Implementation of a Benchmark Suite for Strymon

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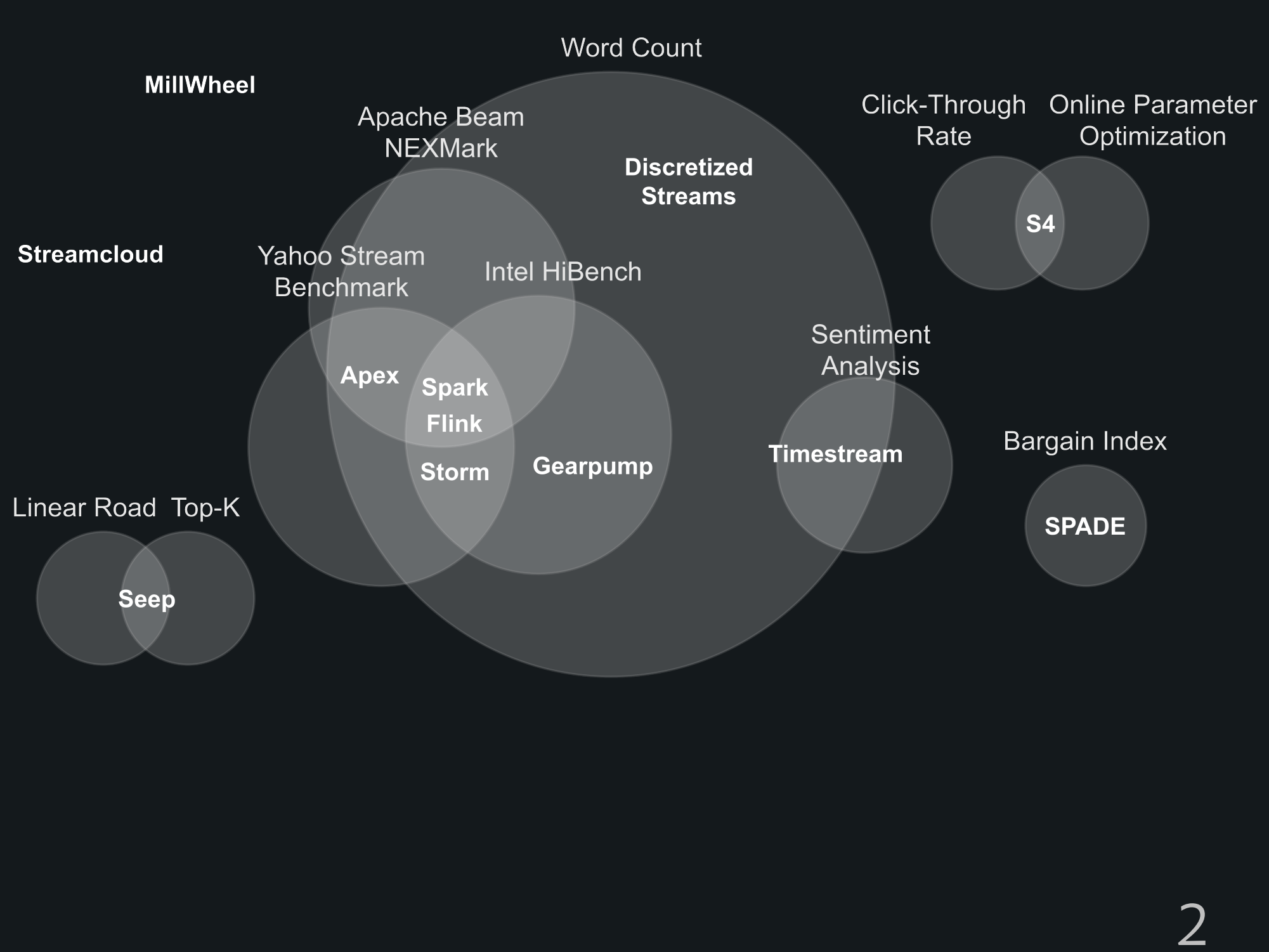
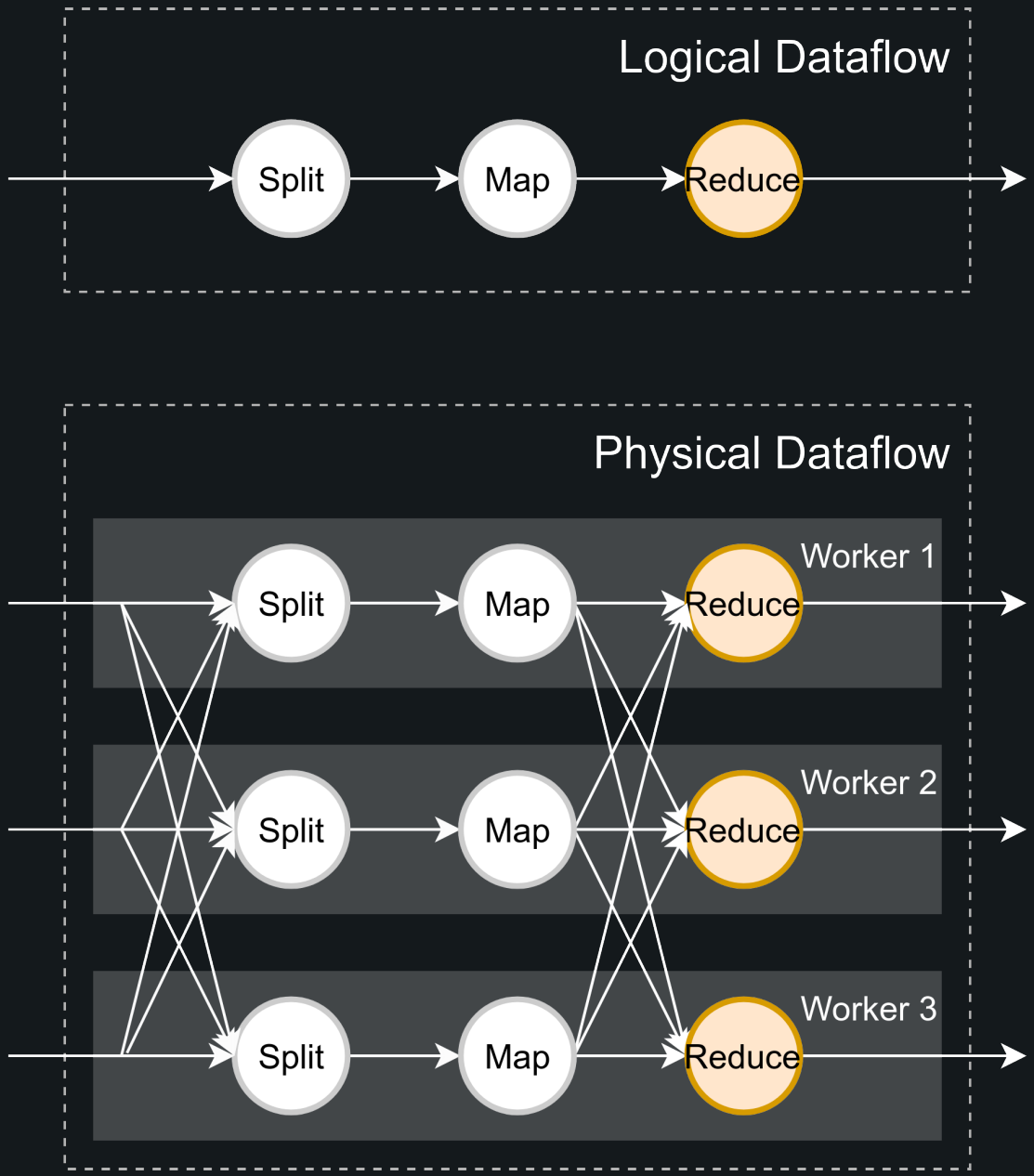

