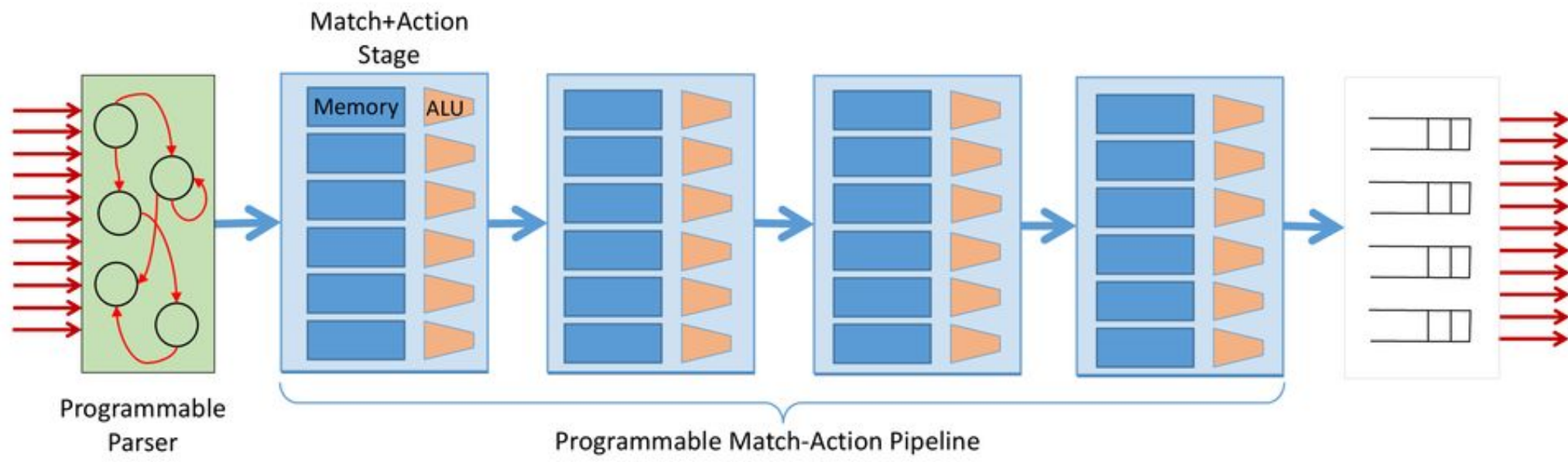


# DISCOvering the Heavy Hitters with Disaggregated Sketches

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## 1. Network programmability

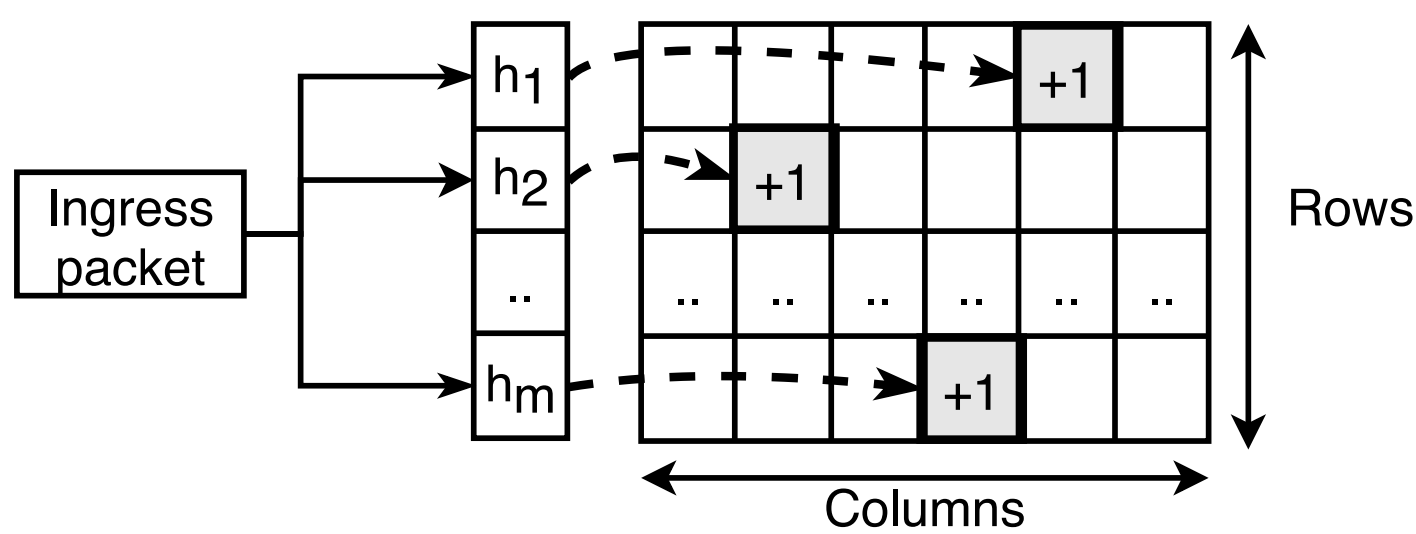
- It allows to **customize** how packets are processed by individual switches.
- The **programmability** supported by new network equipment is **increasing**.



