	9	0	24150
Frame Send Rate (fps)	0	0	33
Frame Receive Rate (fps)	0	0	33

Annotations on the screenshot:

- 3. 按下Apply**: Points to the Apply button in the Statistics section.
- 2. 重複發送**: Points to the 'Goto first' button in the Stream List.
- 1. 選Port**: Points to the 'Port 0-0' column header in the Statistics table.
- 4. 發送**: Points to the 'Send' button (cannon icon) in the Stream List.



# Lab 3-1: Ostinato simple test

## ❖ Step 2: h2接收封包

❖ 在mininet中使用指令xterm h2 進入h2命令列模式

❖ 使用h2的命令列打開Ostinato

```

"Node: h2"
client(CallMethod) sending 12 bytes encoding <port_id {
  id: 2
}
>
0001000400000004
In virtual void MyService::getStreamConfig(google::protobuf::RpcController*, const
st OstreamProto::StreamIdList*, OstreamProto::StreamConfigList*, google::protobuf::Closu
re*)
Server(done): sending 12 bytes to client encoding <port_id {
  id: 2
}
>
client(on_mpSocket_readyRead): Parsed as port_id {
  id: 2
}
>
In void PortGroup::processStreamConfigList(int, PbRpcController*)
portstate changed
portGroupId = 0, portId = 0
In when_portModel_dataChanged
portstate changed
portGroupId = 0, portId = 2
In when_portModel_dataChanged

```

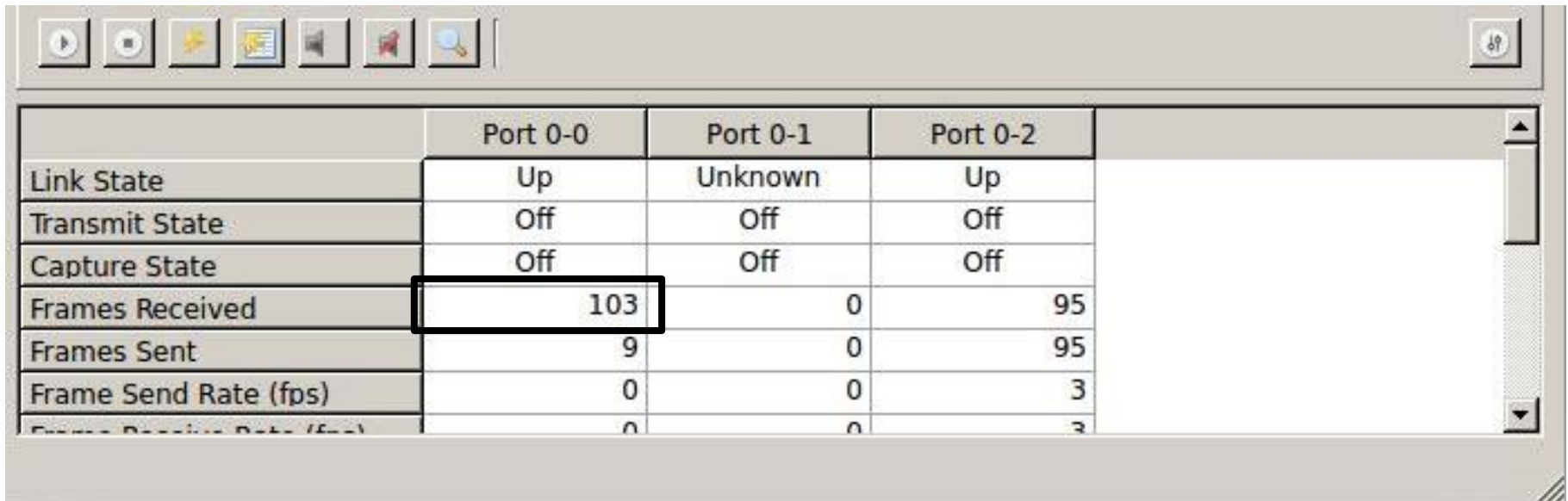
The screenshot shows the Ostinato application window. The 'Ports and Streams' panel on the left lists three ports: Port 0: h2-eth0 [0.0.0.0] (I), Port 1: any [0.0.0.0] (Pseudo-device that ...), and Port 2: lo [0.0.0.0] (I). The 'Statistics' panel at the bottom displays a table of network statistics for three ports (Port 0-0, Port 0-1, Port 0-2).