Word Count
MillWheel
Apache Beam
NEXMark
Discretized
Streams
Click-Through
Rate
Online Parameter
Optimization
S4
Streamcloud
Yahoo Stream
Benchmark
Intel HiBench
Sentiment
Analysis
Apex
Spark
Flink
Storm
Gearpump
Timestream
Bargain Index
SPADE
Linear Road
Top-K
Seep

Other Works

- Investigated 9 papers for other systems
- Almost no paper used a standardised benchmark
- Often very simple benchmarks like Word Count
- Code and data often not published

Timely


Logical Dataflow
Split
Map
Reduce
Physical Dataflow
Worker 1
Split
Map
Reduce
Worker 2
Split
Map
Reduce
Worker 3
Split
Map
Reduce

Benchmarks

- We implemented three benchmarks:

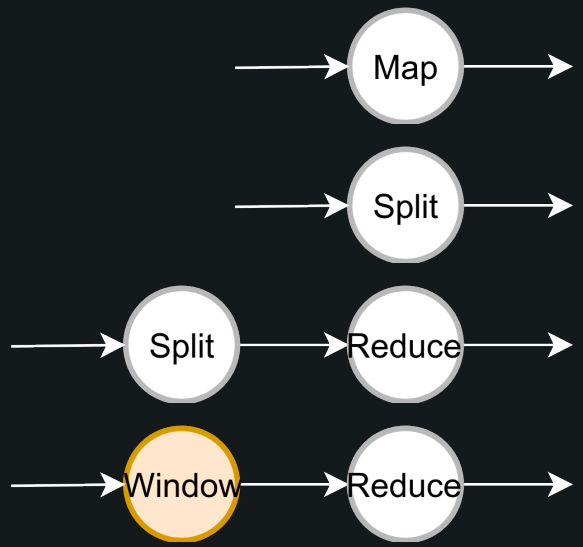
1. Intel's HiBench
2. Yahoo's Streaming Benchmark
3. Apache Beam's NEXMark

- Comparable against many other systems

Intel's HiBench

- Big Data micro-benchmark
- Only four data flows:

1. Identity
2. Repartition
3. Word Count
4. Window Reduce

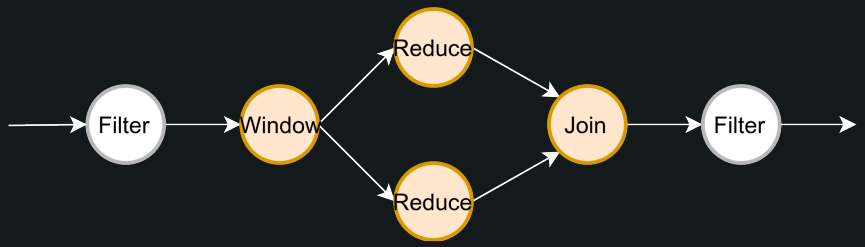


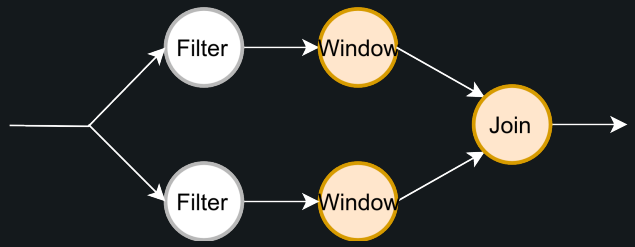
Yahoo Stream Benchmark

- Count ad views for ad campaigns
- Only one, relatively simple data flow:

Beam's NEXMark[1]

- Implements an "auctioning system"
- 13 data flows in total
- Uses filter, map, reduce, join, window, session, partition
- Dataflows for Query 5 and 8:



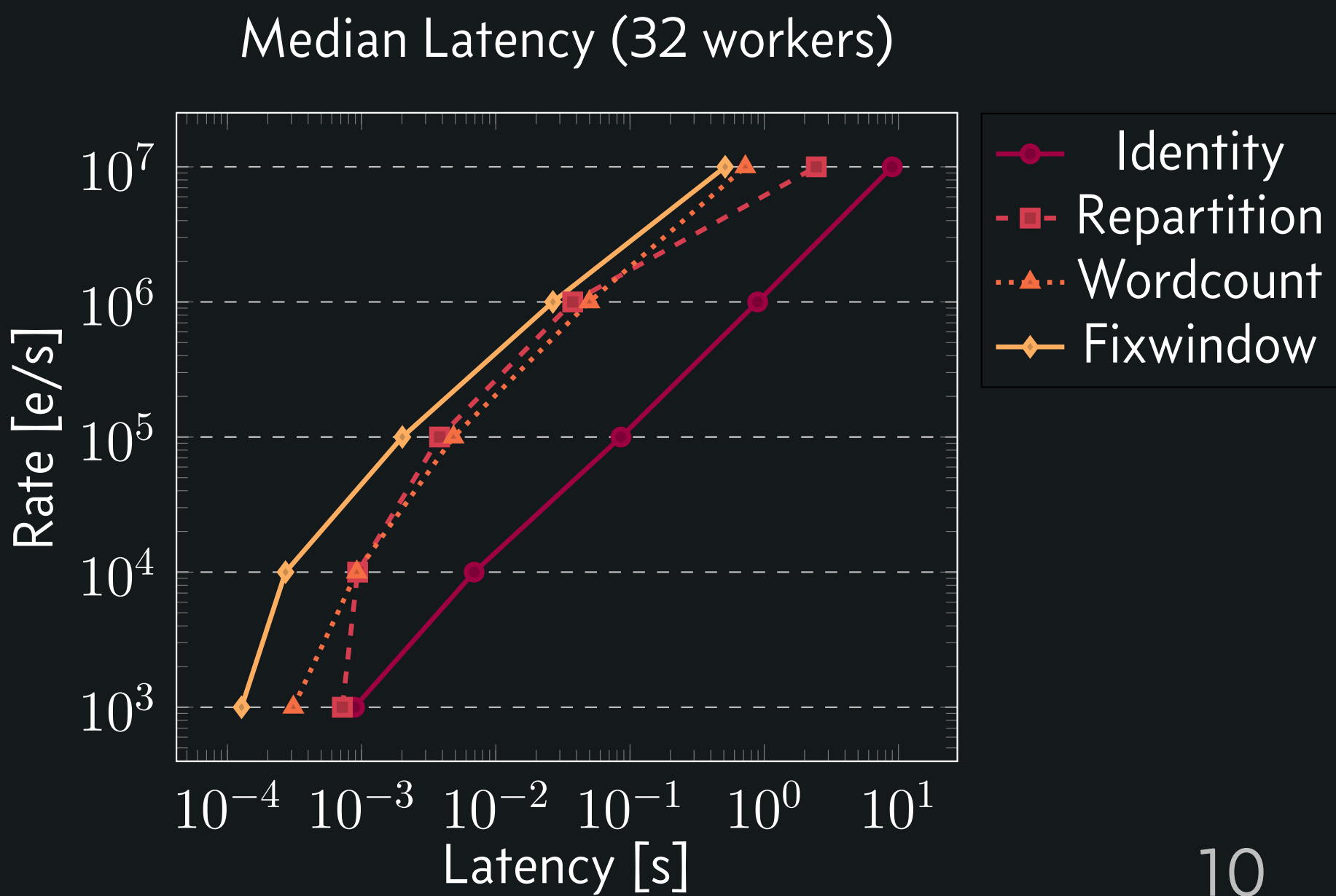


[1] Pete Tucker et al. NEXMark–A Benchmark for Queries over Data Streams (DRAFT). Tech. rep. Technical report, OGI School of Science & Engineering at OHSU, Septembers, 2008.

