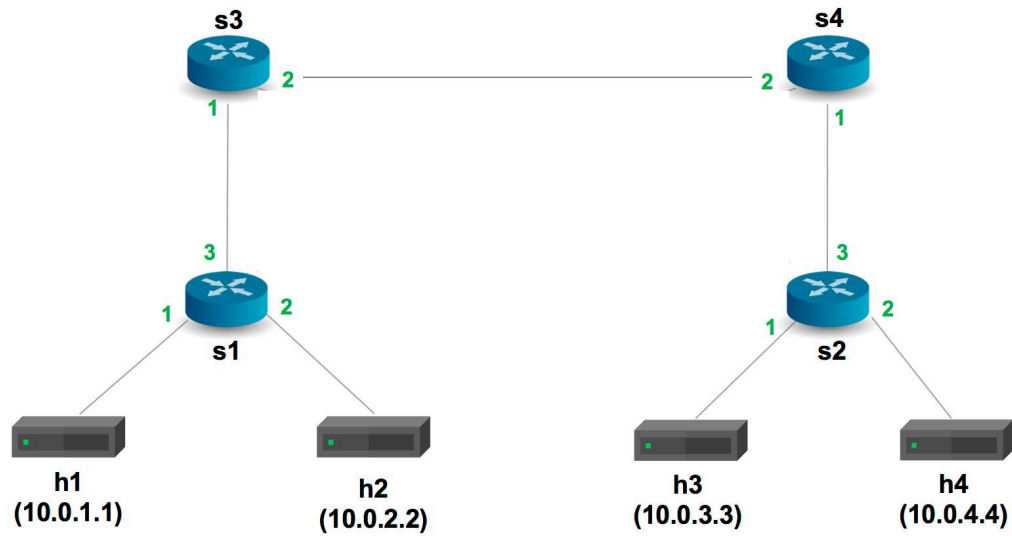
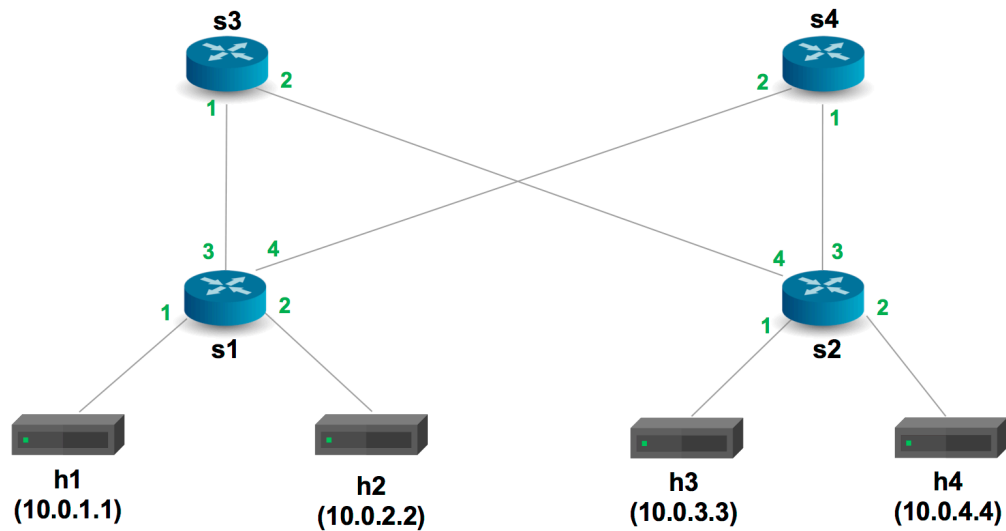


Assignment 1: Basic Forwarding in a Linear Topology

Aim: To implement a linear topology between switches S1, S2, S3 and S4 as follows:



The original topology provided is a pod topology, as follows:



Changes made:

We need to change 2 things:

1. Topology definition: This states the physical connections between the nodes.
2. Table entries: Runtime table entries populated by the control plane need to also be updated, to actually send the packets at runtime