	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	103	0	95
Frames Sent	9	0	95
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3



## Lab 3-1: Ostinato simple test

- ❖ Step 2: h2接收封包
  - ❖ 在mininet中使用指令xterm h2 進入h2命令列模式
  - ❖ 使用h2的命令列打開Ostinato
- ❖ 觀察h2的Statistics列表
  - ❖ 確認Frames Received是否有增加



	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	103	0	95
Frames Sent	9	0	95
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3



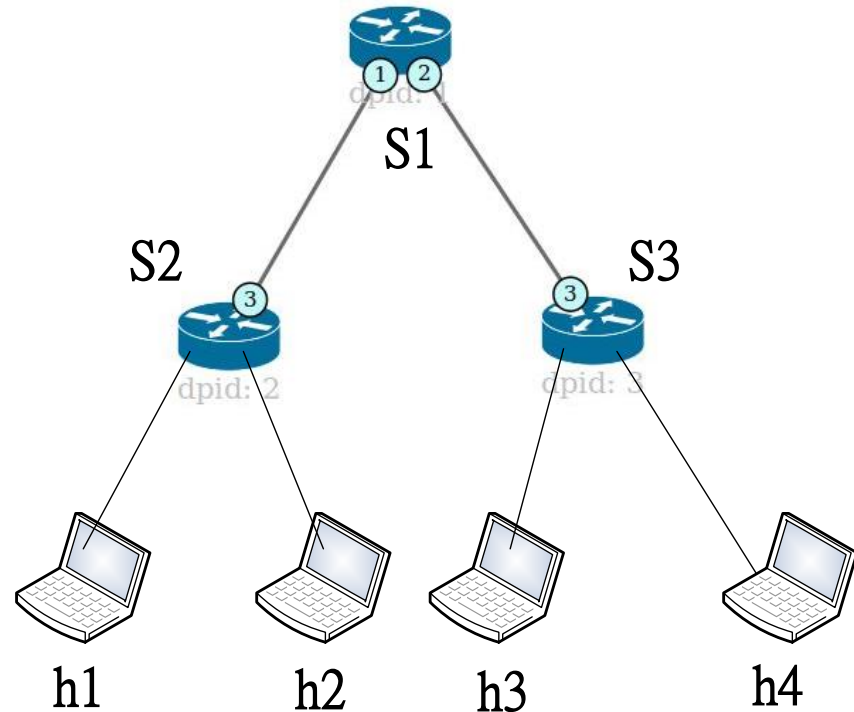
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## Lab 3-2: Multiple interface