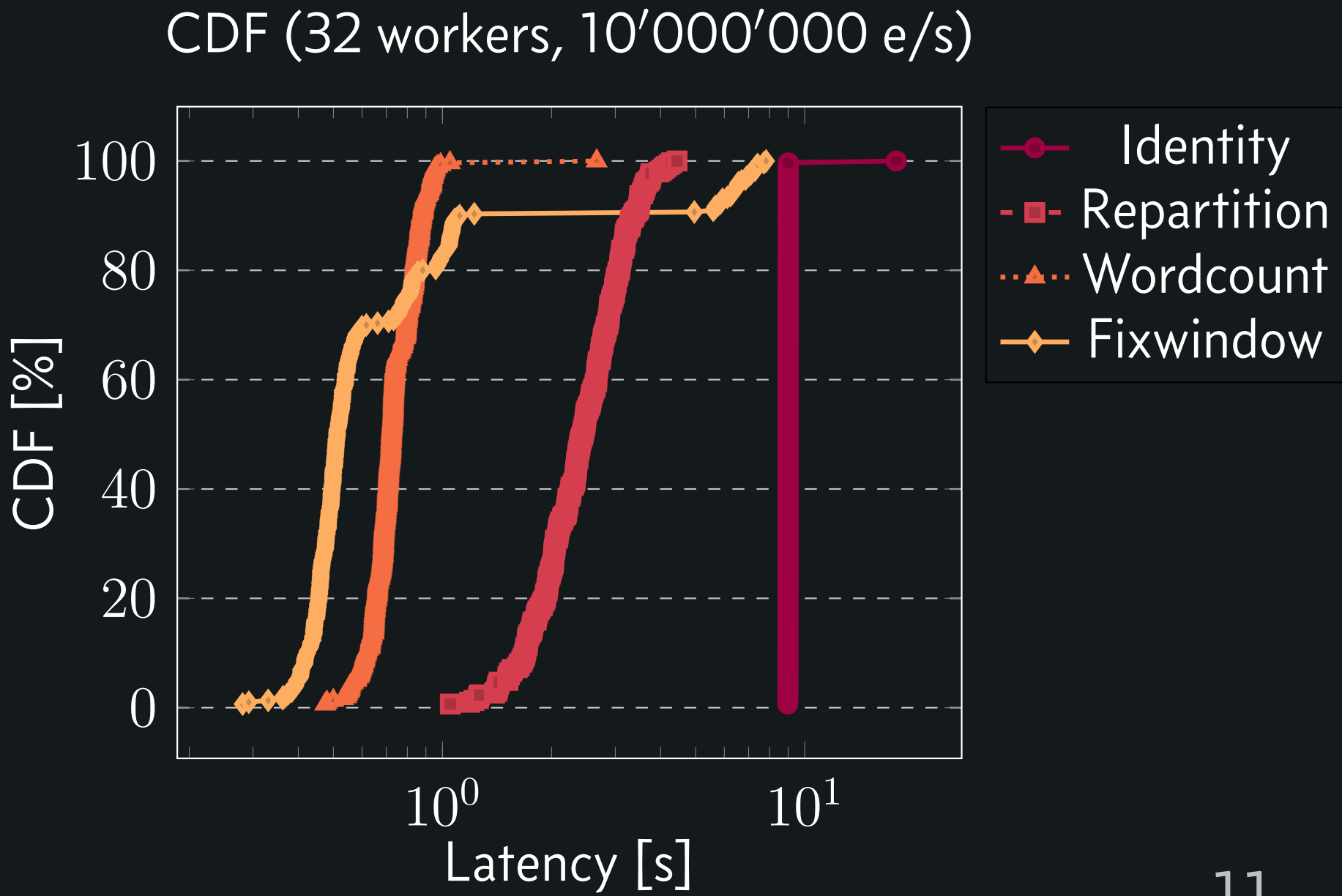
Evaluation

- Run on sgs-r815-03 (AMD, 32 cores, 2.4GHz)
- Measured closed-loop per-epoch latency
- Data generated directly in memory
- Generation re-implemented in Rust
- No foreign systems like Kafka used
- Workload varied between 1K-10Me/s, 1-32 workers