1. Topology Definition

In the `topology.json` we need to

1. Declare new link between `s3-port2` and `s4-port2`
2. Delete the links between: `s1-port4` and `s4-port2`, `s2-port4` and `s3-port2`

`topology.json` (updated section only)

```
},
"links": [
  [
    "h1",
    "s1-p1"
  ],
  [
    "h2",
    "s1-p2"
  ],
  [
    "s1-p3",
    "s3-p1"
  ],
  [
    "h3",
    "s2-p1"
  ],
  [
    "h4",
    "s2-p2"
  ],
  [
    "s2-p3",
    "s4-p1"
  ],
  [
    "s3-p2",
    "s4-p2"
  ]
]
```

2. Table Entries

We need to update the table entries of each of the switches to actually enable the packet forwarding

1. S1

Prev			New		
dst_IP	dst_mac	port	dst_IP	dst_mac	port
10.0.1.1	08:00:00:00:01:11	1	10.0.1.1	08:00:00:00:01:11	1
10.0.2.2	08:00:00:00:02:22	2	10.0.2.2	08:00:00:00:02:22	2
10.0.3.3	08:00:00:00:03:00	3	10.0.3.3	08:00:00:00:03:00	3
10.0.4.4	08:00:00:00:04:00	4	10.0.4.4	08:00:00:00:03:00	3

2. S2

Prev			New		
dst_IP	dst_mac	port	dst_IP	dst_mac	port
10.0.1.1	08:00:00:00:03:00	4	10.0.1.1	08:00:00:00:04:00	3
10.0.2.2	08:00:00:00:04:00	3	10.0.2.2	08:00:00:00:04:00	3
10.0.3.3	08:00:00:00:03:33	1	10.0.3.3	08:00:00:00:03:33	1
10.0.4.4	08:00:00:00:04:44	2	10.0.4.4	08:00:00:00:04:44	2

3. S3

Prev			New		
dst_IP	dst_mac	port	dst_IP	dst_mac	port
10.0.1.1	08:00:00:00:01:00	1	10.0.1.1	08:00:00:00:01:00	1
10.0.2.2	08:00:00:00:01:00	1	10.0.2.2	08:00:00:00:01:00	1
10.0.3.3	08:00:00:00:02:00	2	10.0.3.3	08:00:00:00:04:00	2
10.0.4.4	08:00:00:00:02:00	2	10.0.4.4	08:00:00:00:04:00	2

4. S4

Prev			New		
dst_IP	dst_mac	port	dst_IP	dst_mac	port
10.0.1.1	08:00:00:00:01:00	2	10.0.1.1	08:00:00:00:03:00	2
10.0.2.2	08:00:00:00:01:00	2	10.0.2.2	08:00:00:00:03:00	2
10.0.3.3	08:00:00:00:02:00	1	10.0.3.3	08:00:00:00:02:00	1
10.0.4.4	08:00:00:00:02:00	1	10.0.4.4	08:00:00:00:02:00	1

The updated files are as follows:

s1-runtime.json

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$ cat s1-runtime.json
{
  "target": "bnv2",
  "p4info": "build/basic.p4.p4info.txt",
  "bmv2_json": "build/basic.json",
  "table_entries": [
    {
      "table": "MyIngress.ipv4_lpm",
      "default_action": true,
      "action_name": "MyIngress.drop",
      "action_params": { }
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": ["10.0.1.1", 32]
      },
      "action_name": "MyIngress.ipv4_forward",
      "action_params": {
        "dstAddr": "08:00:00:00:01:11",
        "port": 1
      }
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": ["10.0.2.2", 32]
      },
      "action_name": "MyIngress.ipv4_forward",
      "action_params": {
        "dstAddr": "08:00:00:00:02:22",
        "port": 2
      }
    }
  ]
}
```

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": ["10.0.2.2", 32]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:02:22",
    "port": 2
  }
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": ["10.0.3.3", 32]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:03:00",
    "port": 3
  }
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": ["10.0.4.4", 32]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:03:00",
    "port": 3
  }
}
}
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$
```