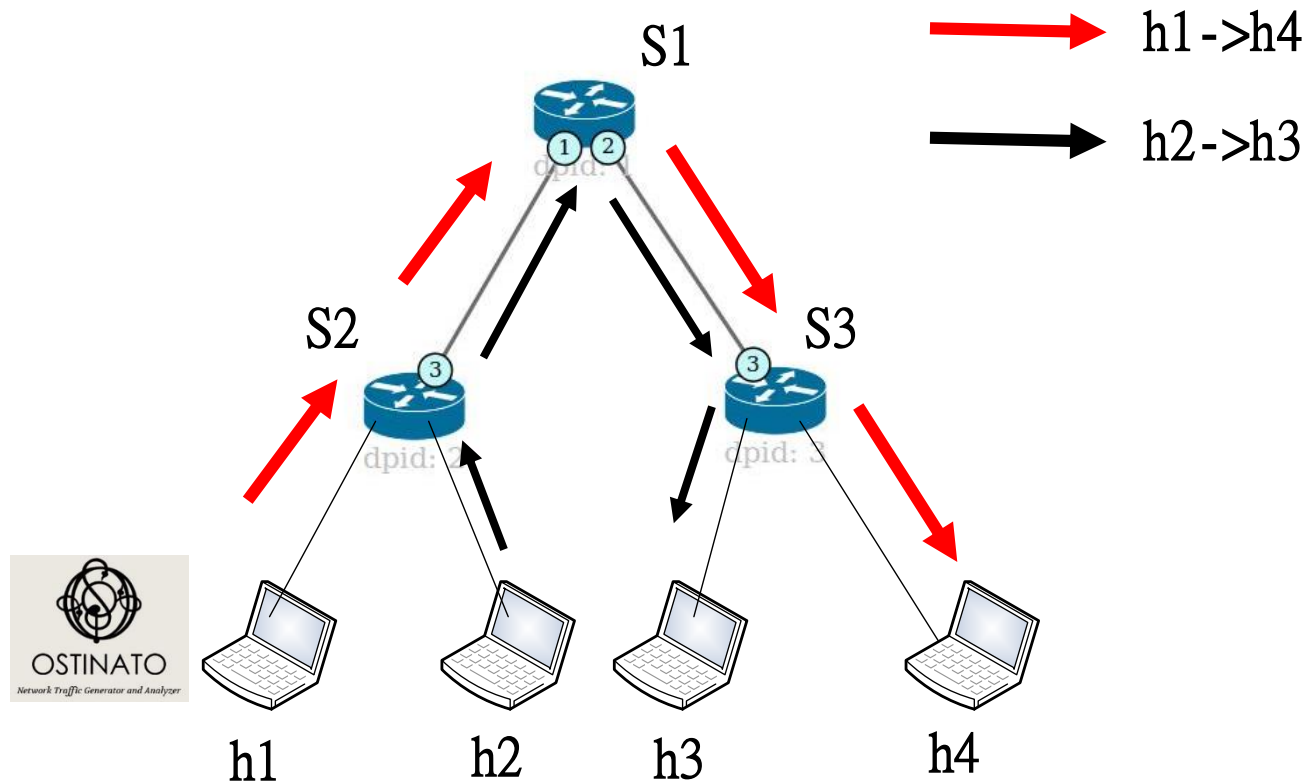
- ❖ 使用自訂拓撲建立以下拓撲檔案位置
- ❖ 指令: `cd ~/mininet/custom/`
- ❖ 指令: `vim multiple_interface.py` (自行完成)
- ❖ 指令: `sudo mn --custom mininet/custom/multiple_interface.py --topo=mytopo`





## Lab 3-2: Multiple interface

❖ 使用Ostinato從h1->h4、h2->h3發送封包





## Lab 3-2: Multiple interface

- ❖ Step 1: 在Mininet 中輸入指令
  - ❖ 指令: `xterm h1 h2 h3 h4`
- ❖ 於h1 h2 h3 h4 分別開啟Ostinato
  - ❖ 指令: `sudo ostinato`