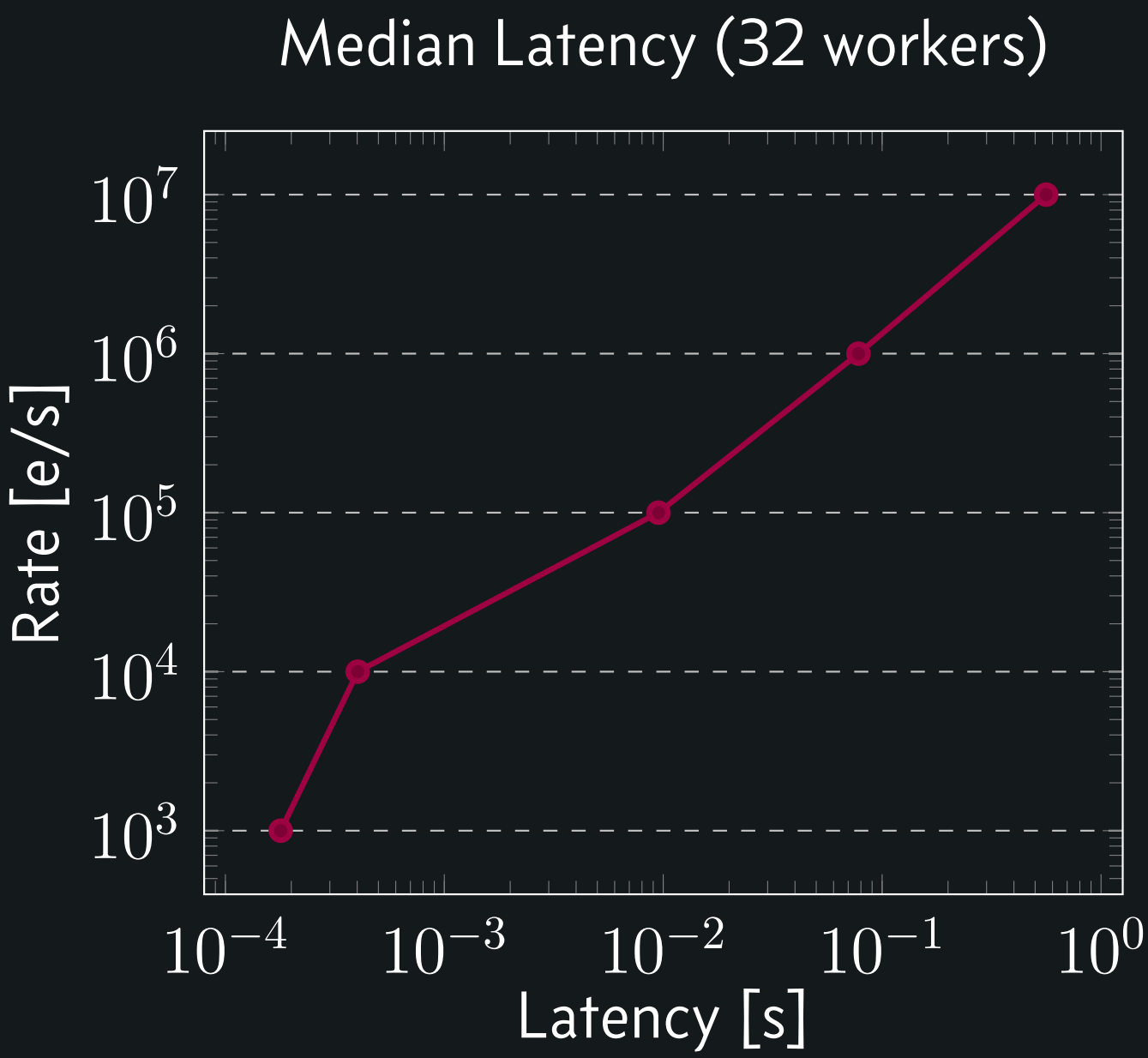
HiBench Latency Scaling



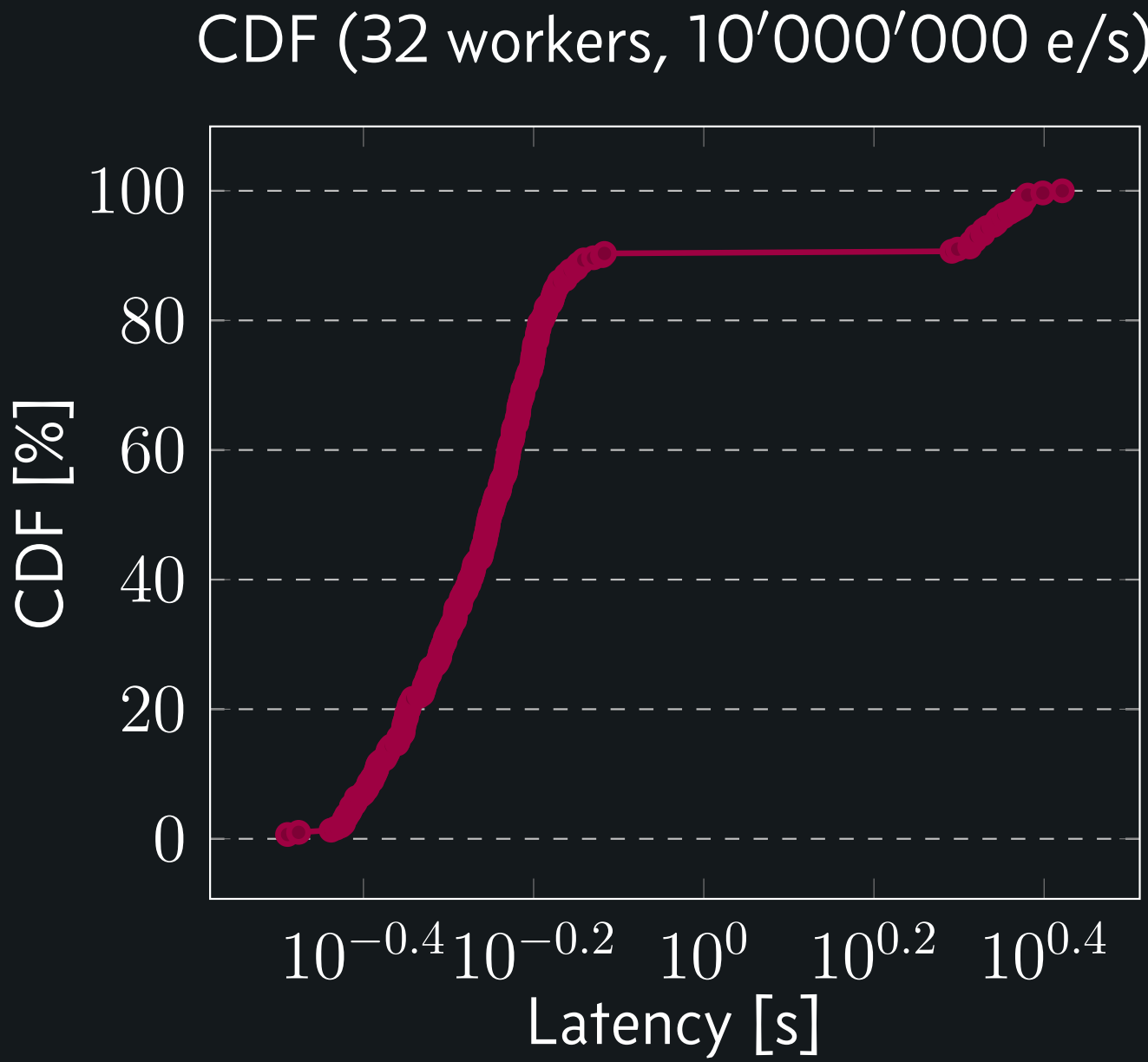
HiBench CDF


CDF (32 workers, 10′000′000 e/s)
CDF [%]
100
80
60
40
20
0
10^0
10^1
Latency [s]
Identity
Repartition
Wordcount
Fixwindow

