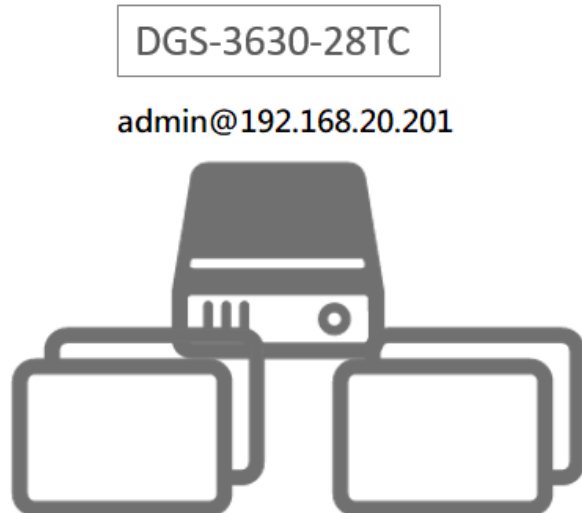


1. 測試內容：

測試 L2 Group Entry with type “SELECT” 能否正確安裝。

2. 測試環境架構：



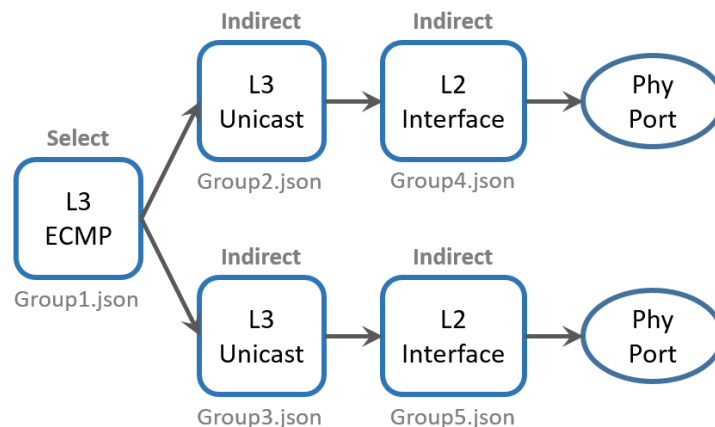
3. 測試環境組態：

- SDN controller: ONOS 1.15.1
- Switch: DGS-3630
- Apps:

```
onos> apps -a -s
* 27 org.onosproject.drivers          1.15.1.SNAPSHOT Default Drivers
* 44 org.onosproject.hostprovider     1.15.1.SNAPSHOT Host Location Provider
* 45 org.onosproject.lldpprovider     1.15.1.SNAPSHOT LLDP Link Provider
* 46 org.onosproject.optical-model    1.15.1.SNAPSHOT Optical Network Model
* 47 org.onosproject.openflow-base   1.15.1.SNAPSHOT OpenFlow Base Provider
* 48 org.onosproject.openflow         1.15.1.SNAPSHOT OpenFlow Provider Suite
* 60 org.onosproject.proxyarp         1.15.1.SNAPSHOT Proxy ARP/NDP
* 64 org.onosproject.mobility         1.15.1.SNAPSHOT Host Mobility
```

4. 使用之 JSON 文件：

- 根據 *Appendix - OpenFlow Object Details.pdf*，建立 SELECT group 需要使用下列五項 group entries：



- 此外，L3 Unicast 的部分也依據規格書的內容，額外加上 Decrement TTL 以及 Set-Fields。

L3 Unicast Group Entry Bucket Actions

Field	Description
Group	Must chain to a L2 Interface group entry. Required.
Decrement TTL	Decrement TTL. *Note: it not support checking invalid TTL.
Set-Field	Set ETH_DST, ETH_SRC and VLAN_ID fields. Required.