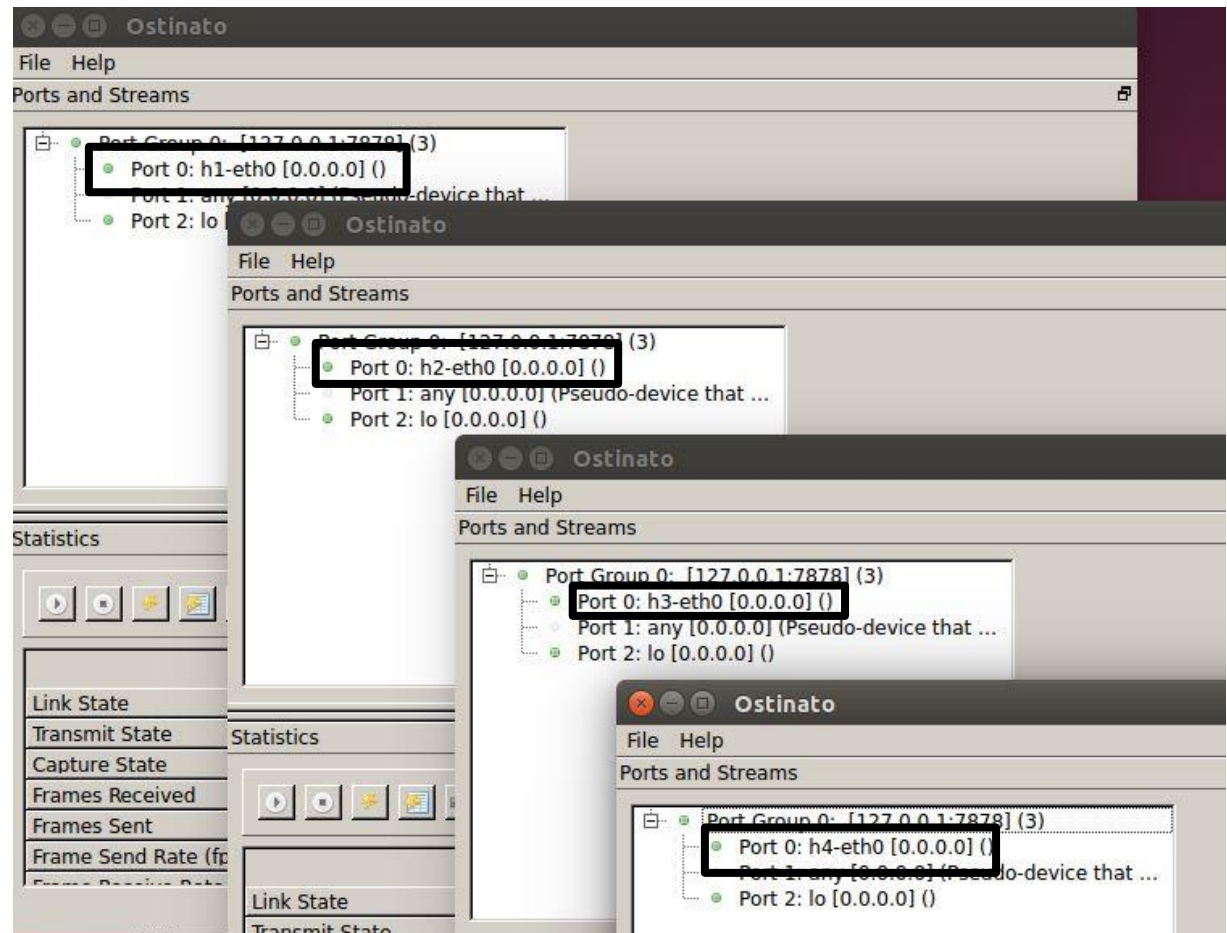
The screenshot shows a Mininet environment. On the left, a terminal window displays the command `xterm h1 h2 h3 h4` being executed in the `mininet>` prompt. On the right, four separate terminal windows are shown, each representing a host in the network: `Node: h1`, `Node: h2`, `Node: h3`, and `Node: h4`. Each of these host terminals shows the command `root@mininet-VirtualBox:~# sudo ostinato` being entered at the prompt.





