《虚拟化与云计算实践》

（2024-2025 学年第 2 学期）

实验三

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1 使用 Python 3.8 创建虚拟环境并安装 Ryu

1. 安装系统依赖：

```
sudo apt update
sudo apt install -y build-essential python3.8-dev libffi-dev
   libssl-dev
```

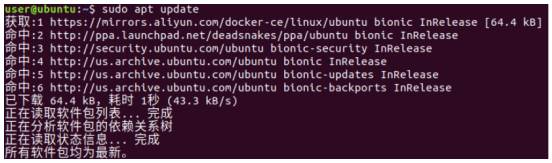

图 1: *
执行 sudo apt update

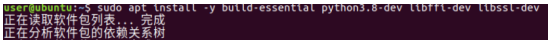

图 2: *
执行 apt install 安装依赖

2. 进入虚拟环境：

```
source ~/ryu_env/bin/activate
```

图 3: 激活虚拟环境的终端截图

3. 降级 setuptools 到兼容版本

```
pip install setuptools==59.5.0
```

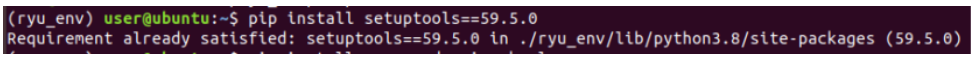

图 4: 降级 setuptools 到 59.5.0

4. 升级 pip 和 wheel

```
pip install --upgrade pip wheel
```

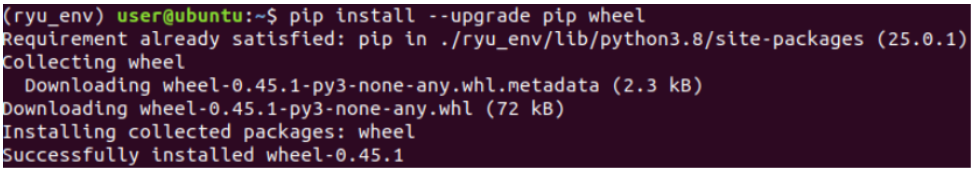

图 5: 升级 pip 与 wheel

5. 卸载当前 eventlet，安装兼容的 eventlet 版本

```
pip uninstall eventlet
pip install eventlet==0.30.2
```

