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TriggerBench: A Performance Benchmark for Serverless Function Triggers

Short Paper

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Supported by WASP WALLENBERG AI, AUTONOMOUS SYSTEMS AND SOFTWARE PROGRAM

Motivation

High latency is a problem in serverless
[Leitner et al., JSS'19. Mixed-method study.]

Serverless function triggers are insufficiently studied
[Scheuner et al., JSS'20. Multivocal literature review of 112 studies.]

Event-based triggers are the most cost effective control flow
[Quinn et al., WoSC'21. Implications of alternative serverless application control flow methods]

Goal of the Paper

To enable reproducible performance evaluation of serverless function triggers across cloud providers.

Progression of Deployment Options

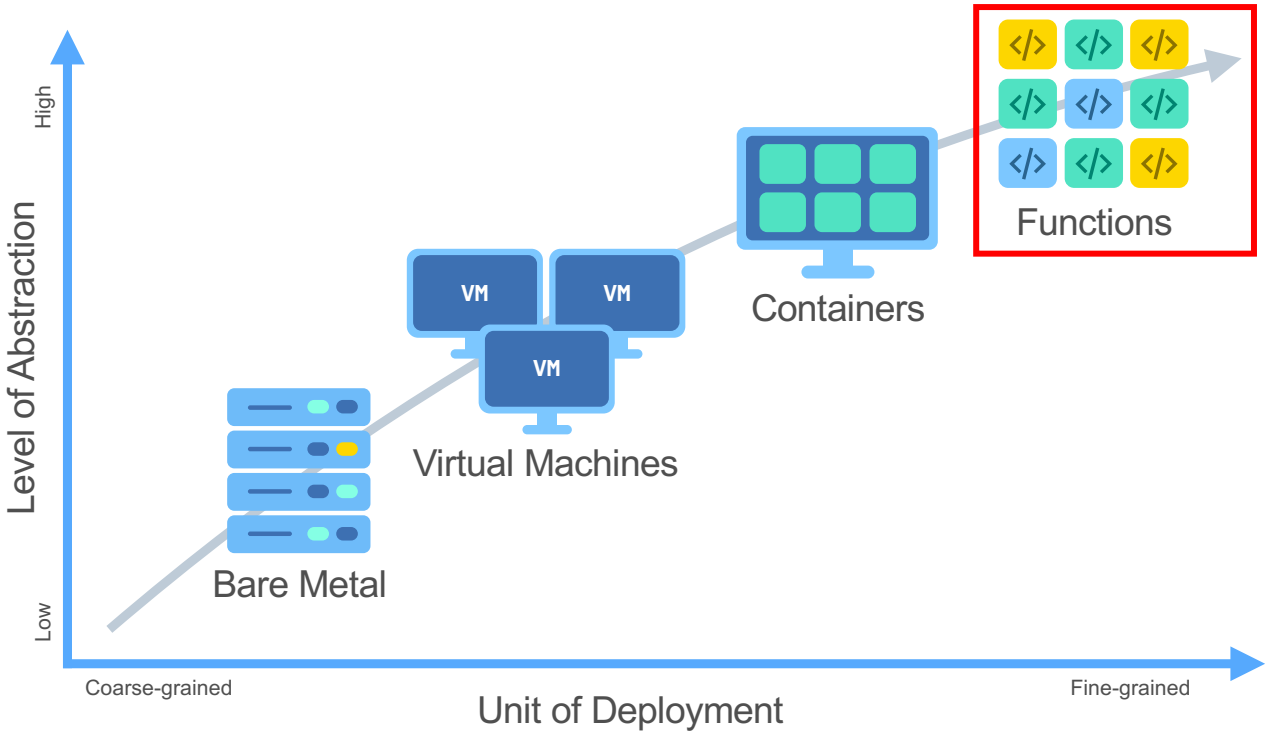
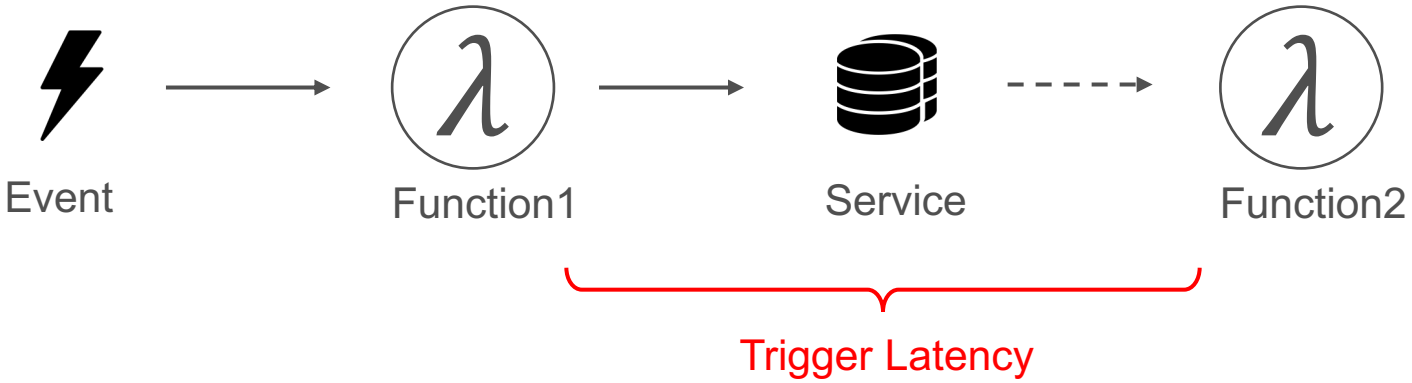
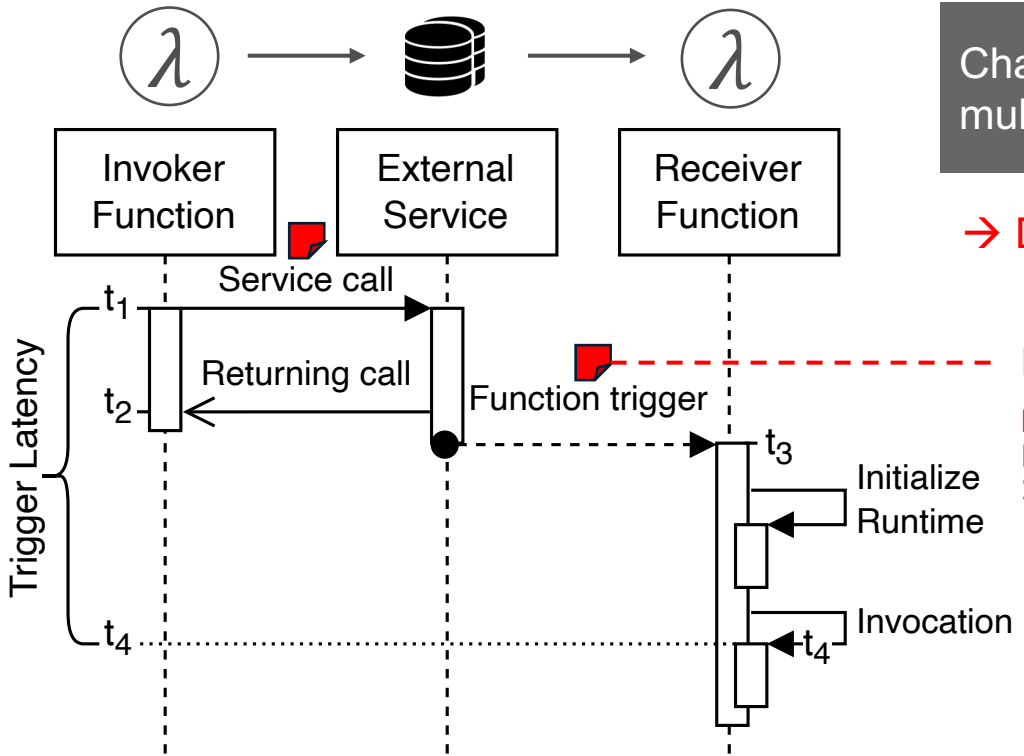


Figure adapted from S. Fink. Serverless – Where Have We Come? Where Are We Going? Keynote at WoSC@CLOUD'18.

