Revisiting Emulated Network Orchestration and Visualisation

James Madeley
Supervisors Iain Phillips & Posco Tso
Email j.i.madeley@lboro.ac.uk

Loughborough University

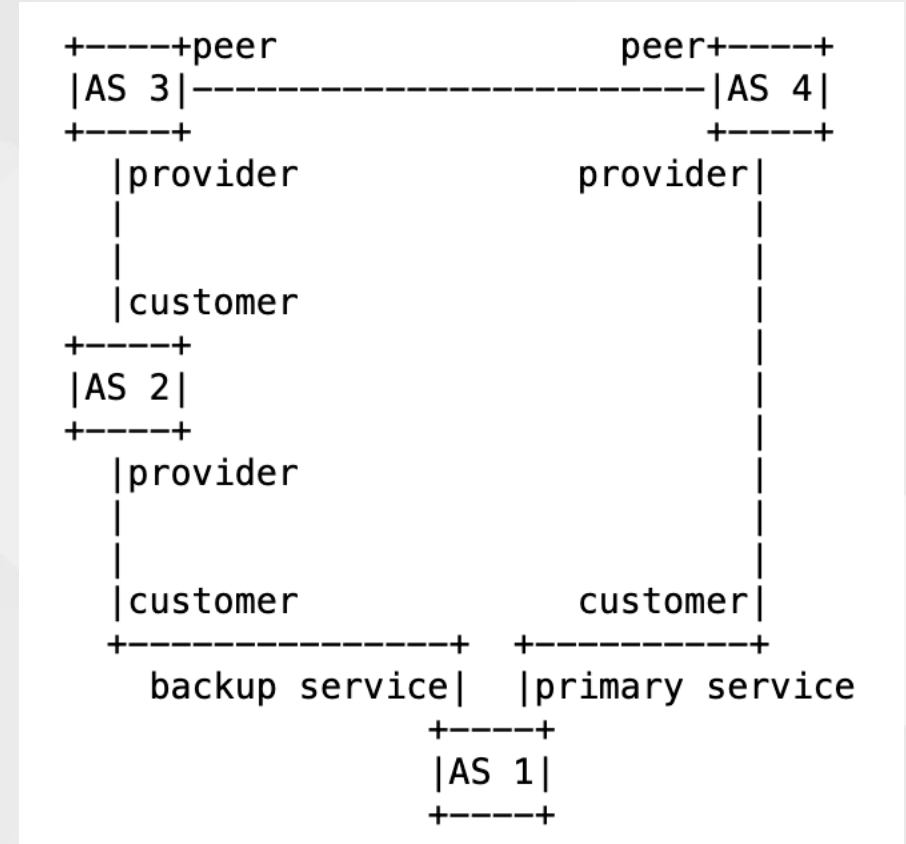#InspiringWinners since 1909

Overview

- Why Revisit?
- BGP Wedgie Demonstration
- Config Generation
- Visualisation
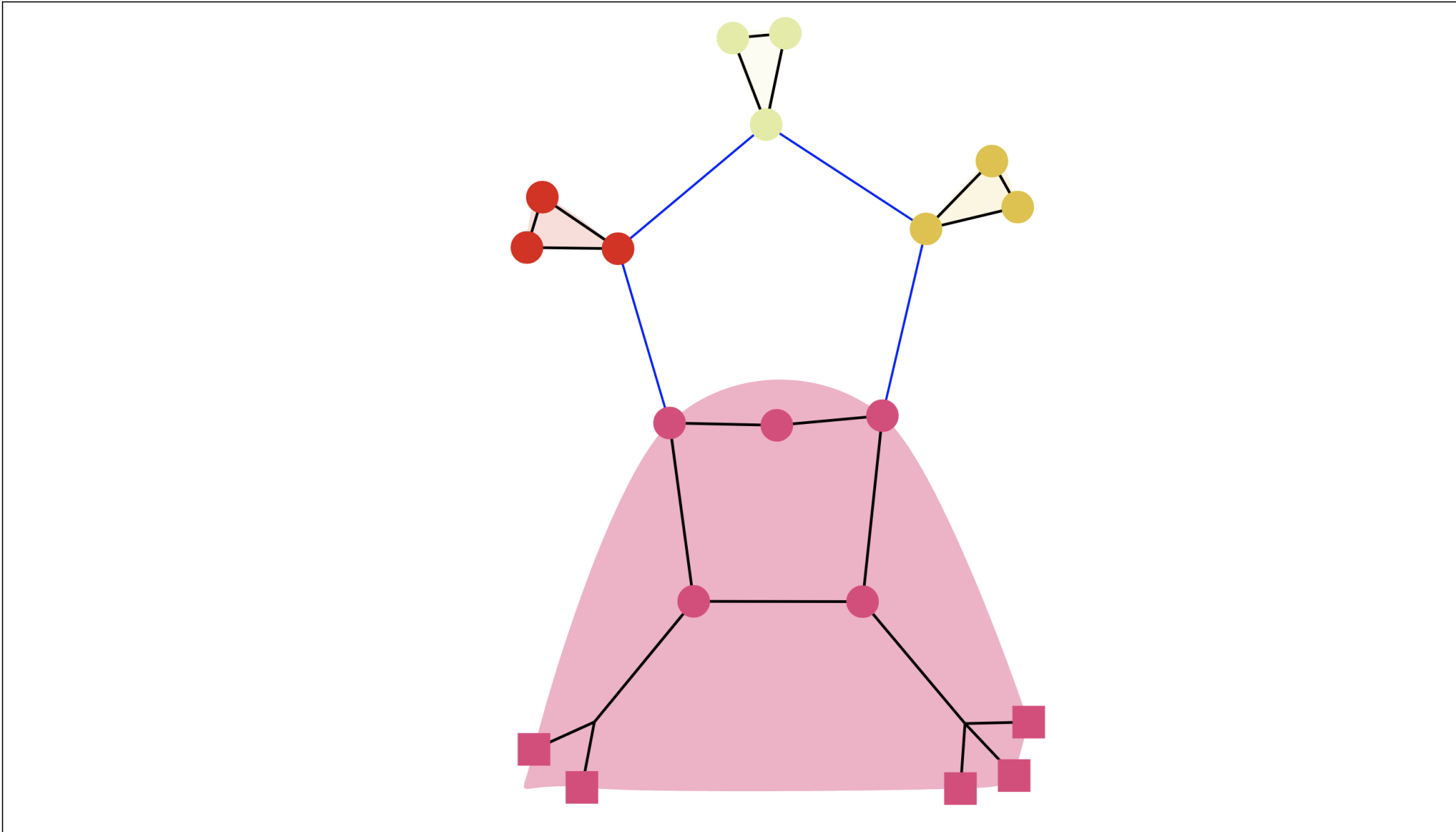- Future Research