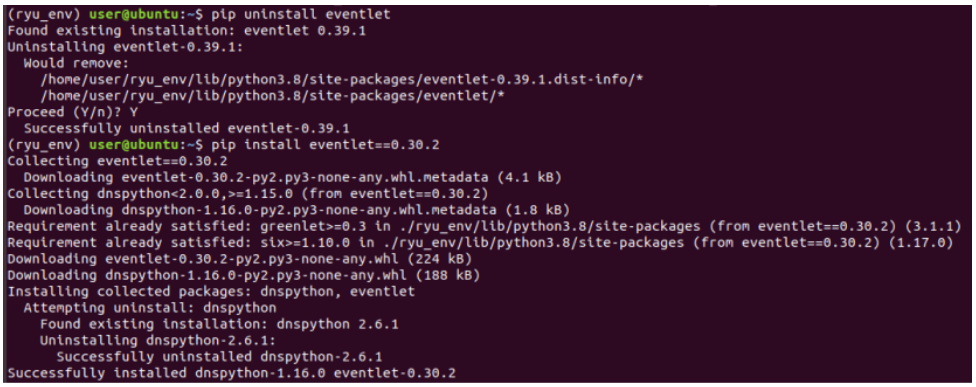

图 6: 卸载并安装兼容的 eventlet 版本

6. 安装 ryu

```
pip install ryu
```

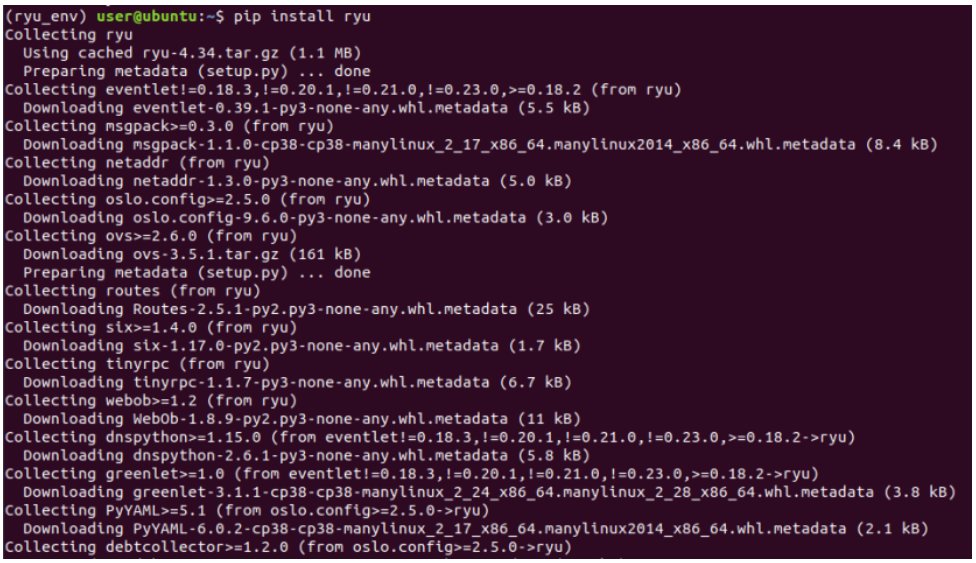

图 7: 安装 Ryu 控制器

7. 后续用完，退出虚拟环境：

```
deactivate
```

再次打开虚拟环境（ryu）：

```
source ~/ryu_env/bin/activate
```

2 安装 Postman

通过 Snap 安装：

```
sudo snap install postman
```

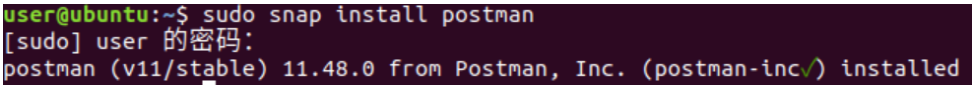

图 8: 通过 Snap 成功安装 Postman 的终端截图

安装后点击”Show Applications”，搜索”Postman” 启动应用。

3 运行控制器与拓扑

1. 启动 Ryu 控制器（终端 1）：

```
ryu-manager ryu.app.ofctl_rest
```

此应用提供了对交换机流表的 REST 控制接口，默认监听端口为 `127.0.0.1:8080`。

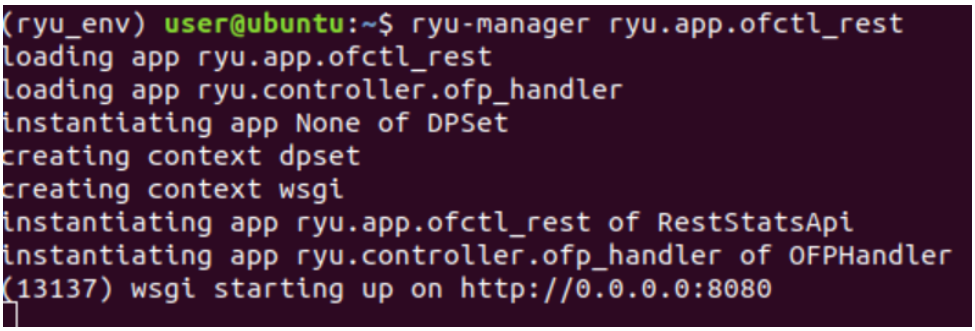

图 9: 启动 Ryu 控制器的终端截图

2. 启动 Mininet 拓扑（终端 2）：

```
sudo mn --controller=remote,ip=127.0.0.1,port=6653 --switch ovs,
   protocols=OpenFlow13
```