s2-runtime.json

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$ cat s2-runtime.json
{
  "target": "bmv2",
  "p4info": "build/basic.p4.p4info.txt",
  "bmv2_json": "build/basic.json",
  "table_entries": [
    {
      "table": "MyIngress.ipv4_lpm",
      "default_action": true,
      "action_name": "MyIngress.drop",
      "action_params": {}
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.1.1",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",
      "action_params": {
        "dstAddr": "08:00:00:00:04:00",
        "port": 3
      }
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.2.2",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",

```

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
{
  "action_params": {
    "dstAddr": "08:00:00:04:00",
    "port": 3
  },
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.3.3",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:03:33",
    "port": 1
  },
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.4.4",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:04:44",
    "port": 2
  },
},
}
}
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$
```

s3-runtime.json

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
}
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$ cat s3-runtime.json
{
  "target": "bmw2",
  "p4info": "build/basic.p4.p4info.txt",
  "bmw2_json": "build/basic.json",
  "table_entries": [
    {
      "table": "MyIngress.ipv4_lpm",
      "default_action": true,
      "action_name": "MyIngress.drop",
      "action_params": {}
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.1.1",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",
      "action_params": {
        "dstAddr": "08:00:00:01:00",
        "port": 1
      },
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.2.2",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",
    },
  ]
}
```

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help

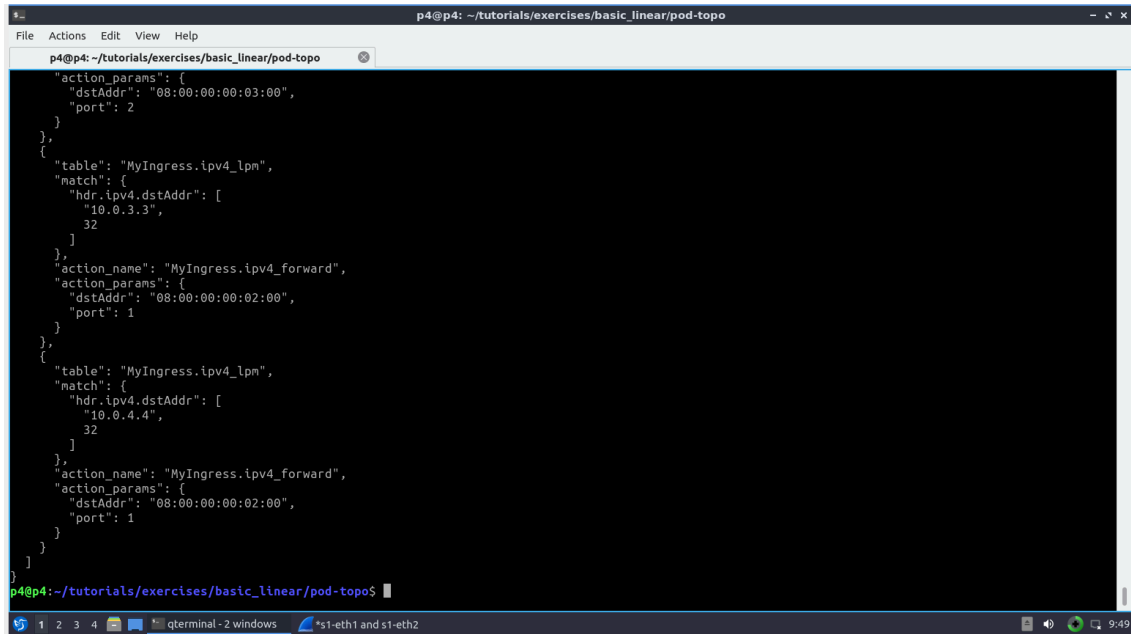
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
{
  "action_params": {
    "dstAddr": "08:00:00:00:01:00",
    "port": 1
  },
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.3.3",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:04:00",
    "port": 2
  },
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.4.4",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:04:00",
    "port": 2
  },
},
}
}

p4@p4:~/tutorials/exercises/basic_linear/pod-topo$
```