Revisiting

- Cisco Modelling Labs, AutoNetkit, etc.
- Netkit -> Kathara
- Containers -> Docker
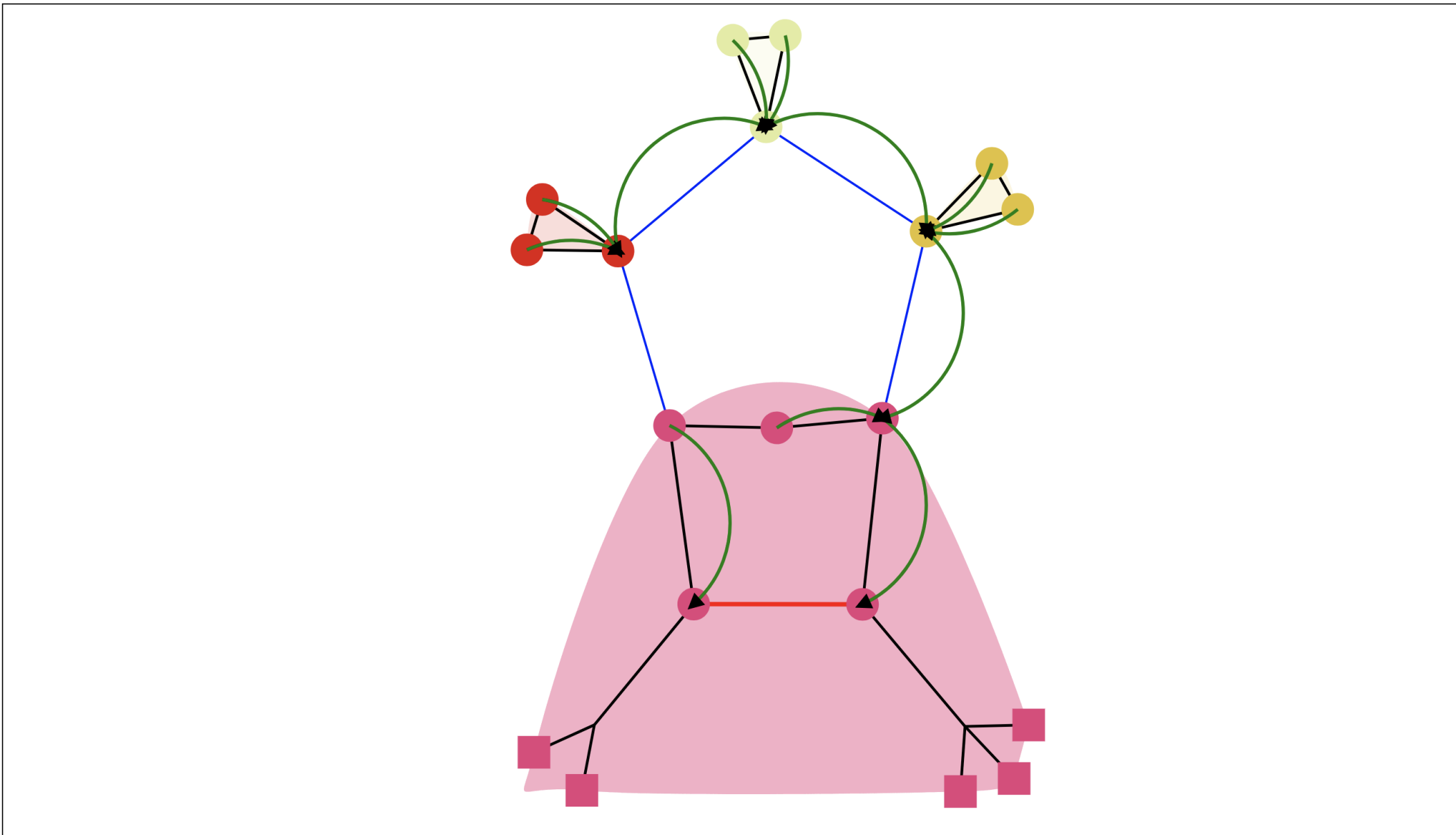