Real Path Discovery Protocol and the SAV Open Playground

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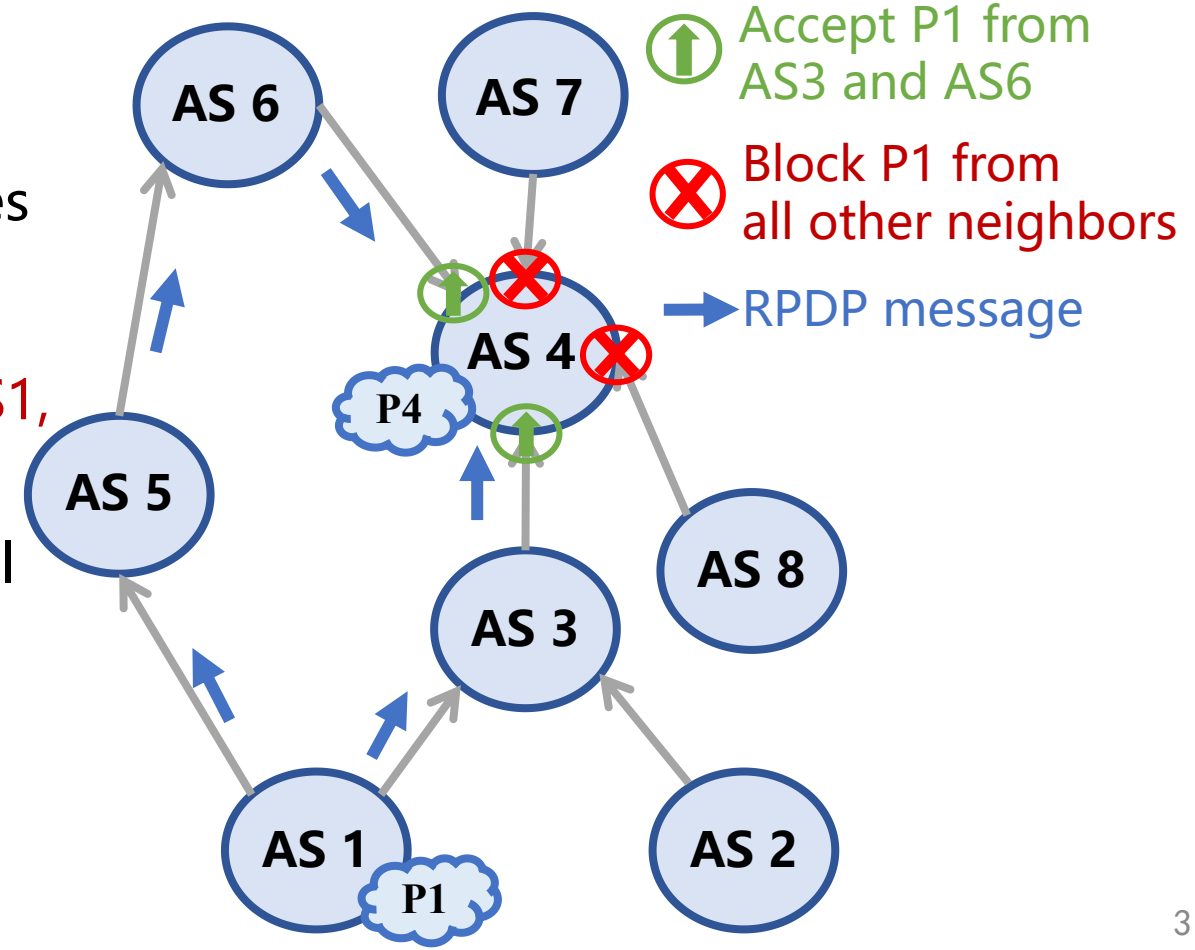
Outline

- Real Path Discovery Protocol（RPDP）
- SAV Open Playground（SAVOP）
- SAVOP Architecture
- SAV Agent with BIRD
- Experiment with SAV Agent and BIRD
- Demo for RPDP Implemented on SAVOP
- SAVOP Development Plan

Real Path Discovery Protocol (RPDP)

- Main idea
  - Origin AS advertises its preferred AS paths to other ASes by RPDP messages
  - Other ASes learn the incoming directions of the origin AS through received RPDP messages
- The illustration of RPDP process
  - AS1 selects AS paths [AS1, AS3, AS4] and [AS1, AS5, AS6, AS4] to P4
  - AS1 sends RPDP messages hop by hop to tell AS4 the paths
  - AS4 learns that AS3 and AS6 are valid incoming directions for P1, and all other neighbors are invalid

