Batchy: Batch-scheduling Data Flow Graphs with Service-level Objectives

Tamás Lévai
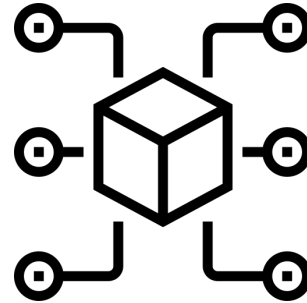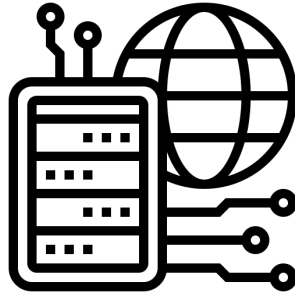Felicián Németh
Barath Raghavan
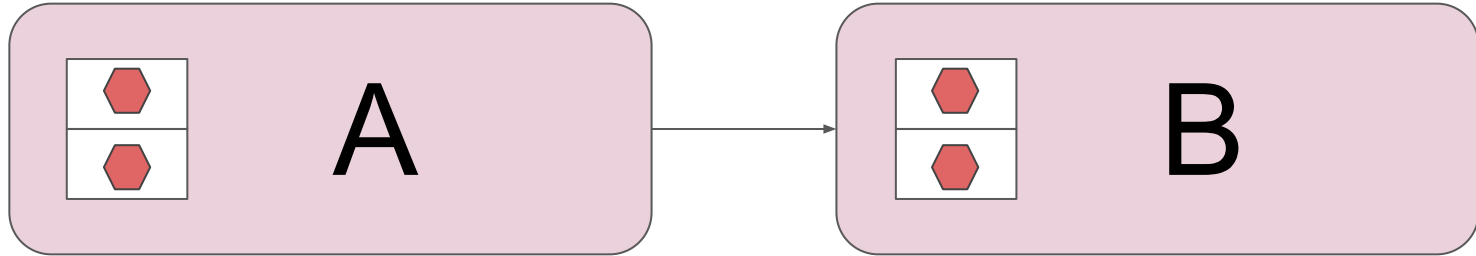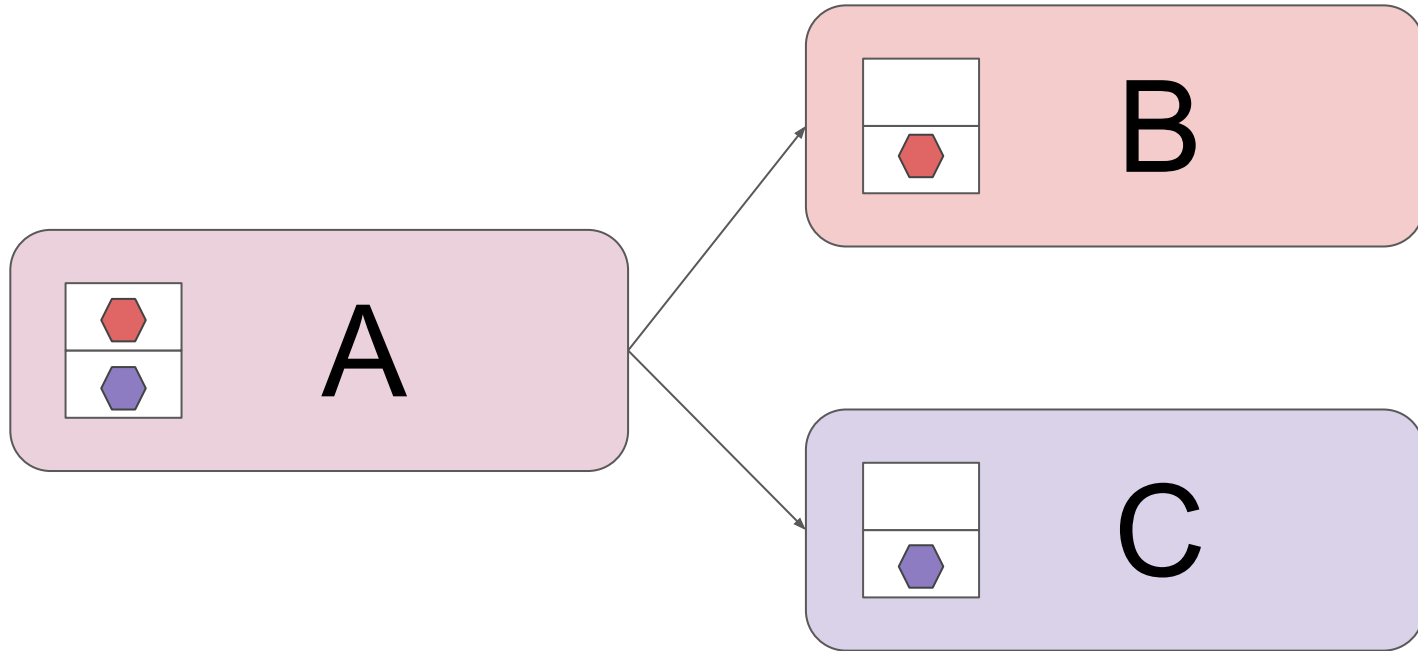Gábor Rétvári