- Megalos for large-scale experiments
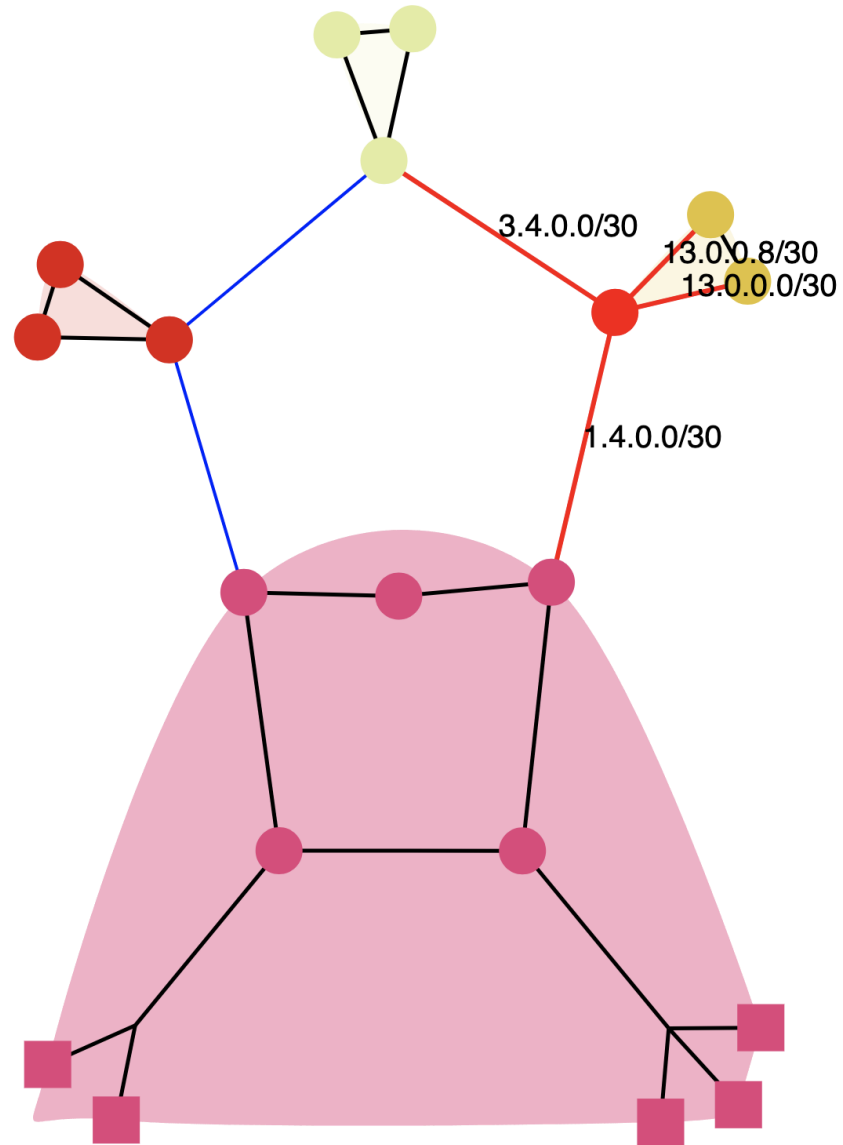
BGP Wedgie Demonstration