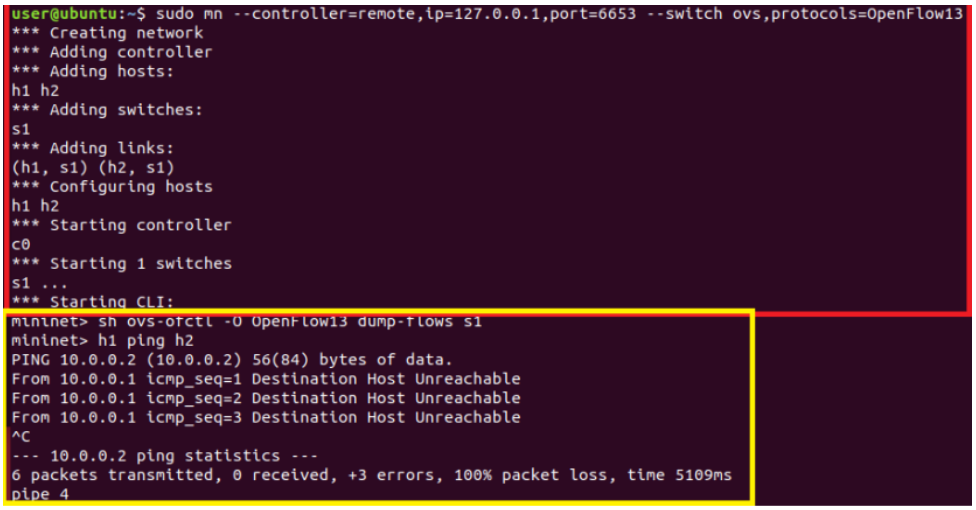

图 10: 启动 Mininet 网络拓扑的终端截图

此时尝试在 CLI 中执行：

```
h1 ping h2
```

会发现 h1 与 h2 无法通信。

4 使用 Postman 控制流表

1. 添加流表项

   打开 Postman，配置如下请求：

   Method：POST

   URL：`http://127.0.0.1:8080/stats/flowentry/add`

   Body → raw → JSON：

```
{
  "dpid": 1,
  "priority": 200,
  "match": {
    "in_port": 1
  },
  "actions": [
    {
      "type": "OUTPUT",
```

```
      "port": 2
    }
  ]
}
```

继续发送另一条规则（in_port 2 → out_port 1）：

```
{
  "dpid": 1,
  "priority": 200,
  "match": {
    "in_port": 2
  },
  "actions": [
    {
      "type": "OUTPUT",
      "port": 1
    }
  ]
}
```

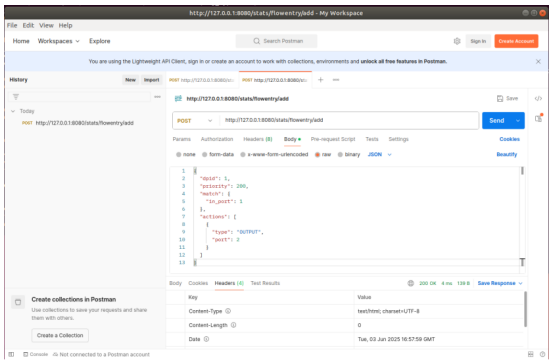

图 11: *
下发 in_port 1 → out_port 2

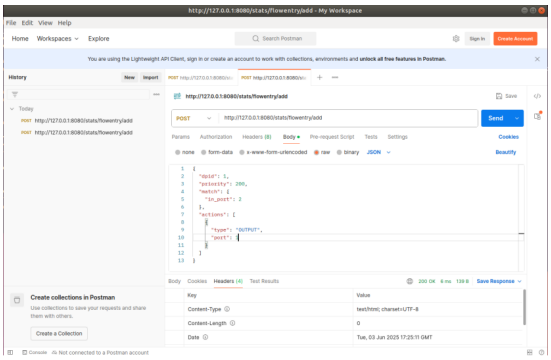

图 12: *
下发 in_port 2 → out_port 1

```
(ryu_env) user@ubuntu:~$ ryu-manager ryu.app.ofctl_rest
loading app ryu.app.ofctl_rest
loading app ryu.controller.ofp_handler
instantiating app None of DPSet
creating context dpset
creating context wsgi
instantiating app ryu.app.ofctl_rest of RestStatsApi
instantiating app ryu.controller.ofp_handler of OFPHandler
(13137) wsgi starting up on http://0.0.0.0:8080
(13137) accepted ('127.0.0.1', 57466)
127.0.0.1 - - [03/Jun/2025 10:25:11] "POST /stats/flowentry/add HTTP/1.1" 200 139 0.003313
127.0.0.1 - - [03/Jun/2025 10:25:28] "POST /stats/flowentry/add HTTP/1.1" 200 139 0.000458
```