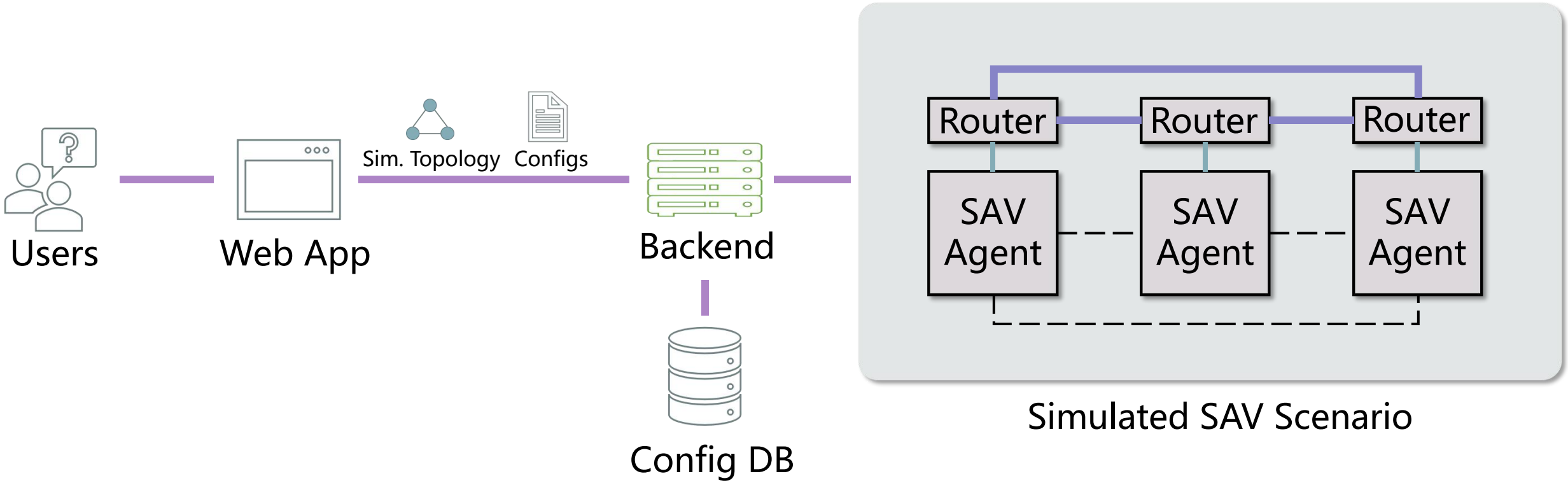
Relationships of AS4 and its neighbors: any one of c2p, p2c, or p2p