- L2 interface 1 (group4. json)

```
{
  "type": "INDIRECT",
  "appCookie": "0x10001",
  "groupId": "65537",
  "buckets": [
    {
      "treatment": {
        "instructions": [
          {
            "type": "OUTPUT",
            "port": "1"
          }
        ]
      }
    }
  ]
}
```

- L2 interface 2 (group5. json)

```
{
  "type": "INDIRECT",
  "appCookie": "0x10002",
  "groupId": "65538",
  "buckets": [
    {
      "treatment": {
        "instructions": [
          {
            "type": "OUTPUT",
            "port": "2"
          }
        ]
      }
    }
  ]
}
```

- L3 Unicast 1 (group2. json)

```
{
  "type": "INDIRECT",
  "appCookie": "0x20000001",
  "groupId": "536870913",
  "buckets": [
    {
      "treatment": {
        "instructions": [
          {
            "type": "GROUP",
            "groupId": "65537"
          },
          {
            "type": "L2MODIFICATION",
            "subtype": "VLAN_ID",
            "vlanId": 1
          }
        ]
      }
    }
  ]
}
```

```

    {
      "type": "L2MODIFICATION",
      "subtype": "ETH_SRC",
      "mac": "00:00:00:11:22:33"
    },
    {
      "type": "L2MODIFICATION",
      "subtype": "ETH_DST",
      "mac": "00:00:00:01:02:03"
    },
    {
      "type": "L3MODIFICATION",
      "subtype": "DEC_TTL"
    }
  ]
}
]
}

```

■ L3 Unicast 2 (group3. json)

```

{
  "type": "INDIRECT",
  "appCookie": "0x20000002",
  "groupId": "536870914",
  "buckets": [
    {
      "treatment": {
        "instructions": [
          {
            "type": "GROUP",
            "groupId": "65538"
          },
          {
            "type": "L2MODIFICATION",
            "subtype": "VLAN_ID",
            "vlanId": 1
          },
          {
            "type": "L2MODIFICATION",
            "subtype": "ETH_SRC",
            "mac": "00:00:00:11:22:33"
          },
          {
            "type": "L2MODIFICATION",
            "subtype": "ETH_DST",
            "mac": "00:00:00:01:02:03"
          },
          {
            "type": "L3MODIFICATION",
            "subtype": "DEC_TTL"
          }
        ]
      }
    }
  ]
}

```

■ L3 ECMP (group1. json)

```

{
  "type": "SELECT",
  "appCookie": "0x70000001",
  "groupId": "1879048193",
  "buckets": [
    {
      "treatment": {
        "instructions": [

```

```

        {
          "type": "GROUP",
          "groupId": "536870913"
        }
      ],
    },
    "weight": "1"
  },
  {
    "treatment": {
      "instructions": [
        {
          "type": "GROUP",
          "groupId": "536870914"
        }
      ]
    },
    "weight": "1"
  }
]
}

```

■ Flow rule (flow.json)

```

{
  "flows": [
    {
      "priority": 40001,
      "timeout": 0,
      "isPermanent": true,
      "deviceId": "of:000078321bdf7600",
      "selector": {
        "criteria": [
          {
            "type": "IN_PORT",
            "port": 1
          },
          {
            "type": "ETH_TYPE",
            "ethType": "0x0800"
          },
          {
            "type": "IPV4_DST",
            "ip": "192.168.202.2/24"
          }
        ]
      },
      "treatment": {
        "instructions": [
          {
            "type": "GROUP",
            "groupId": "1879048193"
          }
        ]
      }
    }
  ]
}

```

5. 測試步驟：

- 使用以下指令倒序安裝 group rules：

```
for i in {5..1}; do curl -user onos:rocks -X POST -H "Content-type: application/json" -d @group$i.json http://localhost:8181/onos/v1/groups/of:000078321bdf7600; done
```

- 再安裝 flow rule：

```
curl --user onos:rocks -X POST -H "Content-type: application/json" -d @flow.json http://localhost:8181/onos/v1/flows
```