图 13: *
Ryu 返回 200 OK

2. 再次测试通信

回到 Mininet CLI：

```
pingall
```

可以看到主机之间已能通信，说明流表生效。

```
user@ubuntu:~$ sudo mn --controller=remote,ip=127.0.0.1,port=6653 --switch ovs,protocols=OpenFlow13
*** 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> sh ovs-ofctl -O OpenFlow13 dump-flows s1
mininet> h1 ping h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable
From 10.0.0.1 icmp_seq=2 Destination Host Unreachable
From 10.0.0.1 icmp_seq=3 Destination Host Unreachable
^C
--- 10.0.0.2 ping statistics ---
6 packets transmitted, 0 received, +3 errors, 100% packet loss, time 5109ms
pipe 4
mininet> sh ovs-ofctl -O OpenFlow13 dump-flows s1
 cookie=0x0, duration=37.978s, table=0, n_packets=0, n_bytes=0, priority=200,in_port="s1-eth1" actions=o
utput:"s1-eth2"
 cookie=0x0, duration=20.718s, table=0, n_packets=0, n_bytes=0, priority=200,in_port="s1-eth2" actions=o
utput:"s1-eth1"
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet>
```

图 14: 成功配置流表后，主机通信正常

3. 查看当前流表

Method：GET

URL：`http://127.0.0.1:8080/stats/flow/1`

可以看到当前交换机中的所有流表项信息。

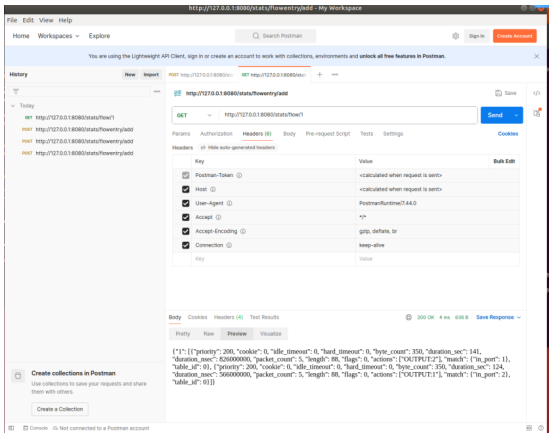

图 15: *
请求查看流表

```
(ryu_env) user@ubuntu:~$ ryu-manager ryu.app.ofctl_rest
loading app ryu.app.ofctl_rest
loading app ryu.controller.ofp_handler
instantiating app None of DPSet
creating context dpset
creating context wsgi
instantiating app ryu.app.ofctl_rest of RestStatsApi
instantiating app ryu.controller.ofp_handler of OFPHandler
(13137) wsgi starting up on http://0.0.0.0:8080
(13137) accepted ('127.0.0.1', 57466)
127.0.0.1 - - [03/Jun/2025 10:25:11] "POST /stats/flowentry/add HTTP/1.1" 200 139 0.003313
127.0.0.1 - - [03/Jun/2025 10:25:28] "POST /stats/flowentry/add HTTP/1.1" 200 139 0.000458
(13137) accepted ('127.0.0.1', 54826)
127.0.0.1 - - [03/Jun/2025 10:27:33] "GET /stats/flow/1 HTTP/1.1" 200 636 0.001134
(13137) accepted ('127.0.0.1', 32972)
127.0.0.1 - - [03/Jun/2025 10:28:56] "DELETE /stats/flowentry/clear/1 HTTP/1.1" 200 139 0.000380
```