MŰEGYETEM 1782
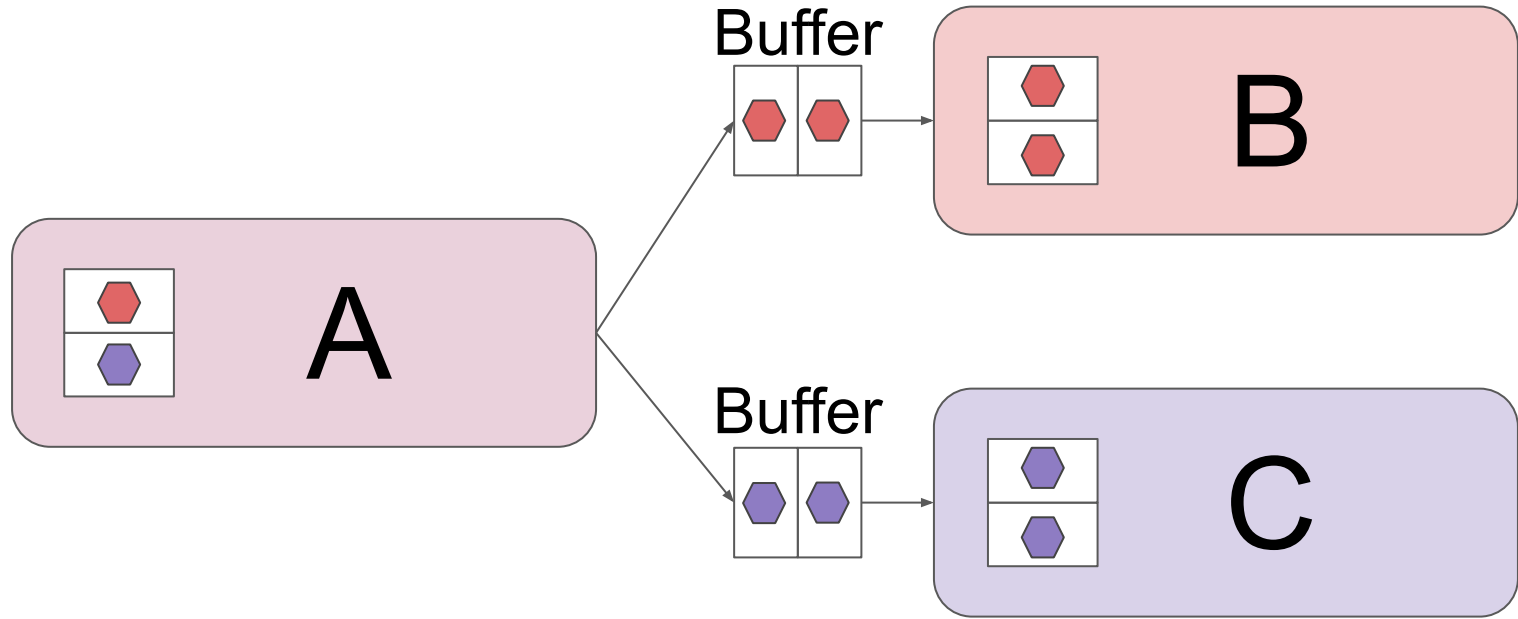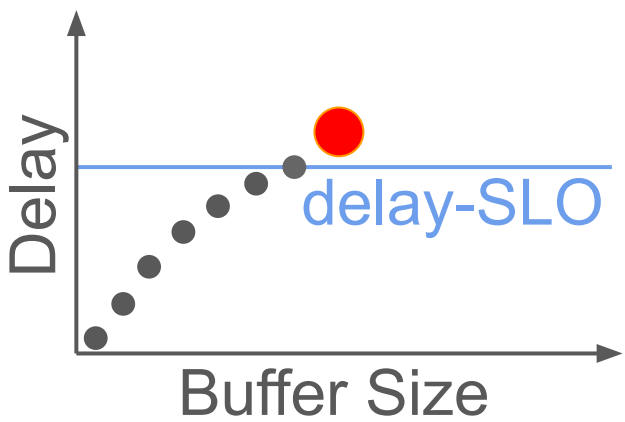