- Demonstrates non-determinism in stable BGP forwarding states
- RFC 4624

```
+----+peer              peer+----+
|AS 3|--------------------|AS 4|
+----+                    +----+
  |provider         provider|
  |                         |
  |                         |
  |customer                 |
+----+                      |
|AS 2|                      |
+----+                      |
  |provider                 |
  |                         |
  |                         |
  |customer         customer|
  +---------------+    +----------+
   backup service|    |primary service
                +----+
                |AS 1|
                +----+
```

Griffin & Huston at https://www.rfc-editor.org/rfc/rfc4264.html, from RFC 4264

3.4.0.0/30

13.0.0.8/30
13.0.0.0/30

1.4.0.0/30

Node: as4dev1 | Prefix | Steal

Prefix - State: 1.4.0.0/30 - down ⌄ | Switch State | eth2 on as4dev1 down

Config Generation

- Built in Python

- Minimal input (JSON or GML)

- Automatic IP allocation

- BGP policy completion

- Jinja Templates

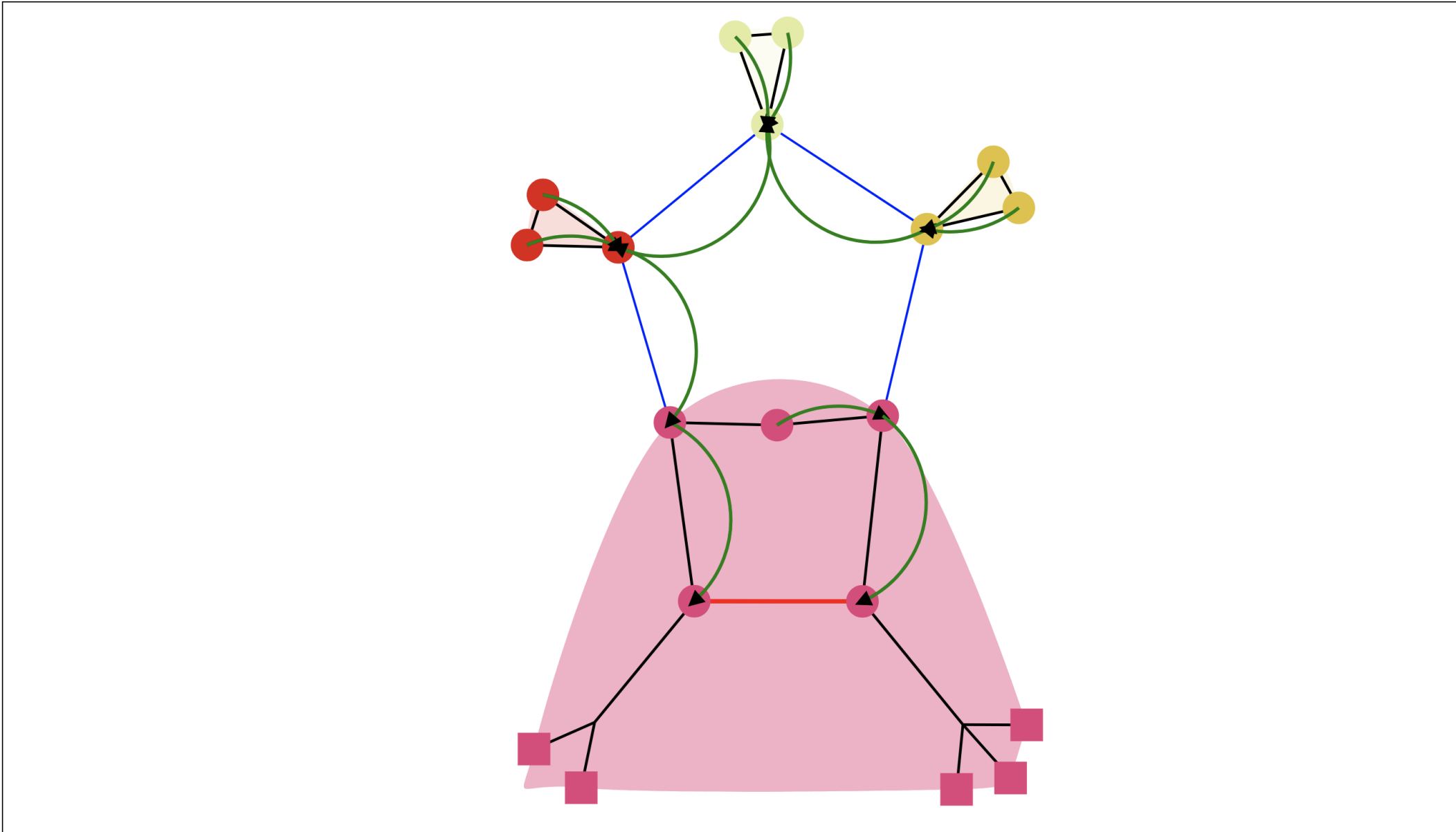| Number of Devices	Time to Generate
250	15s
850	45s
1550	83s

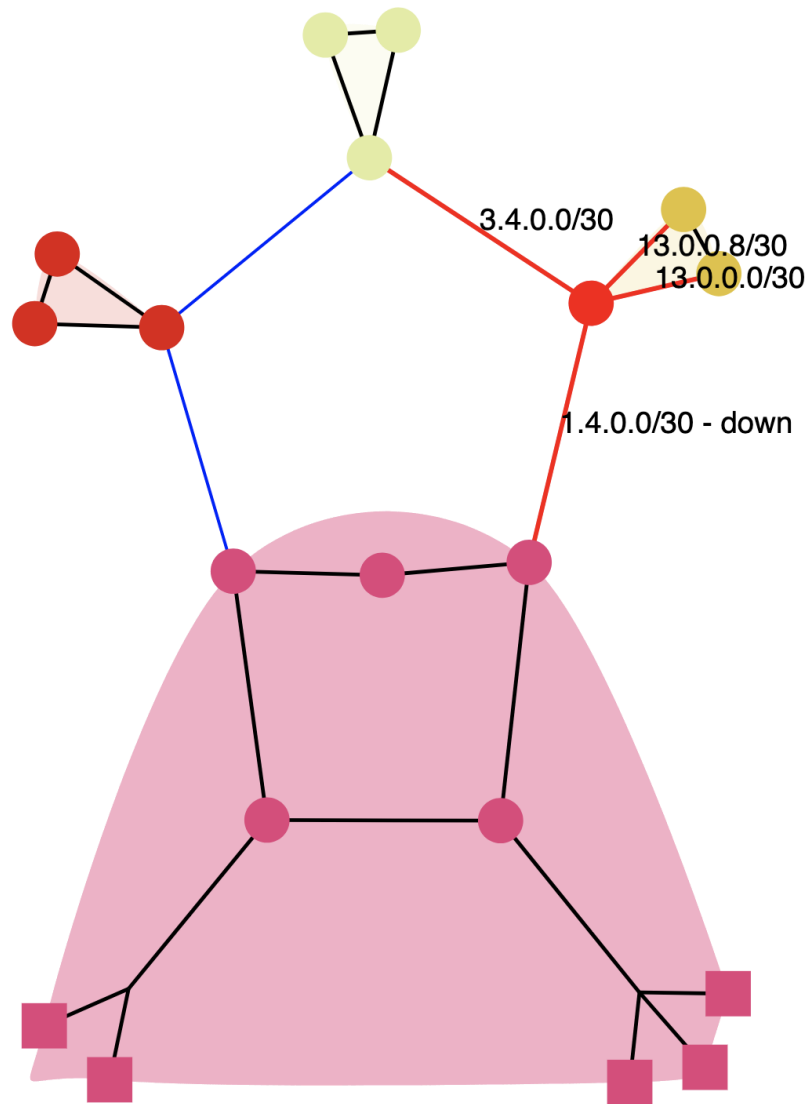(MacBook Pro, 2.3 GHz Quad-Core i7, 16 GB RAM)