## Lab 3-2: Multiple interface

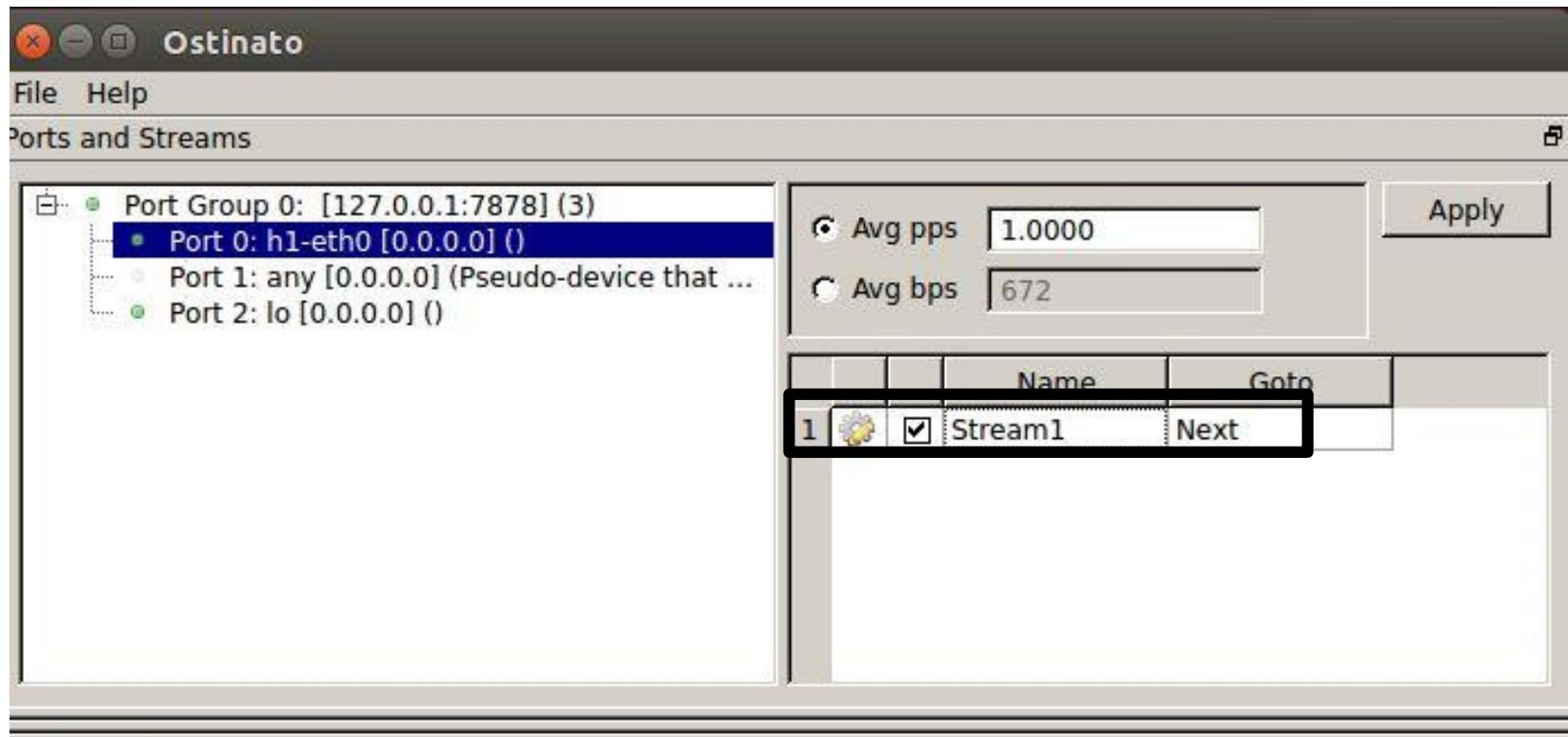
❖ 從Port 0可以看出分別為h1 h2 h3 h4





## Lab 3-2: Multiple interface

- ❖ Step 2: 使用 Lab 3-1 所建立之 pcap 檔案匯入 h1 的 Ostinato
  - ❖ 修改 Stream1 的 Destination MAC 與 Destination IP (下兩頁)
  - ❖ 封包來源為 h1, 目的為 h4





## Lab 3-2: Multiple interface

❖ 配置如下 Destination MAC改為04

Protocol Selection | Protocol Data | Stream Control | Packet View

Media Access Protocol

	Address	Mode	Count	Step
Destination	00 00 00 00 00 02	Fixed	16	1
Source	00 00 00 00 00 01	Fixed	16	1

Ethernet II

Internet Protocol ver 4

User Datagram Protocol

Payload Data



## Lab 3-2: Multiple interface

❖ 配置如下 Destination IP 改為 10.0.0.4

The image shows a screenshot of the 'Edit Stream' configuration window. The 'Protocol Data' tab is selected. The configuration is for a Media Access Protocol, Ethernet II, and Internet Protocol ver 4. The 'Destination' IP is set to 10.0.0.2, which is highlighted by a red box. The 'Mode' is set to 'Fixed'. The 'Count' is 16 and the 'Mask' is 255.255.255.0. The 'Source' IP is 10.0.0.1. Other settings include: Override Version (4), Override Header Length (5), TOS/DSCP (00), Override Length (46), Identification (04 D2), Fragment Offset (0), Don't Fragment (unchecked), More Fragments (unchecked), Time To Live (TTL) (127), Override Protocol (11), and Override Checksum (22 EB).