Get Things Done in Batches
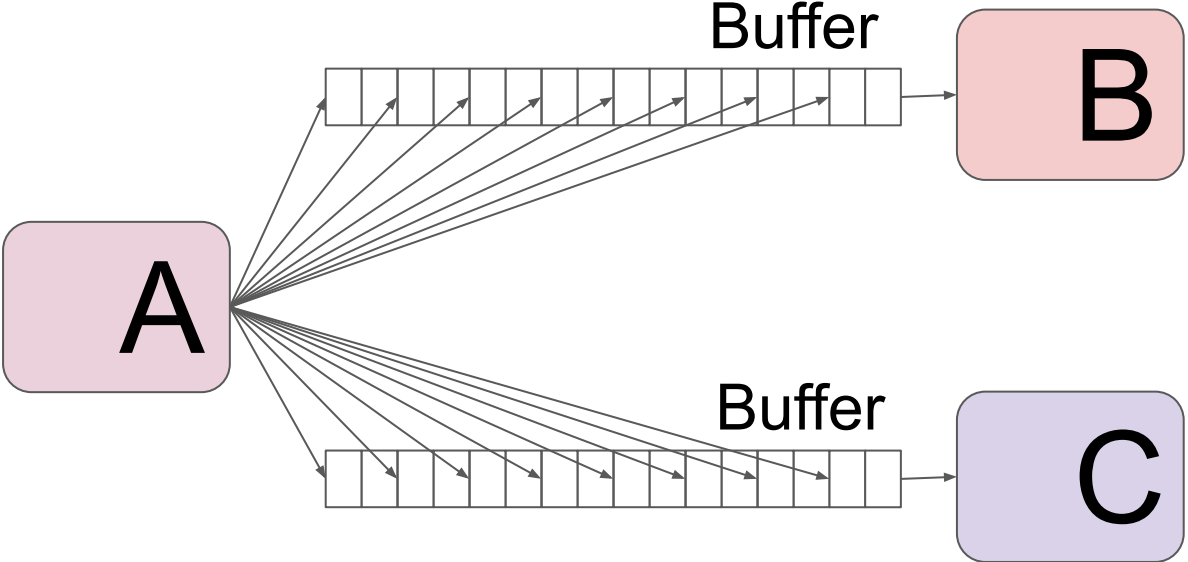
Batch Scheduling 101

