Chapter 4

Implementation

- Design decisions
  - Why RYU?
  - QoS in practice
  - Mininet [Lantz et al., 2010], the test VM, their limitations
  - Adaptivity strategy
  - How do we understand the need for adaptivity
- How to generalize the measurement, make it more robust
- Find more general approach to adaption, configurable thresholds, etc.

4.1 Measurement

- Measurement on the input side of the switchports

4.2 Adaptation algorithm

The adaptation algorithm is responsible for deciding when and how much bandwidth should be assigned to or taken from specific flows.

The following are the definitions and the procedure that run every 10 seconds (by default settings) and updates bandwidths assigned to different flows.

4.2.1 Measures

- F: Set of defined flows
- $f_i \in F$: flow i; its state can be full or unexploited (see below)
- λ_i: Current bandwidth assigned to flow i
- Λ_i: The maximum bandwidth assignable to flow i

- $\lambda^{\varepsilon} = 2Mbps$: Hysteresis for bandwidth setting. Smaller change in λ_i would not actually result in a bandwidth assignment update
- l_i: Average load received by a switchport from any source matching flow i in during the last n measurements (n is implementation detail)
- $s_i = 0.1 \cdot \Lambda_i$: Bandwidth step, the granularity in which adaptation happens.
- $G = \sum_{i \in \text{unexploited}} \Lambda_i - \lambda_i$: Gained bandwidth from unexploited flows

4.2.2 Adapt flow bandwidths

These are the steps (in respective order) to run to update all flows' assigned bandwidths.

1. state of $f_i = \begin{cases} \text{unexploited}, & \text{if } l_i < \Lambda_i \\ \text{full}, & \text{if } l_i \geq \Lambda_i \end{cases}$ – Collect "unexploited" and "full" flows
2. $i \in \text{unexploited}; \lambda_i^{\text{new}} = \begin{cases} \left\lceil \frac{l_i}{s_i} \right\rceil \cdot s_i, & \text{if } |l_i - \lambda_i^{\text{old}}| \geq \lambda^{\varepsilon} \\ \lambda_i^{\text{old}}, & \text{otherwise} \end{cases}$
   In words, the unexploited flows' bandwidth gets updated *only if* the load is farther away from λ_i^{old} than λ^{ε}. This is to avoid flapping between settings if load moves around an adaptation point.
3. Calculate G
4. $i \in \text{full}; \lambda_i^{\text{new}} = \Lambda_i + \frac{G}{F^{\text{full}}}$