	Mode	Count	Mask
Source	Fixed	16	255.255.255.0
Destination	Fixed	16	255.255.255.0



# Lab 3-2: Multiple interface

❖ 按下OK回到主畫面

**3. 按下Apply**

**2. 重複發送**

**1. 選Port**

**4. 發送**

The screenshot shows the Ostinato network simulator interface. The 'Ports and Streams' section on the left lists 'Port Group 0: [127.0.0.1:7878] (3)' with three sub-ports: 'Port 0: h1-eth0 [0.0.0.0] ()', 'Port 1: any [0.0.0.0] (Pseudo-device that ...)', and 'Port 2: lo [0.0.0.0] ()'. The 'Port 0' is selected. On the right, the 'Avg pps' is set to 100.0000 and 'Avg bps' to 67,200. The 'Apply' button is highlighted. Below this, the 'Statistics' section shows a table with columns for 'Port 0-0', 'Port 0-1', and 'Port 0-2'. The 'Port 0-0' column is highlighted. The table shows various statistics like Link State, Transmit State, Capture State, Frames Received, Frames Sent, Frame Send Rate (fps), and Frame Receive Rate (fps). The 'Send' button (a play icon) is highlighted in the top left of the statistics section.

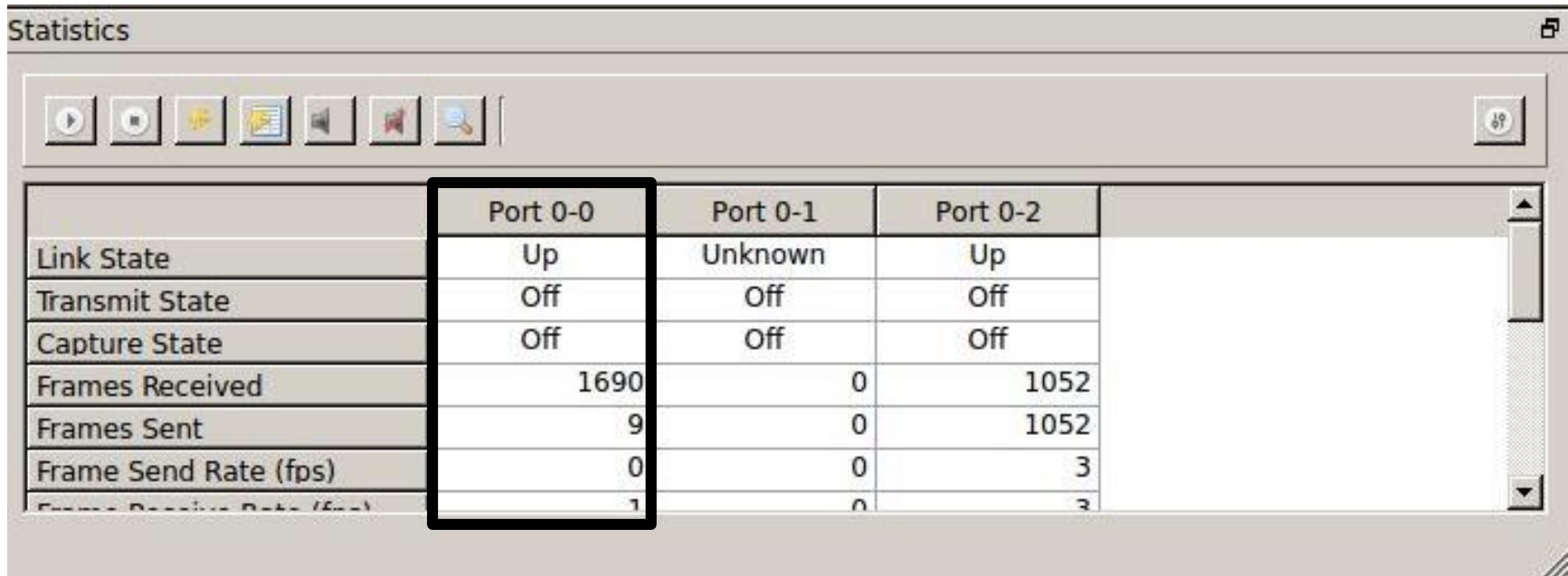
	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	226	0	759
Frames Sent	1399	0	759
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3