Batch Fragmentation

Batch Defragmentation

Batch Defragmentation

Batchy

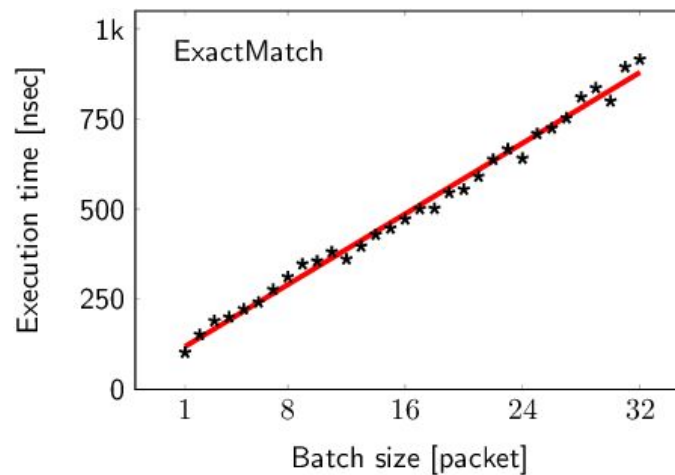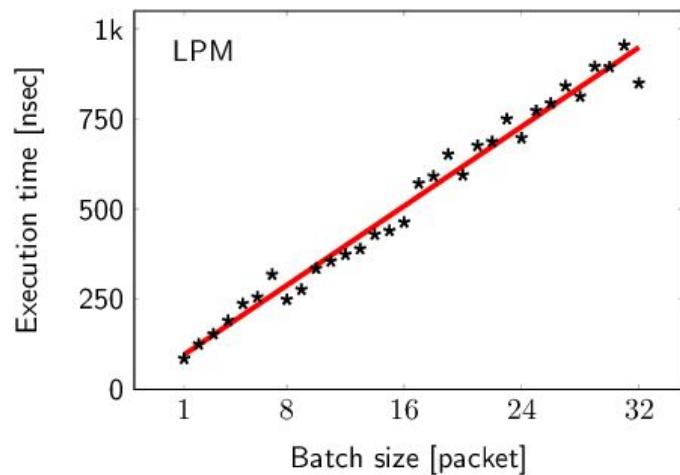Controls queue backlogs to balance **efficiency** and **delays**:

- Process as large batches as possible

- Comply with SLOs by provisioning enough resource

Profile node processing times

Batchiness:

$$\frac{T_{\text{N packets in a single batch}}}{T_{\text{N-times single-packet batches}}}$$

ExactMatch
DPDKACL
LPM
NAT

0   0.3   1

← **better**
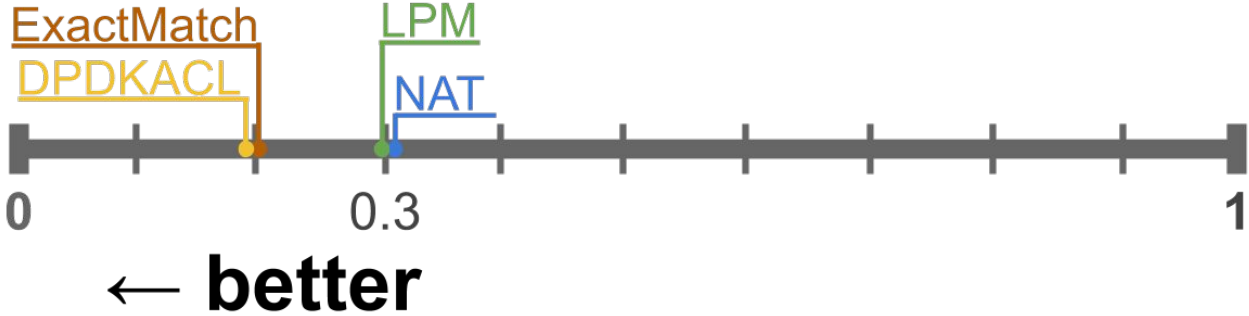
System Model

Fractional Buffer

Node
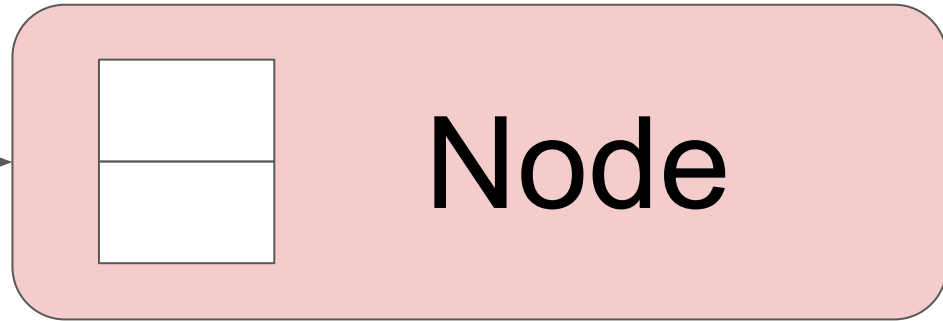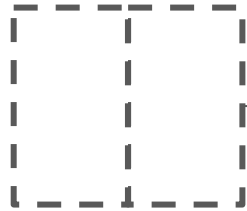
Controller