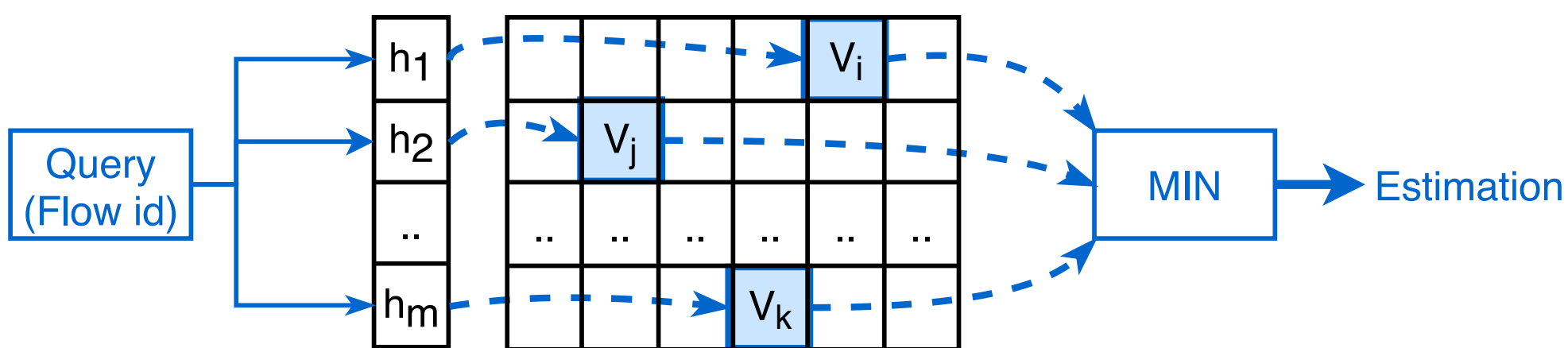
## 2. Performing network monitoring without starving all switch resources