- 查看 ONOS GUI Group view

GROUP ID	APP ID	STATE	TYPE	PACKETS	BYTES
0x10001	org.onosproject.rest	ADDED	Indirect	0	0
0x10002	org.onosproject.rest	ADDED	Indirect	0	0
0x20000001	org.onosproject.rest	ADDED	Indirect	0	0
0x20000002	org.onosproject.rest	ADDED	Indirect	0	0
0x70000001	org.onosproject.rest	ADDED	Select	0	0

- 透過 switch CLI 查看 groups

```
Switch#show openflow group-desc

===
GroupId=65537, Hex=0x00010001 (L2 Interface, ChainId=1, Port=1)
Type=Indirect, Reference count=1
Create time=2015-08-16 13:55:38
Bucket=1: Output=1

===
GroupId=65538, Hex=0x00010002 (L2 Interface, ChainId=1, Port=2)
Type=Indirect, Reference count=1
Create time=2015-08-16 13:55:38
Bucket=1: Output=2

===
GroupId=536870913, Hex=0x20000001 (L3 Unicast, Id=1)
Type=Indirect, Reference count=1
Create time=2015-08-16 14:00:30
Bucket=1: Group=65537, Dec TTL, SrcMac=00-00-00-11-22-33, DstMac=00-00-00-01-02-03, VlanId=(1|present)

===
GroupId=536870914, Hex=0x20000002 (L3 Unicast, Id=2)
Type=Indirect, Reference count=1
Create time=2015-08-16 13:59:36
Bucket=1: Group=65538, Dec TTL, SrcMac=00-00-00-11-22-33, DstMac=00-00-00-01-02-03, VlanId=(1|present)

===
GroupId=1879048193, Hex=0x70000001 (L3 ECMP, Id=1)
Type=Select, Reference count=0
Create time=2015-08-16 14:00:30
Bucket=1: Group=536870913
Bucket=2: Group=536870914

Total:5
```

可以發現五條 group entries 都成功安裝。

- 查看 ONOS GUI Flow view

STATE	PACKETS	DURATION	FLOW PRIORITY	TABLE NAME	SELECTOR	TREATMENT	APP NAME
Added	0	23,471	40000	0	ETH_TYPE:dddp	imm[OUTPUT:CONTROLLER], cleared:true	*core
Added	0	23,471	40000	0	ETH_TYPE:lldp	imm[OUTPUT:CONTROLLER], cleared:true	*core
Added	0	23,470	40000	0	ETH_TYPE:arp	imm[OUTPUT:CONTROLLER], cleared:true	*core
Added	0	8	40001	0	IN_PORT:1, ETH_TYPE:ipv4, IPV4_DST:192.168.202.0/24	def[GROUP:0x70000001], cleared:false	*rest

- 透過 switch CLI 查看 flows (僅擷取後三條)

```
===  
Match Fields:  
  ETH_TYPE=0x88CC  
Priority=40000  
Cookie=0x00010000948A7777  
Idle timeout=0, Hard timeout=0  
Table=0, Packets=0, Bytes=0  
Create time=2015-09-13 17:53:07  
Instructions:  
  Apply-Actions: Output=CONTROLLER(Reserved)  
  Clear-Actions  
  
===  
Match Fields:  
  ETH_TYPE=0x8942  
Priority=40000  
Cookie=0x00010000326F1D0A  
Idle timeout=0, Hard timeout=0  
Table=0, Packets=0, Bytes=0  
Create time=2015-09-13 17:53:07  
Instructions:  
  Apply-Actions: Output=CONTROLLER(Reserved)  
  Clear-Actions  
  
===  
Match Fields:  
  IN_PORT=1  
  ETH_TYPE=0x0800  
  IPV4_DST/Mask=192.168.202.0/255.255.255.0  
Priority=40001  
Cookie=0x00BC0000913B006A  
Idle timeout=0, Hard timeout=0  
Table=0, Packets=0, Bytes=0  
Create time=2015-09-14 00:24:10  
Instructions:  
  Write-Actions: Group=1879048193  
  
Total:4
```

可以發現指向 SELECT group 的 flow rule 也順利安裝。

6. 測試結果：

L2 Group Entry with type “SELECT” 能夠正確安裝。