图 16: *
Ryu 返回 200 OK

4. 清除流表

Method：DELETE

URL：`http://127.0.0.1:8080/stats/flowentry/clear/1`

流表已清空。

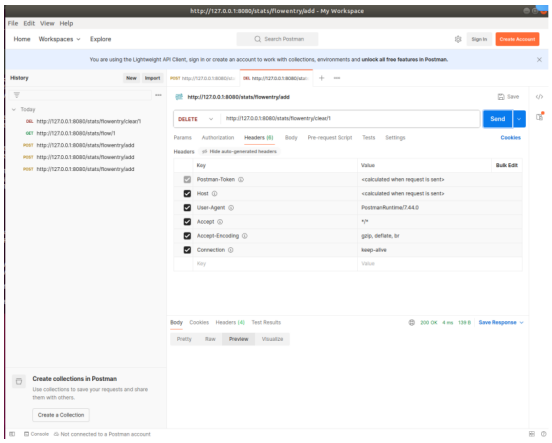

图 17: *
向交换机发送清除流表请求

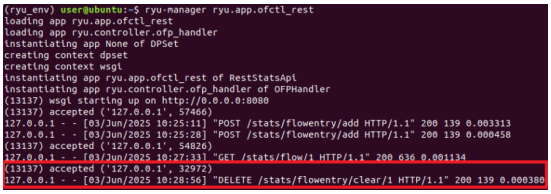

图 18: *
Ryu 返回 200 OK

发送后再次执行 `pingall`，发现通信中断。

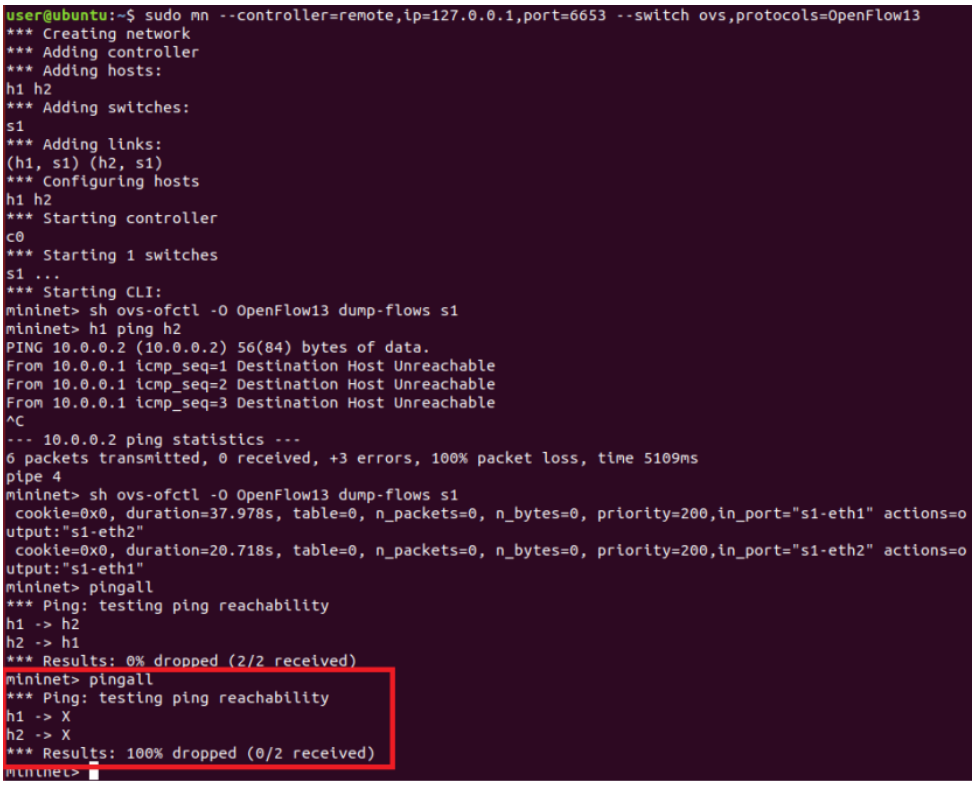

图 19: 通过 Postman 清空交换机流表后通信中断