**PROBLEM:** Leverage programmability to improve **data plane visibility**

**TYPICAL SOLUTION:** approximate data structures (e.g., **sketches**)



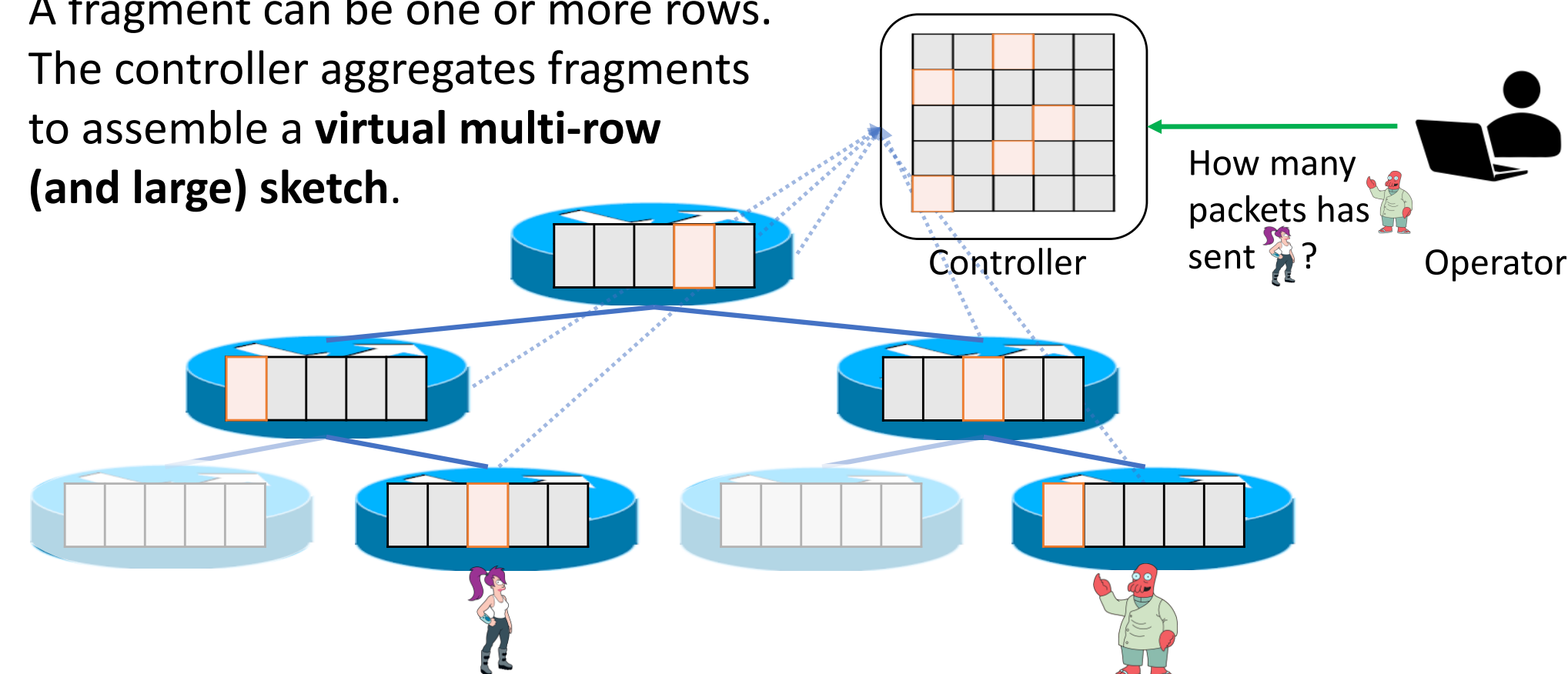
- Interesting trade-off between efficiency and accuracy.
- In practice, it is **hard** to fit sketches **for high accuracy** in every switch.



**OUR AIM:** a system that **uses a small amount of resources at switches** and **does not compromise accuracy**.

## 3. The DISAggregate and COordinate (DISCO) sketch framework

- DISCO stores a **sketch fragment** on each switch.
- A fragment can be one or more rows.
- The controller aggregates fragments to assemble a **virtual multi-row (and large) sketch**.



The resource requirements at each switch **are significantly reduced**.

Different switches process **different traffic (!)**

DISCO can track various types of heavy hitters:  
Assuming a controller with full network visibility (e.g., routing, topology)