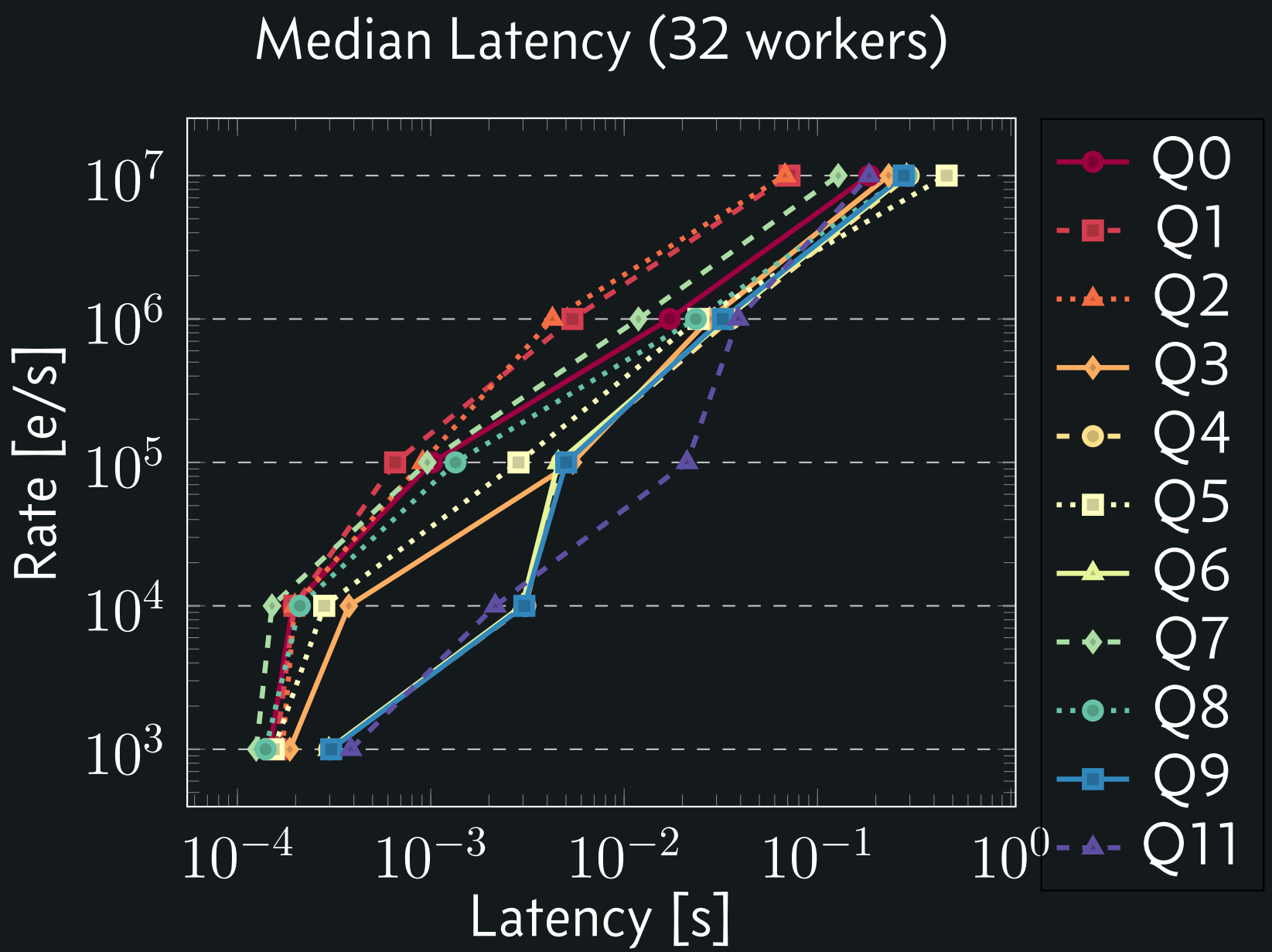
YSB Latency Scaling



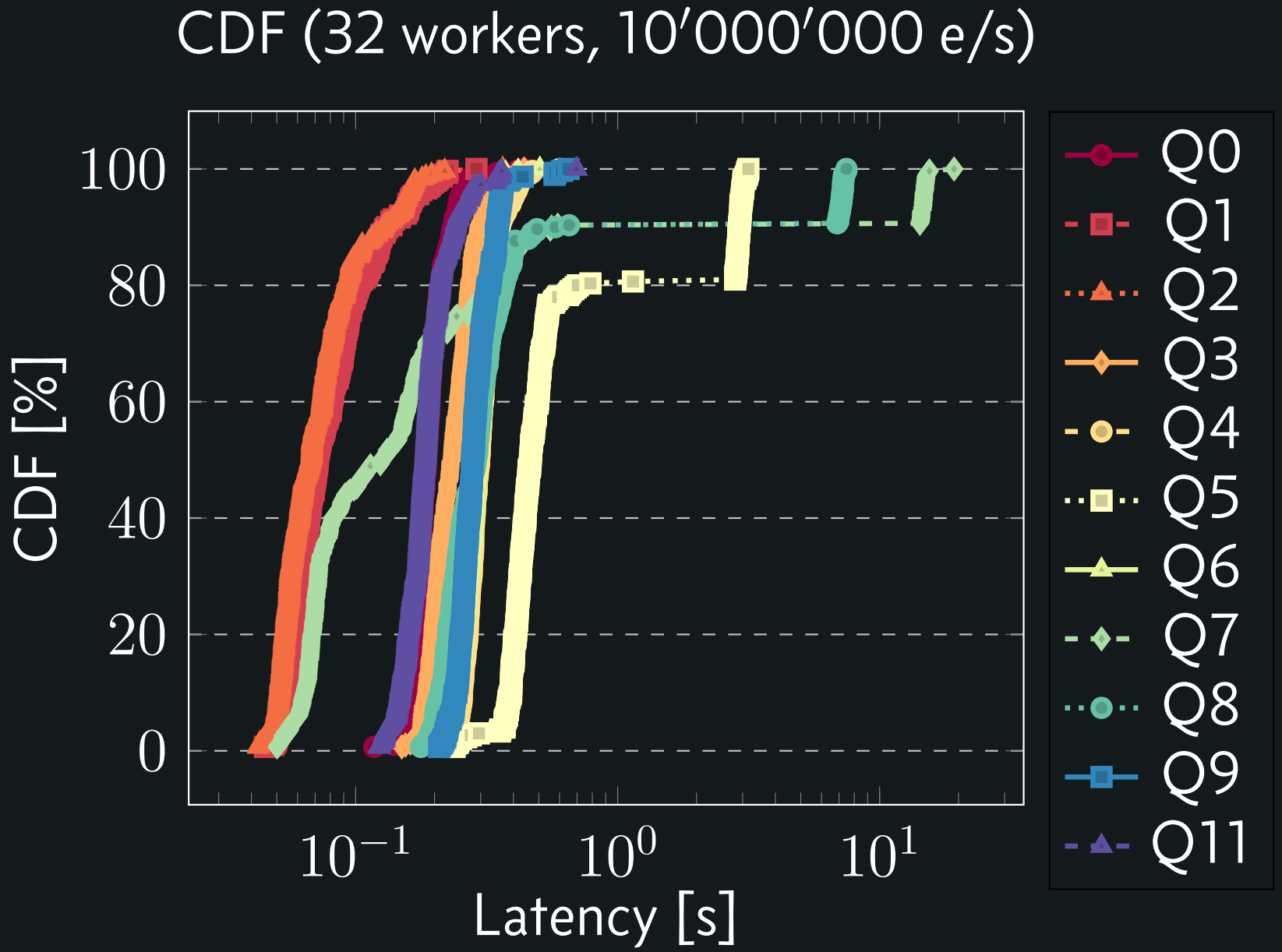
YSB CDF


CDF (32 workers, 10′000′000 e/s)
CDF [%]
100
80
60
40
20
0
$10^{-0.4}$
$10^{-0.2}$
10^{0}
$10^{0.2}$
$10^{0.4}$
Latency [s]