- Set buffer sizes to comply with SLOs

- Short-circuit useless buffers

- Recover from infeasibility

Architecture
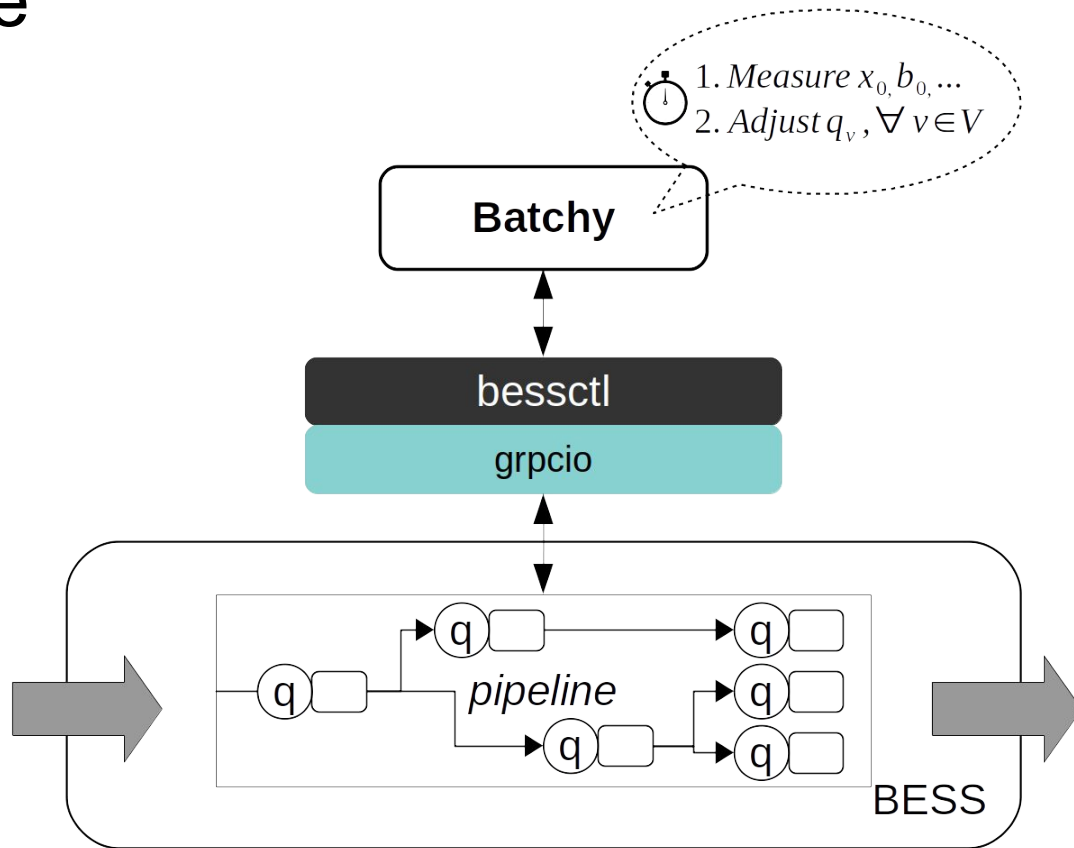
Controllers

Batchy:

- **Full:** buffer size in interval [0, max batch size]
- **On/Off**: buffer size is either 0 or max batch size

Baseline:

- **Null**: no buffering
- **Max**: all buffers are set to max batch size

NFVnice: implemented over BESS

Basic IP Router (L2L3)
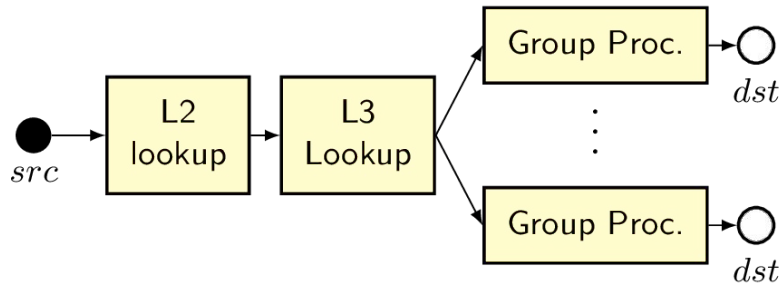
16 next-hops

- Static traffic-mix

- Delay-SLO: 80% of Max

- 100 ms control period

- Steady-state perf.

Static L2L3 results

➔ Batch defragmentation improves throughput

Batchy:

➔ successfully reconstructs batches

➔ complies with delay-SLOs

➔ provides the highest throughput
(thanks to short-circuiting unused queues)

L2L3(16)

Mobile Gateway

QoS: ○
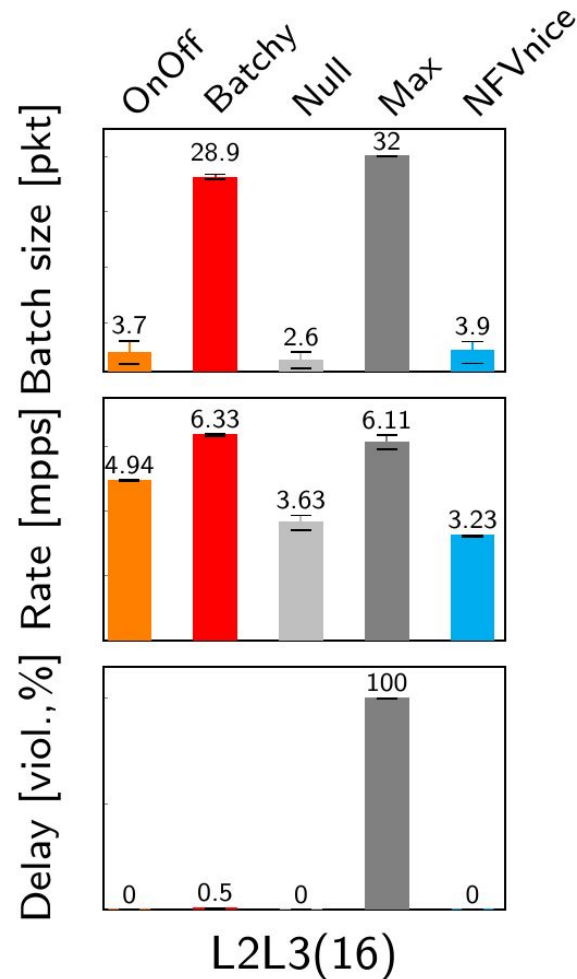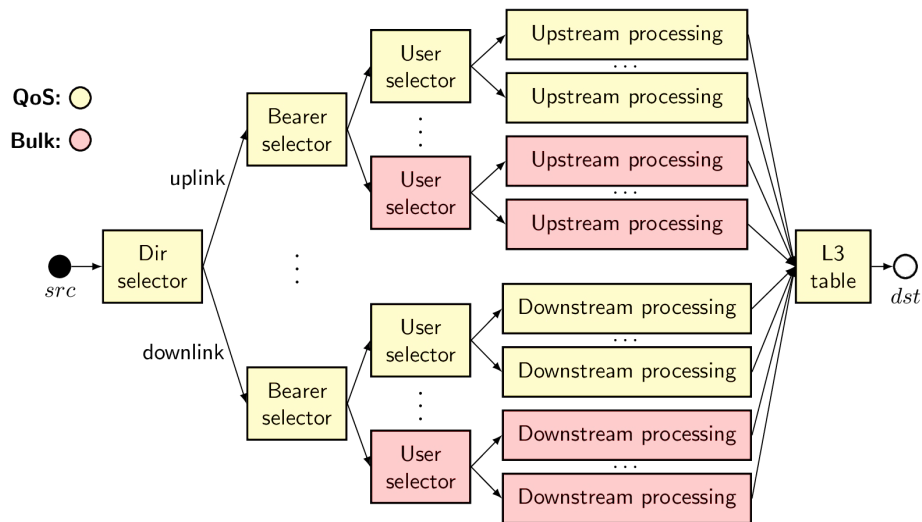Bulk: ○