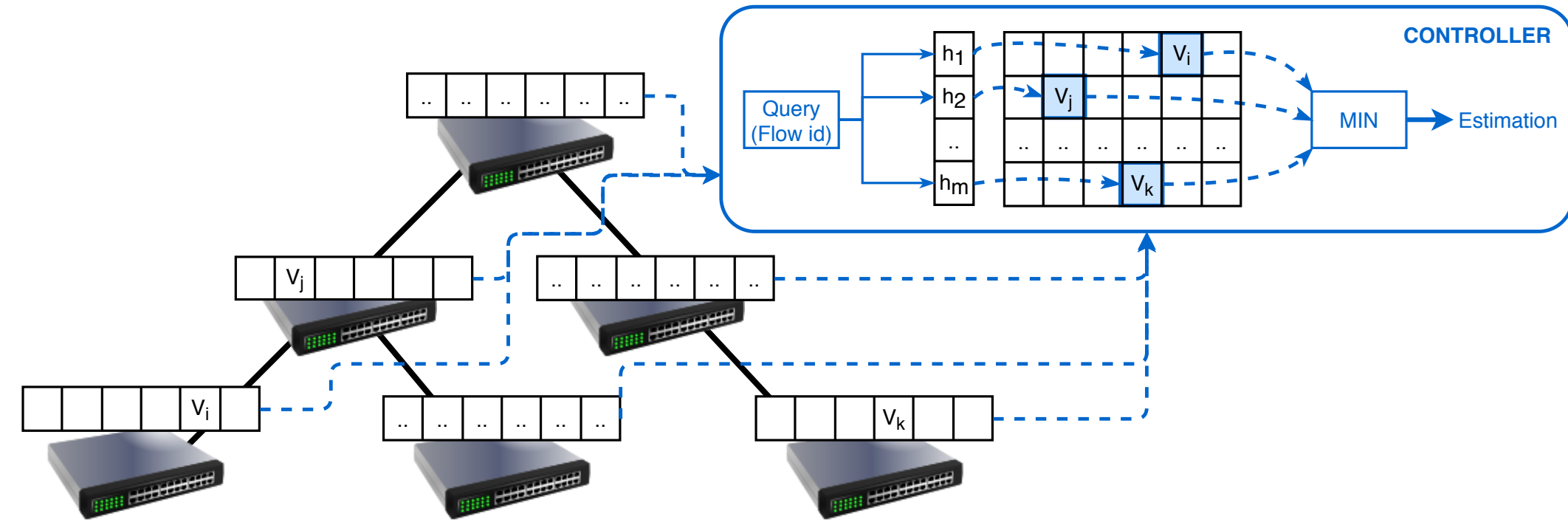
### 1. Path-based Heavy Hitters.

DISCO can detect heavy hitters on a given path efficiently.

### 2. Network-wide Heavy Hitters.

DISCO offers a “one big switch” abstraction with multiple disjoint Origin-Destination (OD)-paths.

## 4. DISCO supports disaggregating common design such as CMS and CS

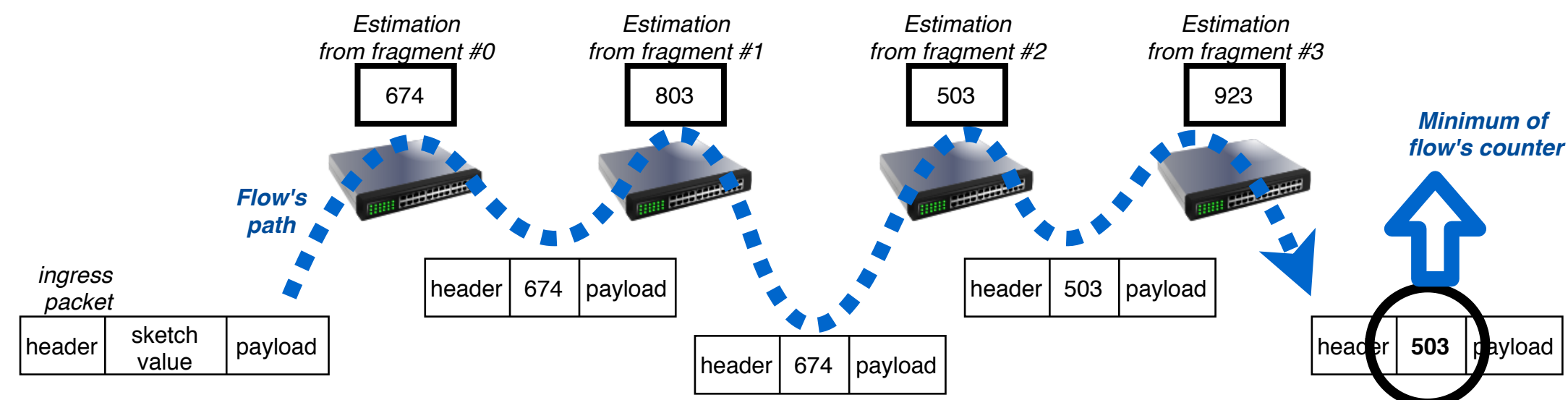


the minimum (or median) is taken among the sketch rows of the virtual sketch.