Config Generation Input

```json
consolidation > files > inputJSONs > {} wedgiePeeringLab2.json > [ ] peerings
1    {
2        "defaults":{"routers": 3, "topology":"ring", "igp":"isis",
         "nameLink":"", "nameFormat":"dev", "extProp": "ibgp", "pullData":
         true, "hostOS":"kali-default"},
3        "networks":
4        [
5            {
6                "name":"as1",
7                "routers": 5,
8                "ext":[{"network":"as2"}, {"network":"as4", "device":"dev3"}
                 ]
9            },
10           {
11               "name":"as2",
12               "ext":[{"network":"as3"}]
13           },
14           {
15               "name":"as3",
16               "ext":[{"network":"as4"}]
17           },
18           {
19               "name":"as4"
20           }
21       ],
```

```json
22       "peerings":
23       [
24           {
25               "name": "as1",
26               "providers":["as2","as4"],
27               "backups":["as2"]
28           },
29           {
30               "name": "as3",
31               "peers":["as4"],
32               "customers":["as2"]
33           }
34       ],
35       "hosts":
36       {"as1": [
37           {
38               "number":3,
39               "device":"dev4"
40           },
41           {
42               "number":2,
43               "device":"dev5"
44           }
45       ]}
```
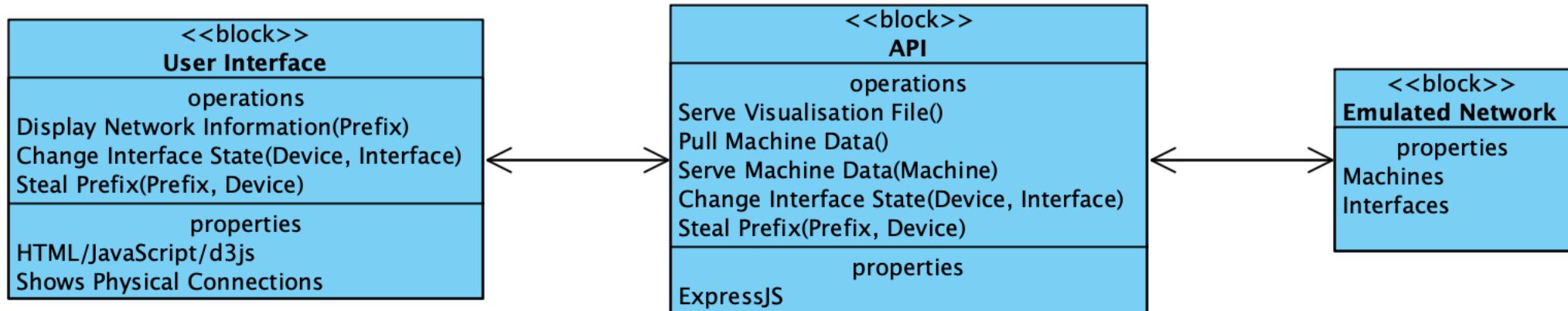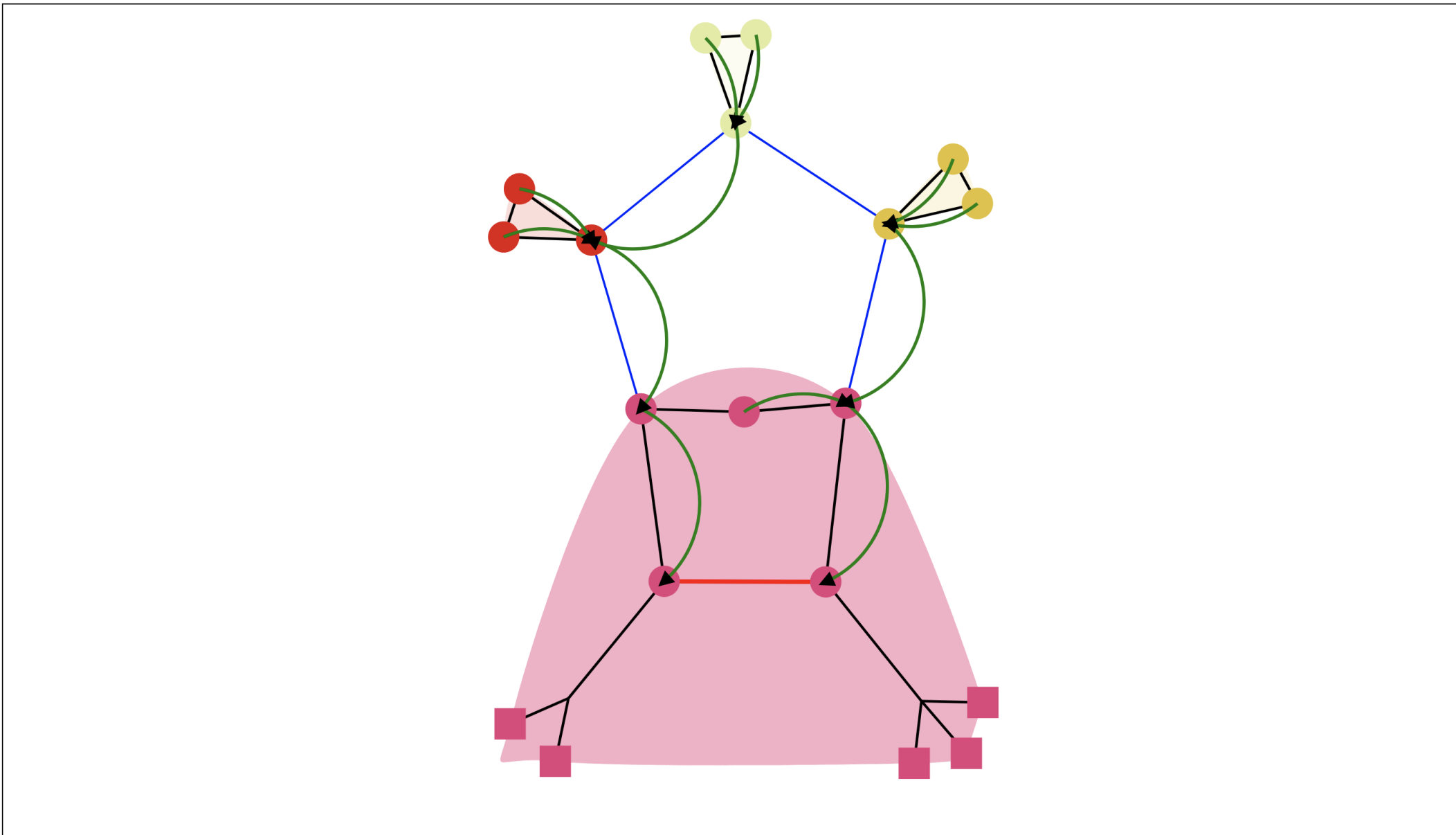
BGP Wedgie Demonstration Part 2

3.4.0.0/30

13.0.0.8/30
13.0.0.0/30

1.4.0.0/30 - down

Node: as4dev1 [Prefix] [Steal]

Prefix - State: [1.4.0.0/30 - up ▾] [Switch State] eth2 on as4dev1 up

Visualisation

BGP Wedgie Demonstration Part 3

Future Research

- Emulating Different Environments
- BGPsec/RPKI
- Cybersecurity Experiments

- …?

Loughborough
University

#InspiringWinners since 1909

Questions

Loughborough University

#InspiringWinners since 1909