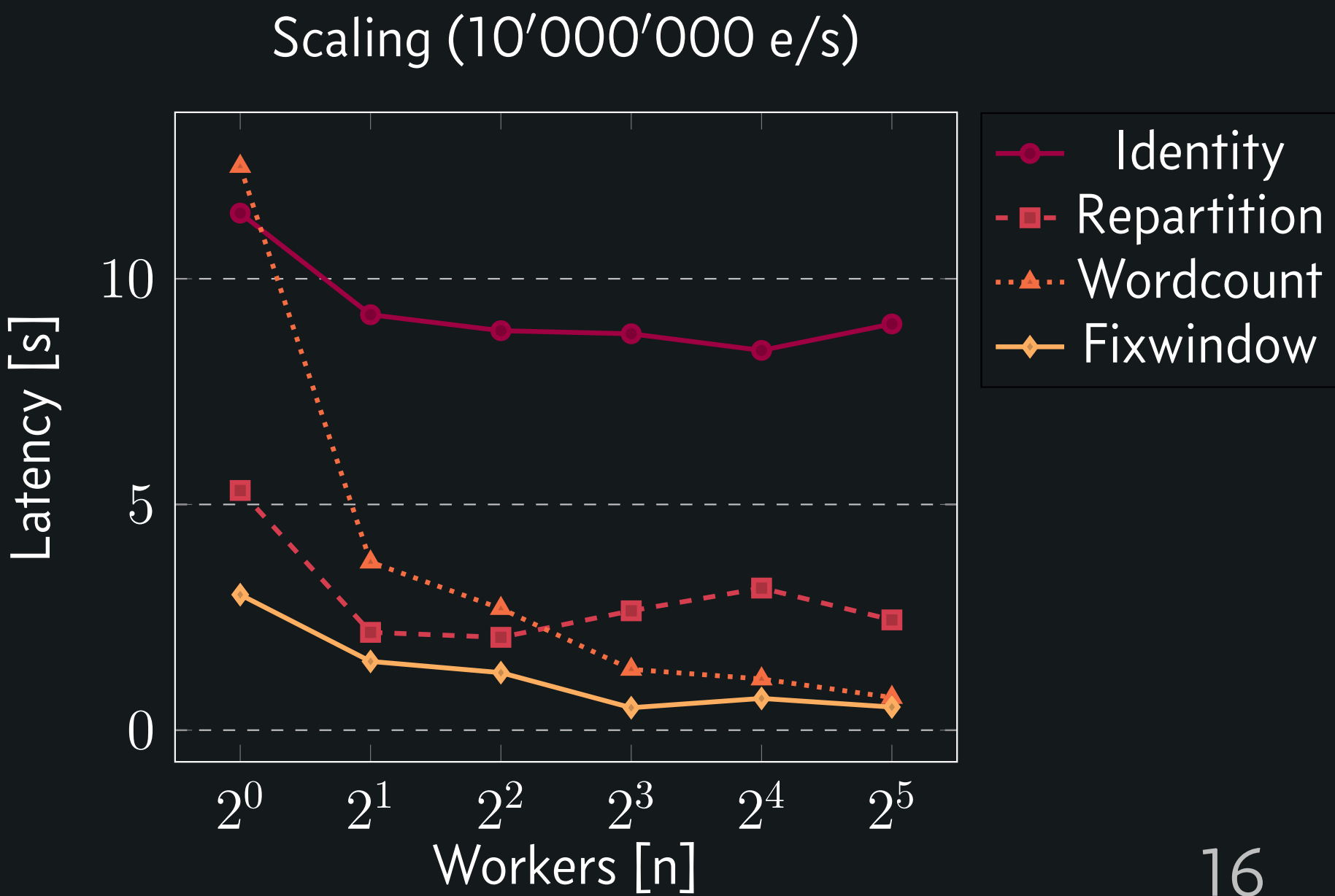
NEXMark Latency Scaling



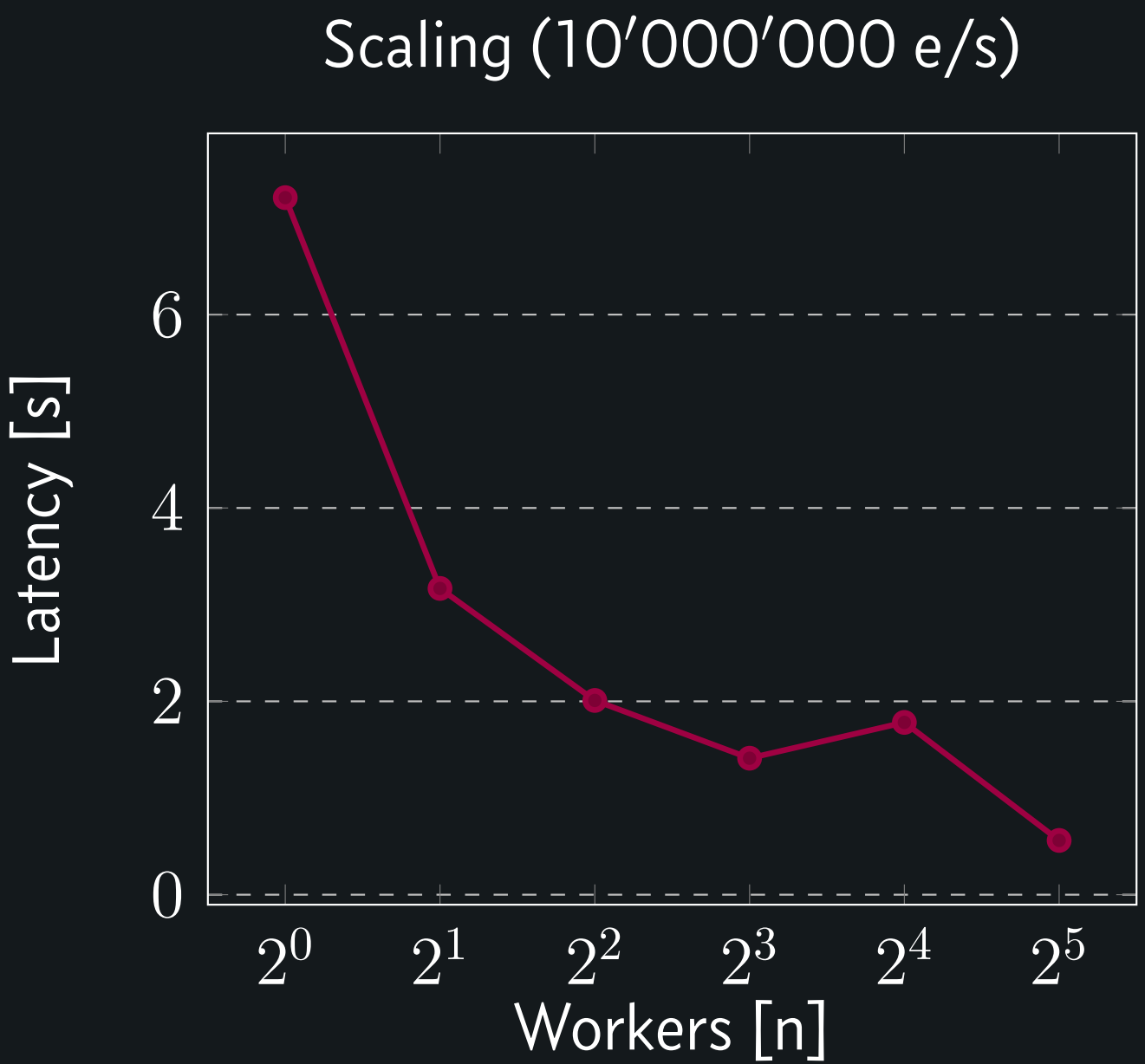
NEXMark CDF


CDF (32 workers, 10′000′000 e/s)
CDF [%]
100
80
60
40
20
0
10^{-1}
10^{0}
10^{1}
Latency [s]
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q11