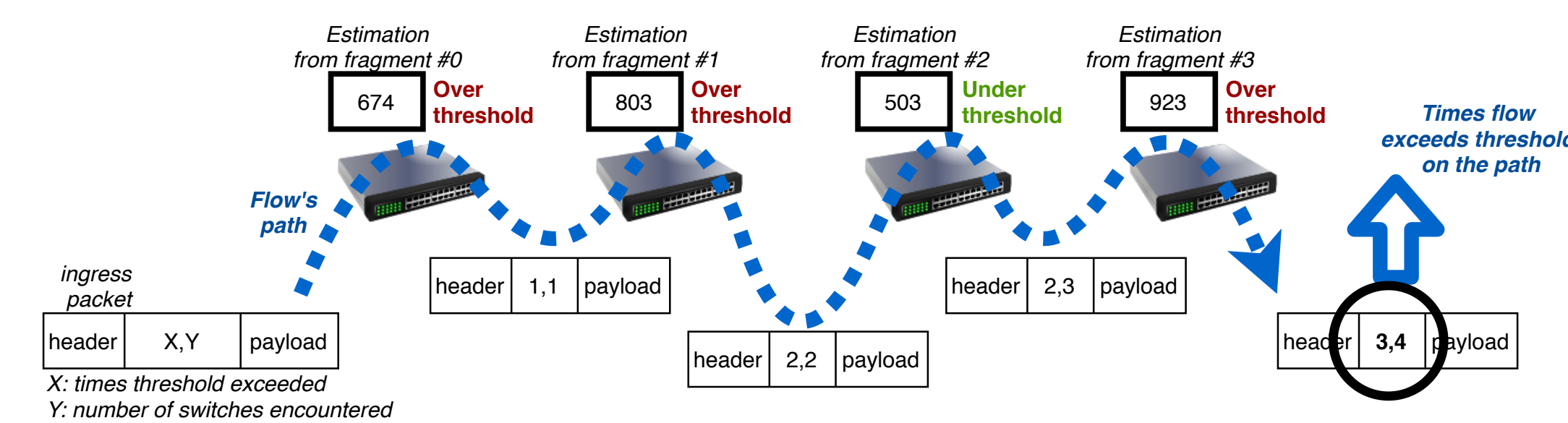
To notice:  
**60k** counters ~ **2 sec** latency  
**< 10k** counters ~ **< 0.5 sec** latency

## 5. DISCO also supports finding the IDs of the Heavy Hitters on the fly

- Count Min Sketch (CMS):** DISCO would carry on packets the minimal estimate seen. The last hop would report the ID to the controller if it exceeded a pre-determined threshold.

