# **Enforcement of Transit Service Level Agreements** using In-band Telemetry and Smart Contracts

### Introduction

Service level agreements are contracts between a customer entity and one or multiple service providers. These contracts specify the quality of service (or Service Level Objectives, i.e., SLO) that the provider should provide in terms of measurable metrics, and the consequences of violating the SLOs.

In terms of traffic transit, the SLOs are specified in terms of maximum drop rate and latency percentile. For example, if the 95th percentile latency is above 15 ms, the provider would refund the customer 5 percent of the service fee, and if it is above 20 ms, the refund would be 10 percent. Similar approaches apply to the drop rate.

### Problem

The problem is in an inter-domain setup, it is notoriously difficult for the source of traffic who has signed an SLA with transit providers to find out which provider on the path is violating the SLA. Therefore, it is usually impossible to get the refund.

All the previous solutions only focus on just the detection from the point of view of the source of the traffic, and not on the automation of the detection-refund process. Furthermore, they rely on techniques that are usually not practical.

#### **Our solution**

To automate the refund process, we rely on smart contracts and in-band network telemetry.

Transit providers publish their SLA terms in smart contracts, including the refund policy. The source ASes purchase the SLA assets and start sending traffic.

The source then uses in-band network telemetry (INT [1]) to monitor network faults. INT an implemented P4 [2] standard that allows network telemetry using the data packets by adding small headers to data packets. So, there is not need for additional probing packets (like ICMP).

To detect packet drops, the source needs to order all providers on the path to sample random packets. To that end, it uses INT-MX [1], an INT header type that allows sampling packets. The providers then export those data packets and insert them in a log.

Periodically, the source calls the evaluation function of the smart contract. In that call, it specifies whether it has experienced a violation of the SLA or not. If not, the money is transferred to providers. Otherwise, the contract asks all providers to submit their logs. The smart contract then compares the logs and detects which providers are guilty of the fault and runs the refund policy.

## Your Task

Your task is to implement the proposed solution. For that, you need to look for the current implementation of the INT and check whether INT-MX exist, or no. If not, you have to implement it yourself in P4 language. P4 is a language to describe data plane functionalities in router and

switcher. When the implementation is ready, you need to evaluate the implementation in terms of performance on the Intel Tofino P4 switch.

After the P4 evaluation, you need to implement the logging system and the smart contract on the SUI blockchain [4]. Finally you need to come up with test scenarios and test the system on such scenarios.

[1] <u>https://p4.org/p4-spec/docs/INT\_v2\_1.pdf</u>

[2] https://p4.org/

[3] <u>https://www.intel.com/content/www/us/en/products/details/network-io/intelligent-fabric-</u>

processors/tofino.html

[4] https://sui.io/