## Lab 3-2: Multiple interface

❖ 觀察h4的Statistics列表

❖ 確認Port 0-0中Frames Received欄位是否有增加

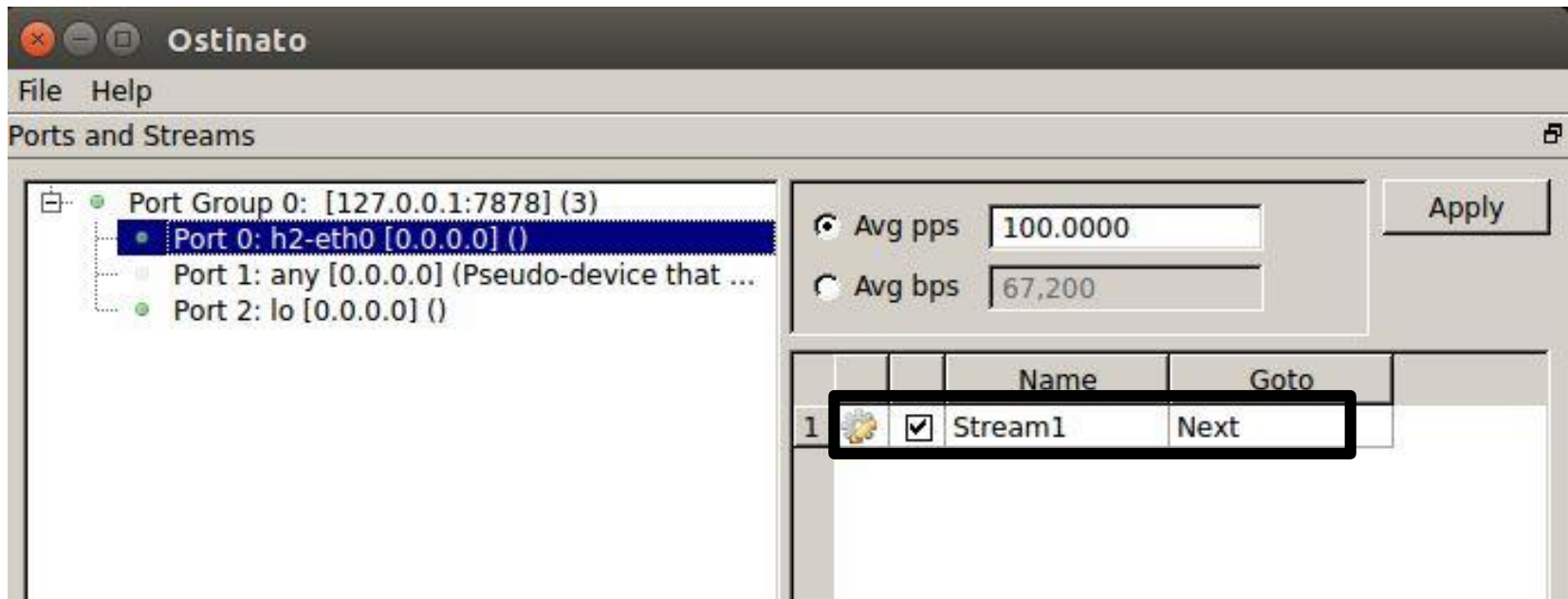


	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	1690	0	1052
Frames Sent	9	0	1052
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	1	0	3



## Lab 3-2: Multiple interface

- ❖ Step 3: 使用 Lab 3-1 所建立之 pcap 檔案匯入 h2 的 Ostinato
  - ❖ 修改 Stream1 的 Destination MAC 與 Destination IP (下兩頁)
  - ❖ 封包來源為 h2, 目的為 h3







## Lab 3-2: Multiple interface

- ❖ 配置如下
  - ❖ Source MAC改為02
  - ❖ Destination MAC改為03

Protocol Selection | Protocol Data | Stream Control | Packet View

Media Access Protocol

	Address	Mode	Count	Step
Destination	00 00 00 00 00 02	Fixed	16	1
Source	00 00 00 00 00 01	Fixed	16	1