s4-runtime.json

```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
File Actions Edit View Help

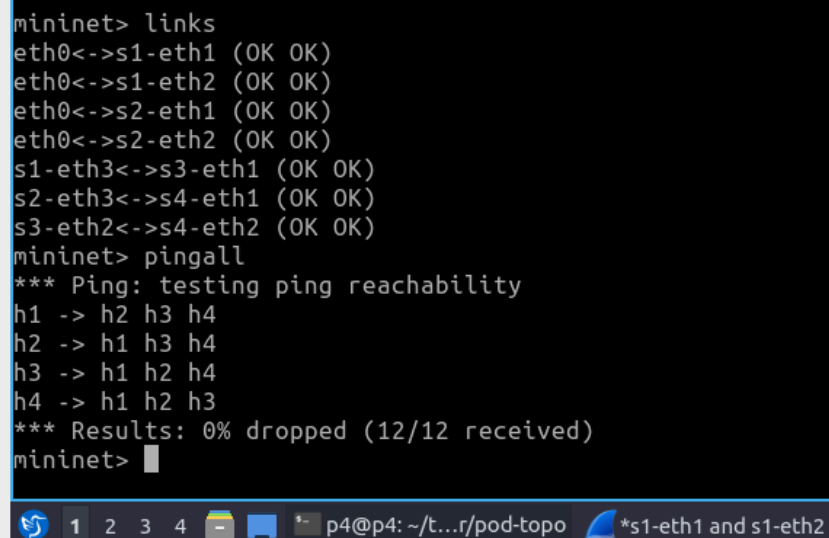
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
}
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$ cat s4-runtime.json
{
  "target": "bmv2",
  "p4info": "build/basic.p4.p4info.txt",
  "bmv2_json": "build/basic.json",
  "table_entries": [
    {
      "table": "MyIngress.ipv4_lpm",
      "default_action": true,
      "action_name": "MyIngress.drop",
      "action_params": {}
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.1.1",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",
      "action_params": {
        "dstAddr": "08:00:00:00:03:00",
        "port": 2
      },
    },
    {
      "table": "MyIngress.ipv4_lpm",
      "match": {
        "hdr.ipv4.dstAddr": [
          "10.0.2.2",
          32
        ]
      },
      "action_name": "MyIngress.ipv4_forward",
    },
  ]
}
```



```
p4@p4: ~/tutorials/exercises/basic_linear/pod-topo
"action_params": {
  "dstAddr": "08:00:00:00:03:00",
  "port": 2
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.3.3",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:02:00",
    "port": 1
  }
},
{
  "table": "MyIngress.ipv4_lpm",
  "match": {
    "hdr.ipv4.dstAddr": [
      "10.0.4.4",
      32
    ]
  },
  "action_name": "MyIngress.ipv4_forward",
  "action_params": {
    "dstAddr": "08:00:00:00:02:00",
    "port": 1
  }
}
}
}
p4@p4:~/tutorials/exercises/basic_linear/pod-topo$
```

Running the simulation

We can see that the links have changed and all hosts can ping each other



```
mininet> links
eth0<->s1-eth1 (OK OK)
eth0<->s1-eth2 (OK OK)
eth0<->s2-eth1 (OK OK)
eth0<->s2-eth2 (OK OK)
s1-eth3<->s3-eth1 (OK OK)
s2-eth3<->s4-eth1 (OK OK)
s3-eth2<->s4-eth2 (OK OK)
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3 h4
h2 -> h1 h3 h4
h3 -> h1 h2 h4
h4 -> h1 h2 h3
*** Results: 0% dropped (12/12 received)
mininet>
```