User selector

Bearer selector

uplink

Dir selector

src

downlink

Bearer selector

User selector

User selector

User selector

User selector

Upstream processing
. . .
Upstream processing

Upstream processing
. . .
Upstream processing

Downstream processing
. . .
Downstream processing

Downstream processing
. . .
Downstream processing
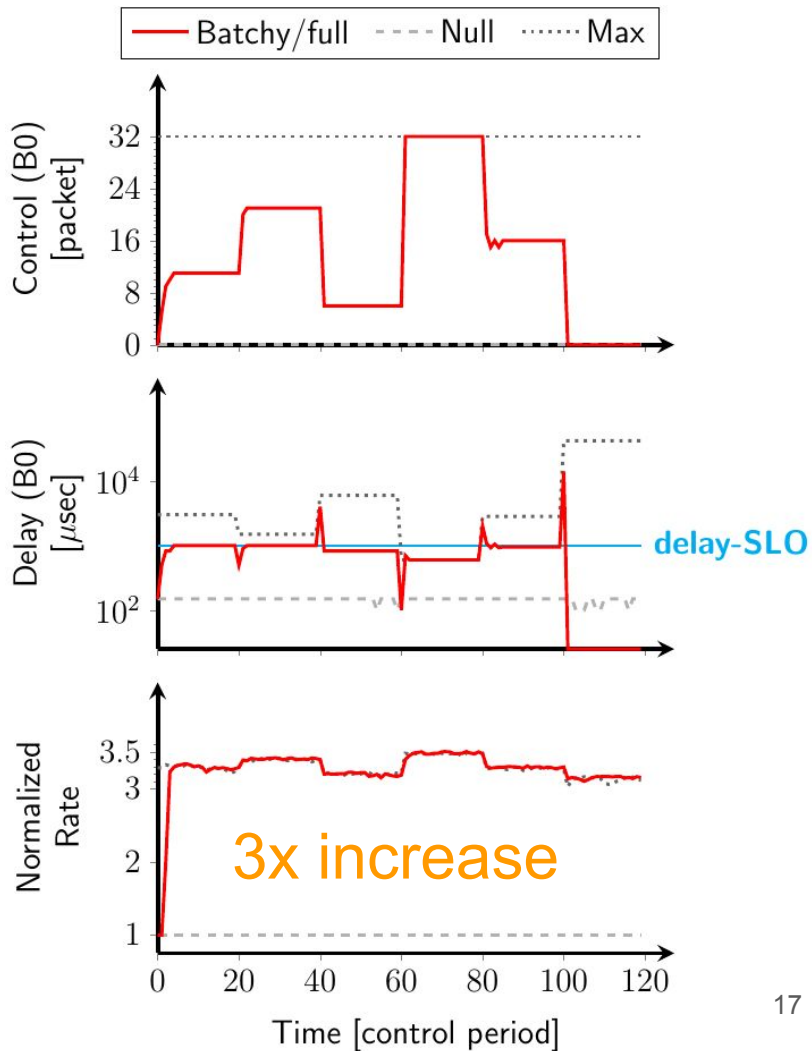
L3 table

dst

16 users, 2 services

- Service0 (B0):
  - 1ms delay req.
  - Throughput [kpps]:
    10 | 20 | 5 | 50 | 15 | 1
- Service1:
  - Bulk traffic

System Dynamics

Batchy:

➔ keeps delay < 1ms
   (except transients)

➔ reacts instantaneously

➔ improves the performance
   of the whole pipeline

3x increase

Conclusion

- **Batchy** can achieve efficient batch processing in arbitrary graphs without sacrificing latency.

- Code and artifacts are available at
  https://github.com/**hsnlab/batchy**