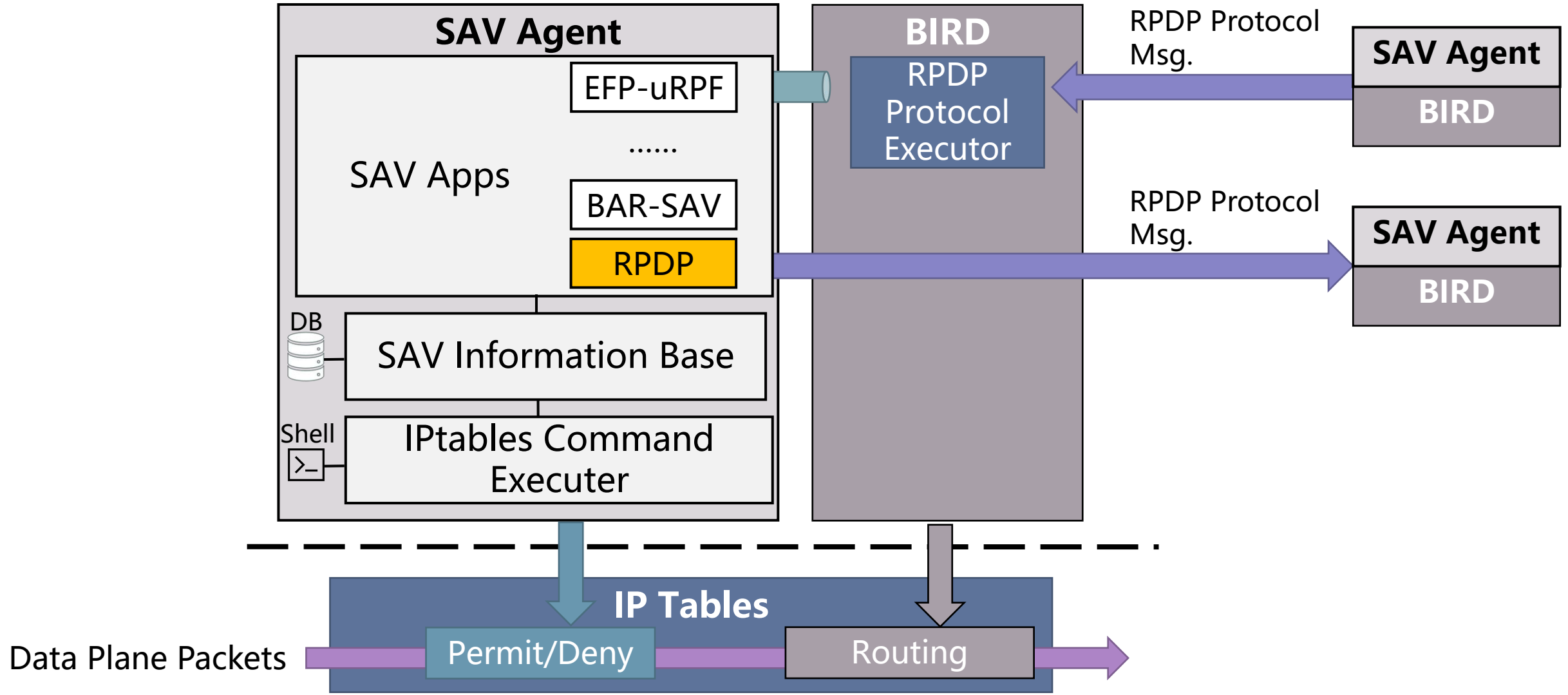
SAV Open Playground（SAVOP）

- A development and simulation platform for new SAV technologies
- An experimentation environment for network operators to test their configuration
- A web application that helps networking professionals understand different SAV mechanism
- An education platform for students to learn about SAV

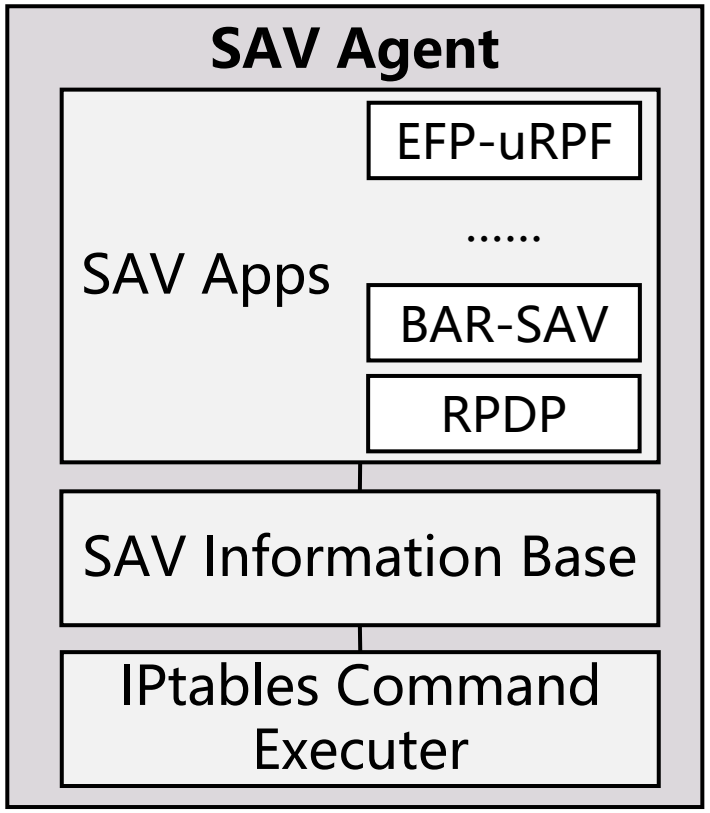
SAVOP Architecture



SAV Agent with BIRD

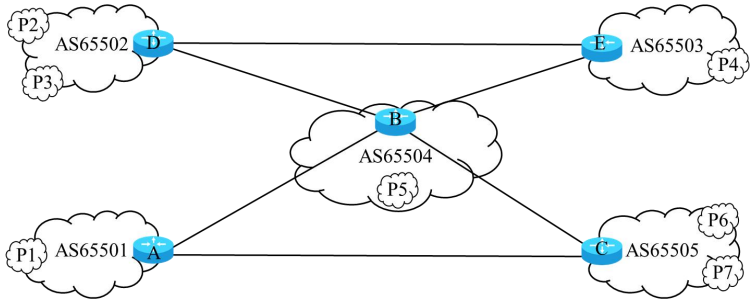


SAV Agent and SAV App



- **SAV Agent** uses SAV Information Base (SIB) to consolidate SAV-related information from various sources, e.g., RPDP, RPKI ROA objects and ASPA objects. Based on the SIB and SAV App, it will use iptables to enable SAV rules and perform SAV in the dataplane
- **SAV App** guides what information within the SIB will be used and how to use the information to generate SAV rules
- **SAV Agent and SAV App** use APIs to communicate by passing JSON messages

