Composable Primitives for SDN Measurements

Paolo Laffranchini
paolo.laffranchini@tecnico.ulisboa.pt

Ph.D. Stage*: Planner*
Research areas: *Software-defined networks, Measurements*

Advisors:
Luis Rodrigues: Instituto Superior Técnico, Portugal
Marco Canini: KAUST, Saudi Arabia

Research Description

- ***Problem statement:***
  Network *measurement is* a concern addressed as an ad-hoc activity with poor reuse of artifacts.
  The absence of a *principled approach* leads to multiple, ad-hoc solutions often overlapping in functionality and only capable to address a limited set of use cases.

- ***Motivation:***
  Development, *deployment, integration* and *maintenance* of measurements are daunting, time-consuming tasks that force operators to understand low-level details of specific approaches and nuances between multiple variations of the same problem.
  Measurement is a crucial activity to efficiently manage a network infrastructure that requires high-level *abstractions* to tackle a large spectrum of measurement requirements.

- ***Research proposal:***
  A set of building blocks, or ***primitives***, that are *orthogonal*, *programmable* and *composable*, capable to flexibly express a wide range of measurement tasks to be automatically deployed in the network.

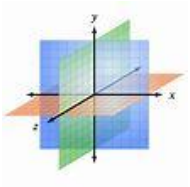
- ***Consequence:***
  Reusable abstractions with well-formed semantic facilitate the task of addressing measurements in a concise and efficient manner. High-level specifications can be managed and optimized at the control plane relieving operators from the exposure to low-level details.

Measurement Primitives

1. *Timestamps*
2. *Counters*
3. *Tags*
4. *Bloom Filters*
5. *Sketches*
6. *Samples*
7. *Matches*

Orthogonal

Each primitive provides unique functionality

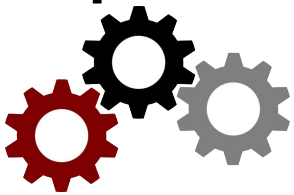


Measurements expressed as compositions of primitives:
>> Sequential
+ Parallel

Programmable

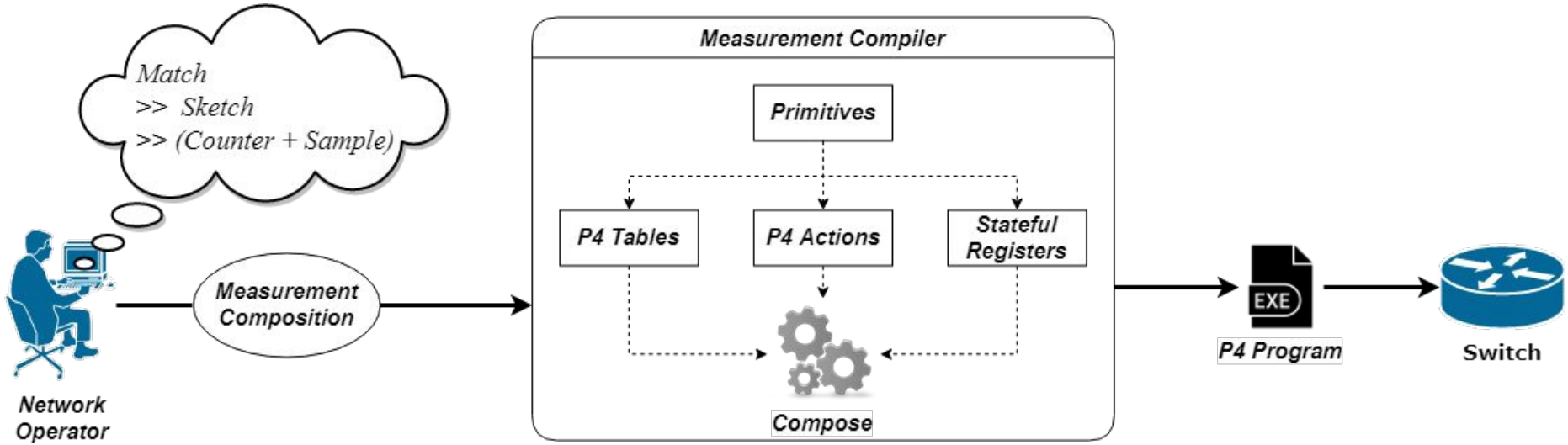
Primitives are configurable with an API

Composable



- Expressed several measurement applications proposed in the literature.
- Solved two novel SDN measurements: i) path changes and ii) latency to flow steering

Primitives Compilation



Research Plan

1. Identification of a set of measurement ***primitives*** and definition of an API to configure and compose a large set of measurement use cases.

2. Implementation of a compiler translating primitive-based measurements into a P4 pipeline configuration.

3. Analyze and model the primitives' memory usage and execution cost when deployed to hardware switches. Automatic assessing of measurements feasibility given hardware resource constraints.

4. Explore distribution, placement and coordination of measurement primitives in a network-wide settings.

5. Integrate measurement in the control plane. Define interactions with the data plane for run-time primitive configuration and tuning. Coordination with forwarding policies so to optimize traffic control and measurement activity.