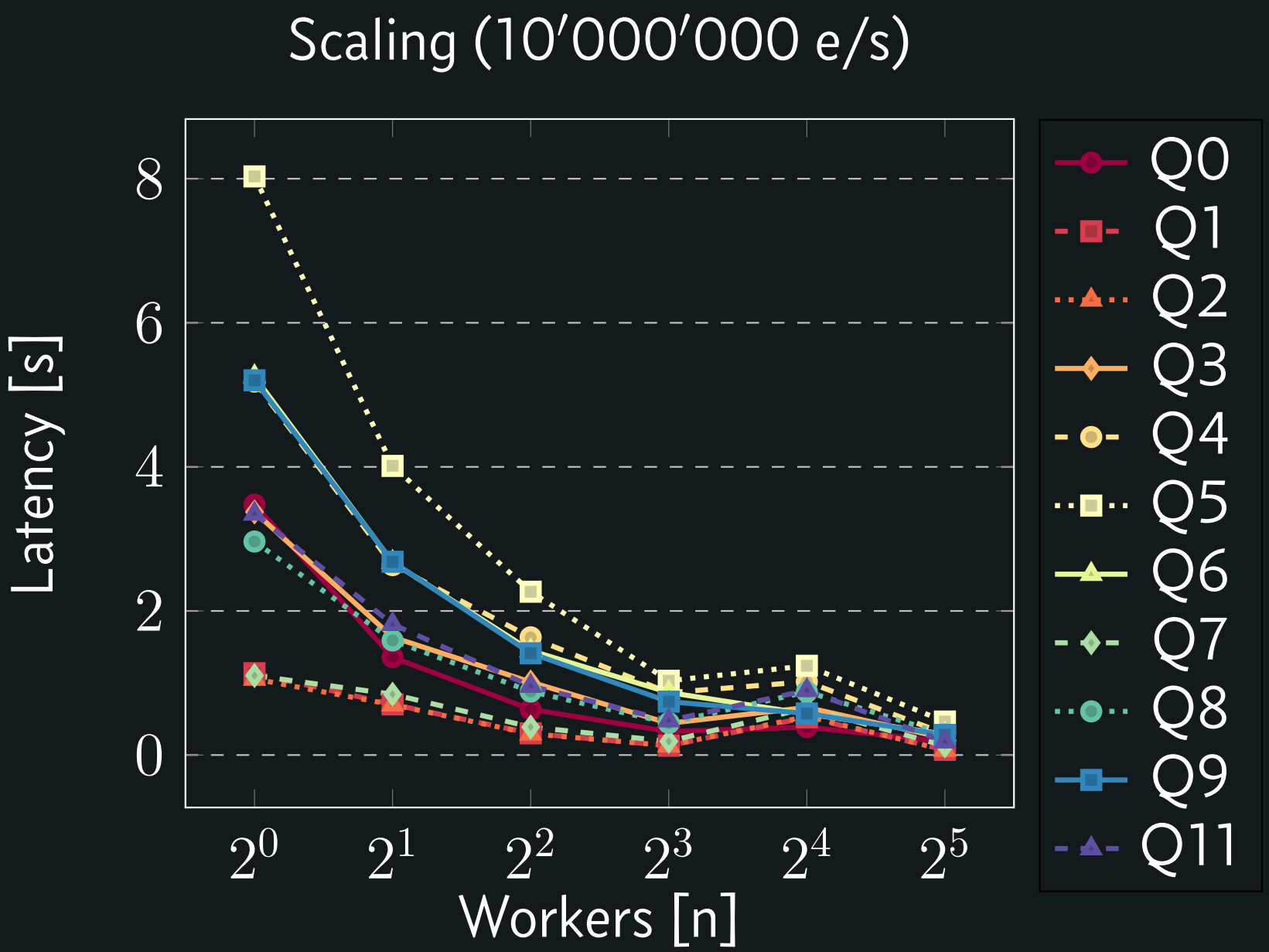
HiBench Worker Scaling



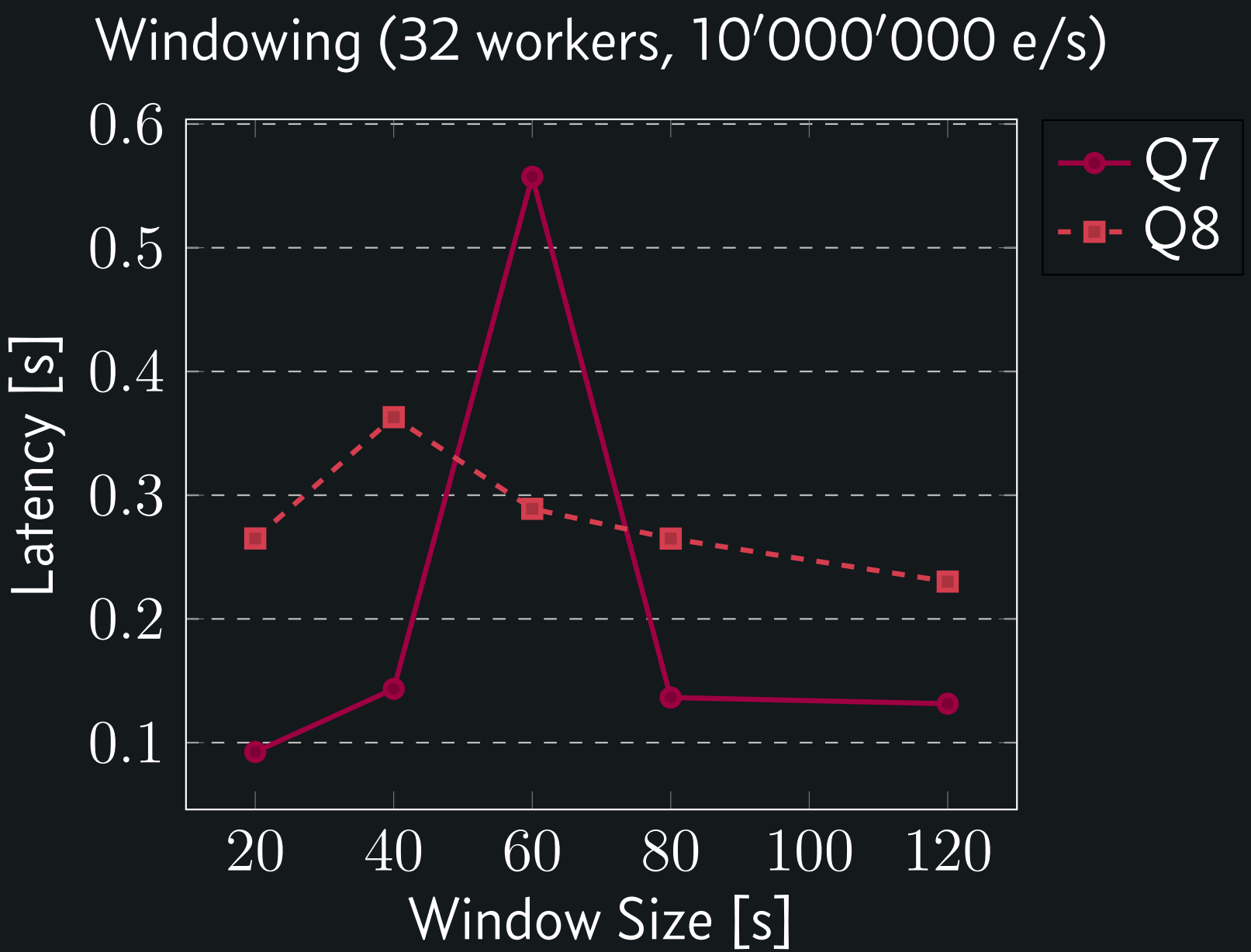
YSB Worker Scaling



NEXMark Worker Scaling

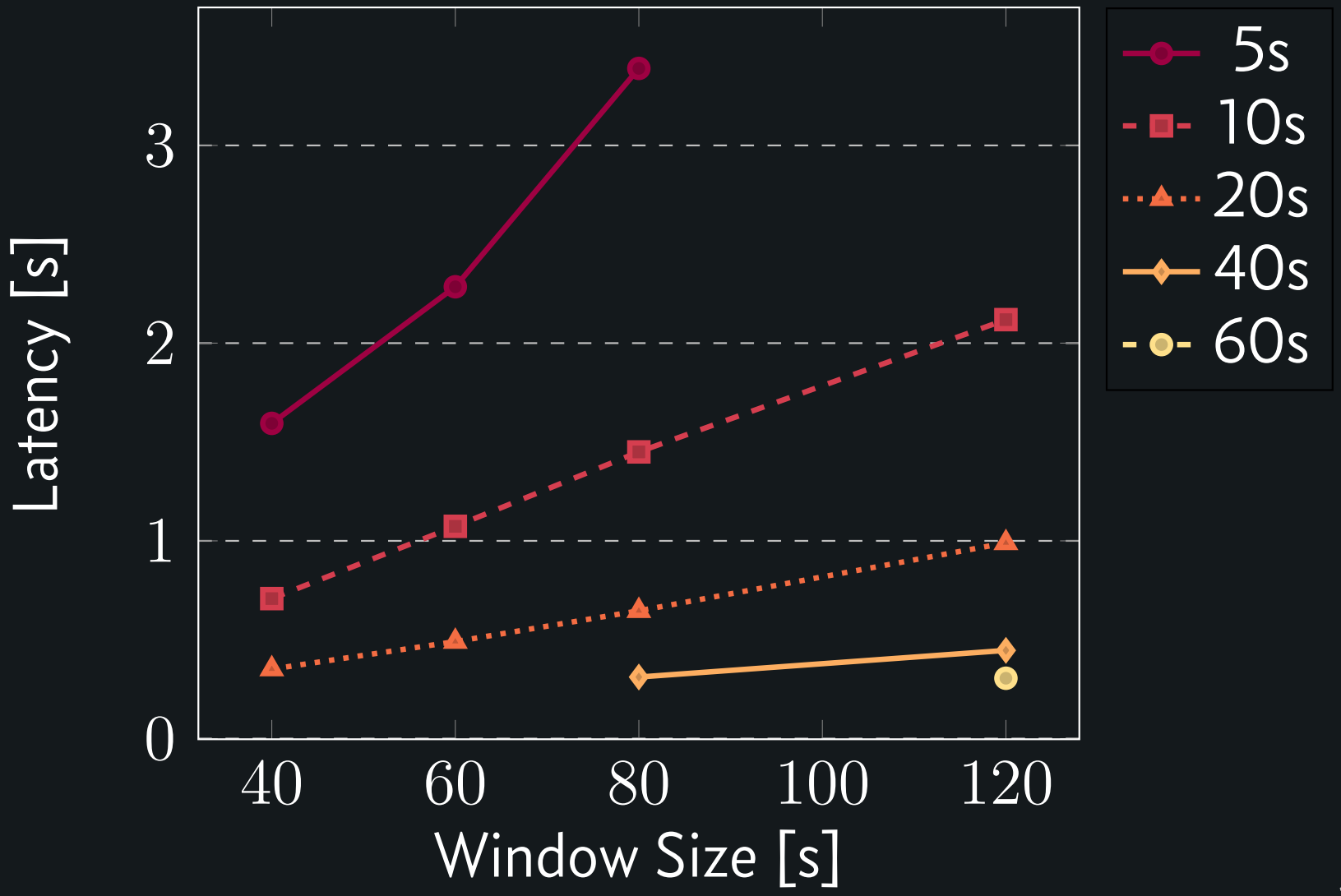


NEXMark Window Scaling



NEXMark Slide Scaling

Window Slides Q5 (32 workers, 10'000'000 e/s)



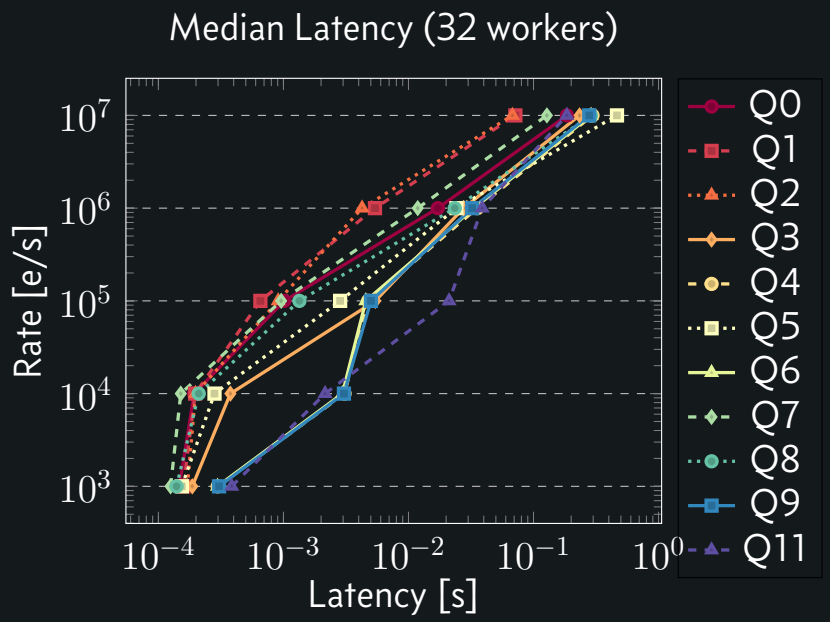
Important Findings

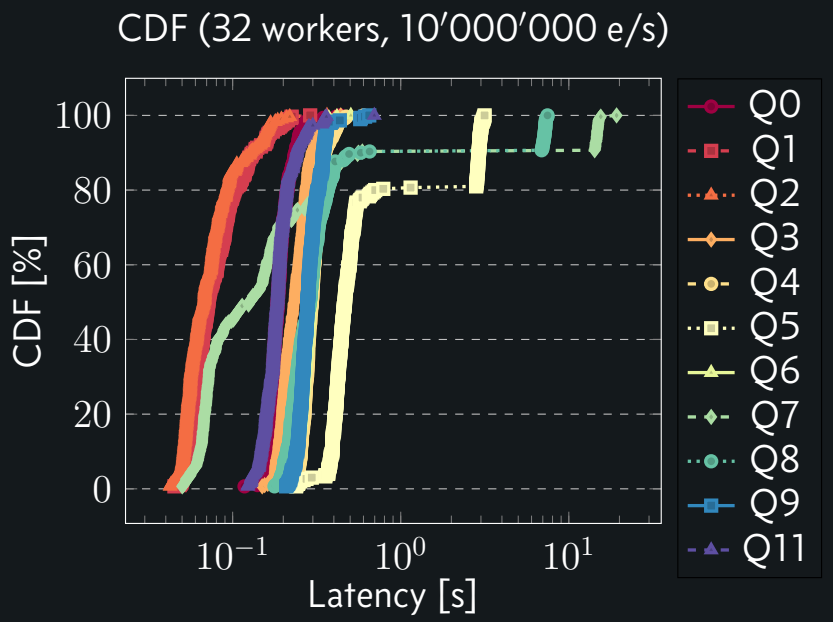
- Benchmarks are underspecified
- No result verification
- External systems compound complexity
- Focus is only on latency

Benchmark Suggestions

- Abstract model definitions for data flows
- Various short and long data flows
- Deterministically generated workloads
- Correctness verification tools

Conclusion





Timely can keep up with 10 million events per second.