## Lab 3-2: Multiple interface

❖ 封包配置如下

❖ Source IP 改為 02

❖ Destination IP 改為 03

Protocol Selection | Protocol Data | Stream Control | Packet View

Media Access Protocol

Ethernet II

Internet Protocol ver 4

☐ Override Version 4

☐ Override Header Length (x4) 5

TOS/DSCP 00

☐ Override Length 46

Identification 04 D2

Fragment Offset (x8) 0

☐ Don't Fragment ☐ More Fragments

Time To Live (TTL) 127

☐ Override Protocol 11

☐ Override Checksum 22 EB

		Mode	Count	Mask
Source	10.0.0.1	Fixed	16	255.255.255.0
Destination	10.0.0.2	Fixed	16	255.255.255.0



# Lab 3-2: Multiple interface

❖ 按下OK回到主畫面

**3. 按下Apply**

**2. 重複發送**

**1. 選Port**

**4. 發送**

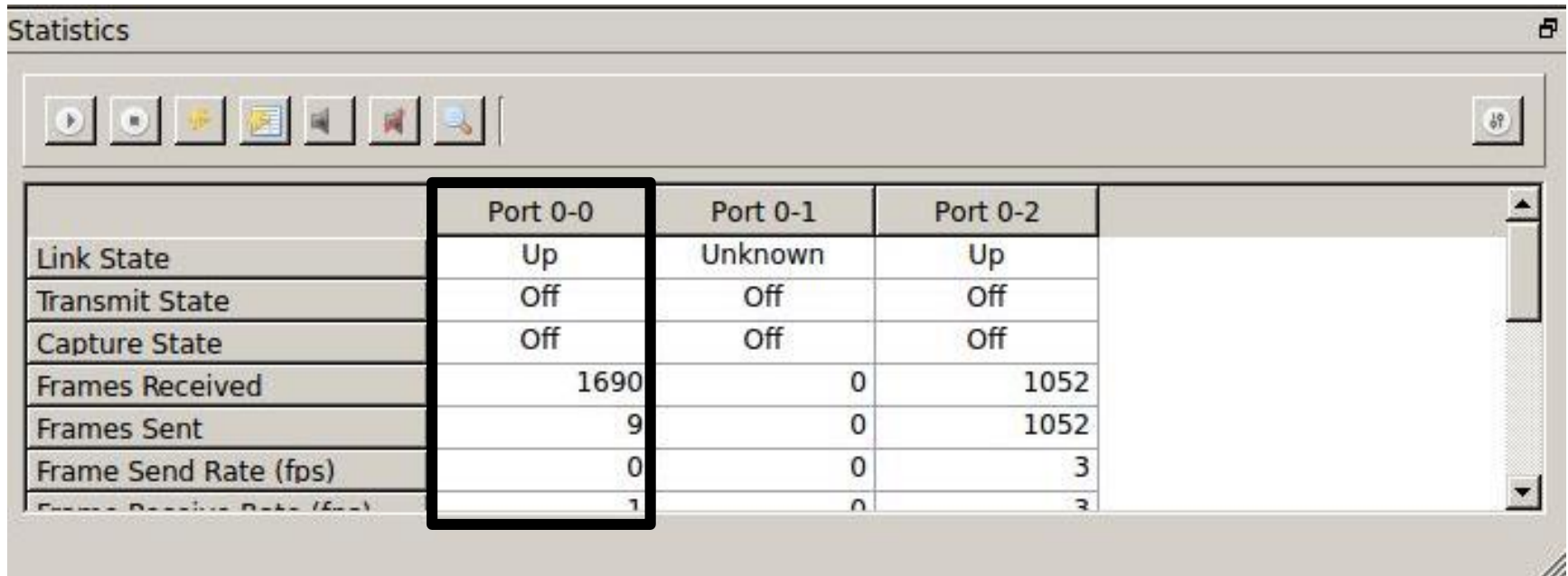
	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	123	0	563
Frames Sent	9	0	563
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	0	0	3



## Lab 3-2: Multiple interface

❖ 觀察h3的Statistics列表

❖ 確認Port 0-0中Frames Received欄位是否有增加



	Port 0-0	Port 0-1	Port 0-2
Link State	Up	Unknown	Up
Transmit State	Off	Off	Off
Capture State	Off	Off	Off
Frames Received	1690	0	1052
Frames Sent	9	0	1052
Frame Send Rate (fps)	0	0	3
Frame Receive Rate (fps)	1	0	3



# Thank you