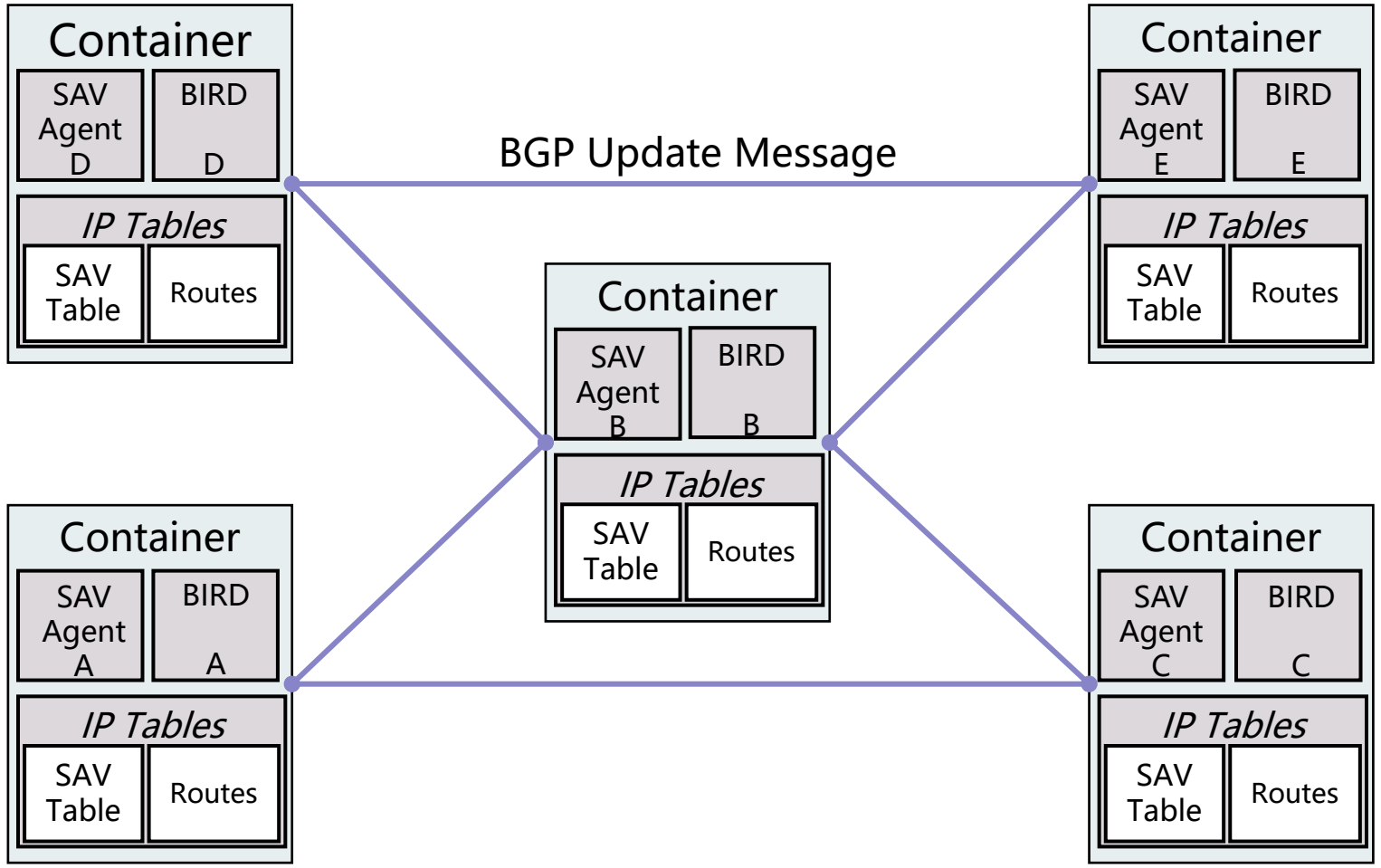
Experiment with SAV Agent and BIRD



User Input

Backend

Simulation Initial Settings
- Initial SIB
- Initial SAV Tables
- Static Routes
- SAV Mechanism