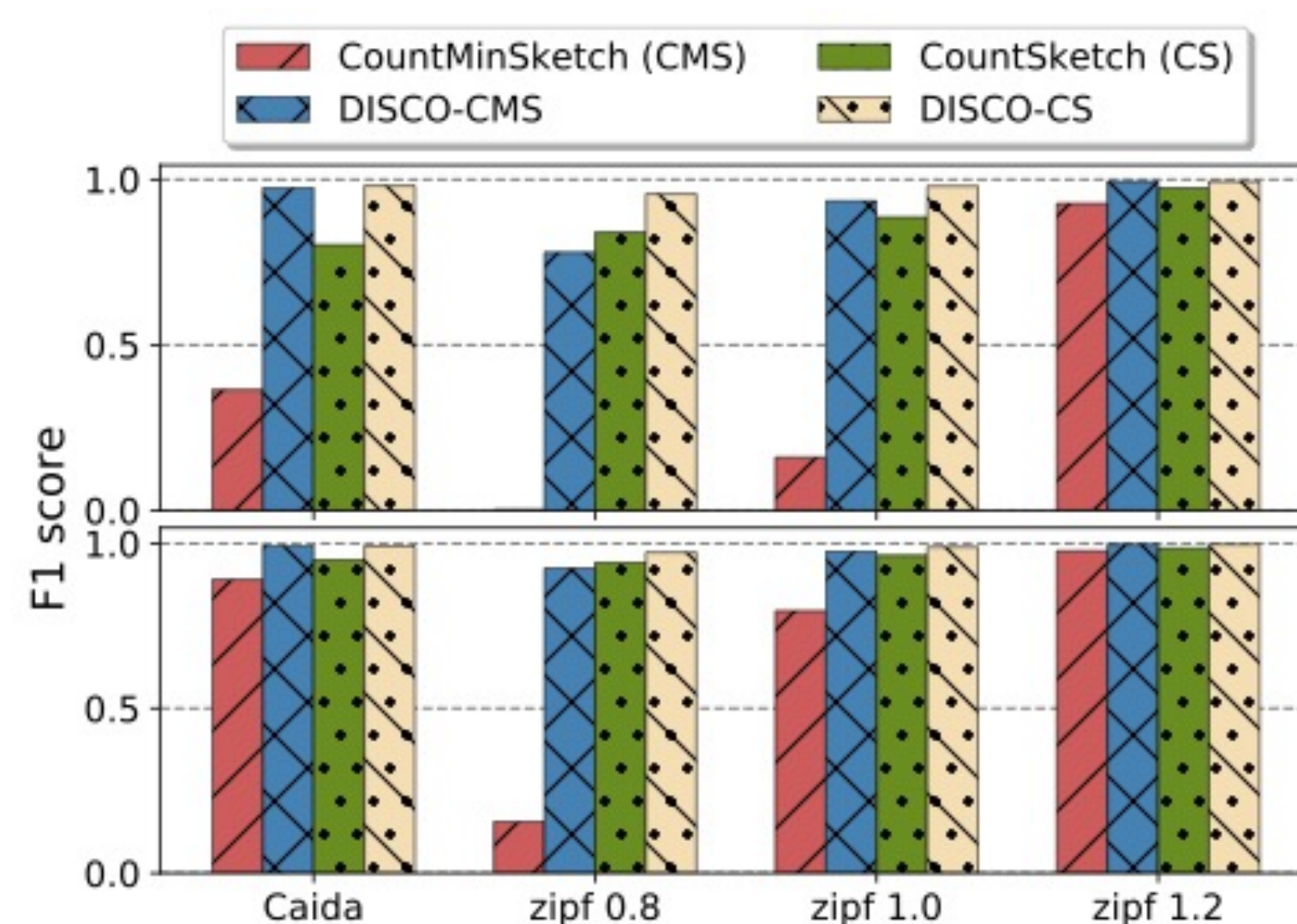


- CountSketch (CS):** DISCO would carry on packets the number of counters on the path that exceed the threshold. The last hop would report the ID to the controller if at least half the counters exceed the threshold.



## 6. Experiments (preliminary insights)

- We find that disaggregation **positively affects accuracy**,
- while keeping a **lightweight footprint on per-switch resources**.
- DISCO achieves **32x** (with CMS) and **1.1x** (with CS) higher F1 score than one large sketch while reducing the per-switch resource footprint by **2.5x**.
- The topology simulated reproduces a  $k = 8$  fat-tree.
- F1 score ( $F1 = TP / (TP + 0.5(FP + FN))$ )



CMS,CS:  
5 rows and 8192 columns

DISCO-CMS,DISCO-CS:  
1 row of 32768 columns  
in each switch.

CMS,CS:  
5 rows and 16384 columns

DISCO-CMS,DISCO-CS:  
1 row of 65536 columns  
in each switch.