SAV Scenario Simulation

Demo for RPDP Implemented on SAVOP

- Network Model 1: https://ki3.org.cn:45679/#/sav?id=62b075de-41e9-4d2e-b458-db5d84f8ee2a
- Network Model 2: https://ki3.org.cn:45679/#/sav?id=4f69374c-df10-4a59-af46-d9fc7a9ddf81
- The nodes, RIB, FIB, SIB in Network Model 1 are listed below


```
{
  "createtime": "Wed, 22 Mar 2023 07:33:06 GMT",
  "direction": null,
  "id": 1,
  "interface": "b_d",
  "neighbor_as": 65502,
  "prefix": "192.168.2.0/24",
  "source": "bird_client"
},
{
  "createtime": "Wed, 22 Mar 2023 07:33:06 GMT",
  "direction": null,
  "id": 2,
  "interface": "b_d",
  "neighbor_as": 65502,
  "prefix": "192.168.3.0/24",
  "source": "bird_client"
},
```


Part of RIB on the node 1

```
192.168.4.0/24       unicast [savnet_ab 05:13:21.098] * (100) [AS65503i]
        via 10.0.1.2 on a_b
        Type: BGP univ
        BGP.origin: IGP
        BGP.as_path: 65504 65503
        BGP.next_hop: 10.0.1.2
        BGP.local_pref: 100
        BGP.otc: 65503
                     unicast [savnet_ac 05:13:17.827] (100) [AS65503i]
        via 10.0.2.2 on a_c
        Type: BGP univ
        BGP.origin: IGP
        BGP.as_path: 65505 65504 65503
        BGP.next_hop: 10.0.2.2
        BGP.local_pref: 100
        BGP.otc: 65503
```

Part of SIB on the node 1

```
[redacted]:~/savnet_bird/logs/1# docker ps
CONTAINER ID   IMAGE              COMMAND                  CREATED       STATUS       PORTS     NAMES
b87b26b302df   savnet_bird_base   "bash container_run.…"   2 hours ago   Up 2 hours             node_1
2c44a80752fe   savnet_bird_base   "bash container_run.…"   2 hours ago   Up 2 hours             node_2
996ba0011371   savnet_bird_base   "bash container_run.…"   2 hours ago   Up 2 hours             node_4
c0ecb7cac59e   savnet_bird_base   "bash container_run.…"   2 hours ago   Up 2 hours             node_3
a9cf574b98d6   savnet_bird_base   "bash container_run.…"   2 hours ago   Up 2 hours             node_5
```

Nodes of network model 1

```
root@b87b26b302df:~/savnet_bird# route -n -F
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.0.1.0        0.0.0.0         255.255.255.0   U     0      0        0 a_b
10.0.1.0        0.0.0.0         255.255.255.0   U     32     0        0 a_b
10.0.2.0        0.0.0.0         255.255.255.0   U     0      0        0 a_c
10.0.2.0        0.0.0.0         255.255.255.0   U     32     0        0 a_c
10.0.4.0        10.0.1.2        255.255.255.0   UG    32     0        0 a_b
10.0.5.0        10.0.1.2        255.255.255.0   UG    32     0        0 a_b
10.0.6.0        10.0.1.2        255.255.255.0   UG    32     0        0 a_b
10.0.7.0        10.0.1.2        255.255.255.0   UG    32     0        0 a_b
192.168.1.0     0.0.0.0         255.255.255.0   U     32     0        0 *
192.168.2.0     10.0.1.2        255.255.255.0   UG    32     0        0 a_b
192.168.3.0     10.0.1.2        255.255.255.0   UG    32     0        0 a_b
192.168.4.0     10.0.1.2        255.255.255.0   UG    32     0        0 a_b
192.168.5.0     10.0.1.2        255.255.255.0   UG    32     0        0 a_b
192.168.6.0     10.0.2.2        255.255.255.0   UG    32     0        0 a_c
192.168.7.0     10.0.2.2        255.255.255.0   UG    32     0        0 a_c
```

FIB on the node 1

SAVOP Development Plan

- Support various communication techniques between SAV Agents
  - Routers: BIRD, Quagga, Huawei, H3C, Cisco, etc.
  - Protocols: BGP, OSPF, ISIS, RIFT, gRPC, etc.
- Support various SAV mechanisms
  - RPDP, strict uRPF, loose uRPF, FP-uRPF, VRF uRPF, EFP-uRPF, BAR-SAV, etc.

SAVOP

We have open-sourced our codes and welcome to try!
https://github.com/SAV-Open-Playground/savop

Thanks!