Serverless Functions Model



Asynchronous Trigger



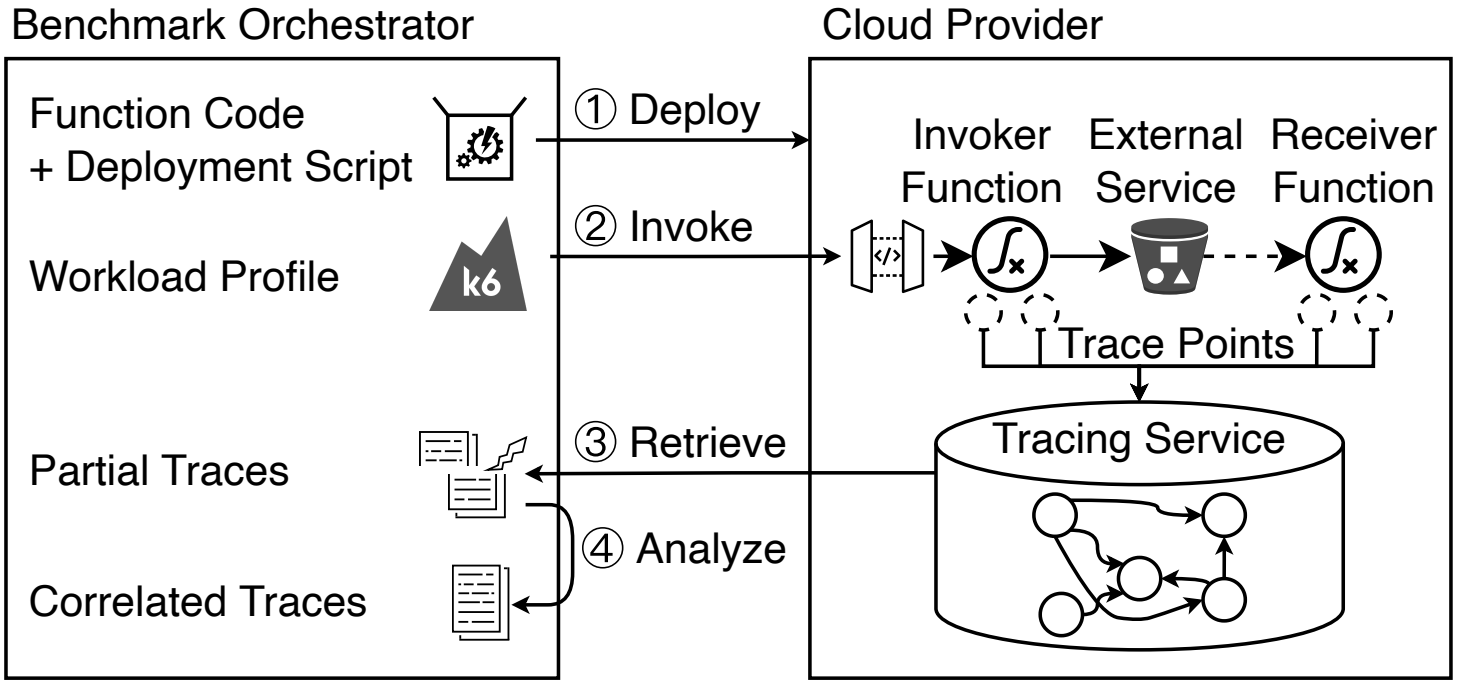
Challenge: Consistent view across multiple (parallel) function invocations

→ Distributed Tracing

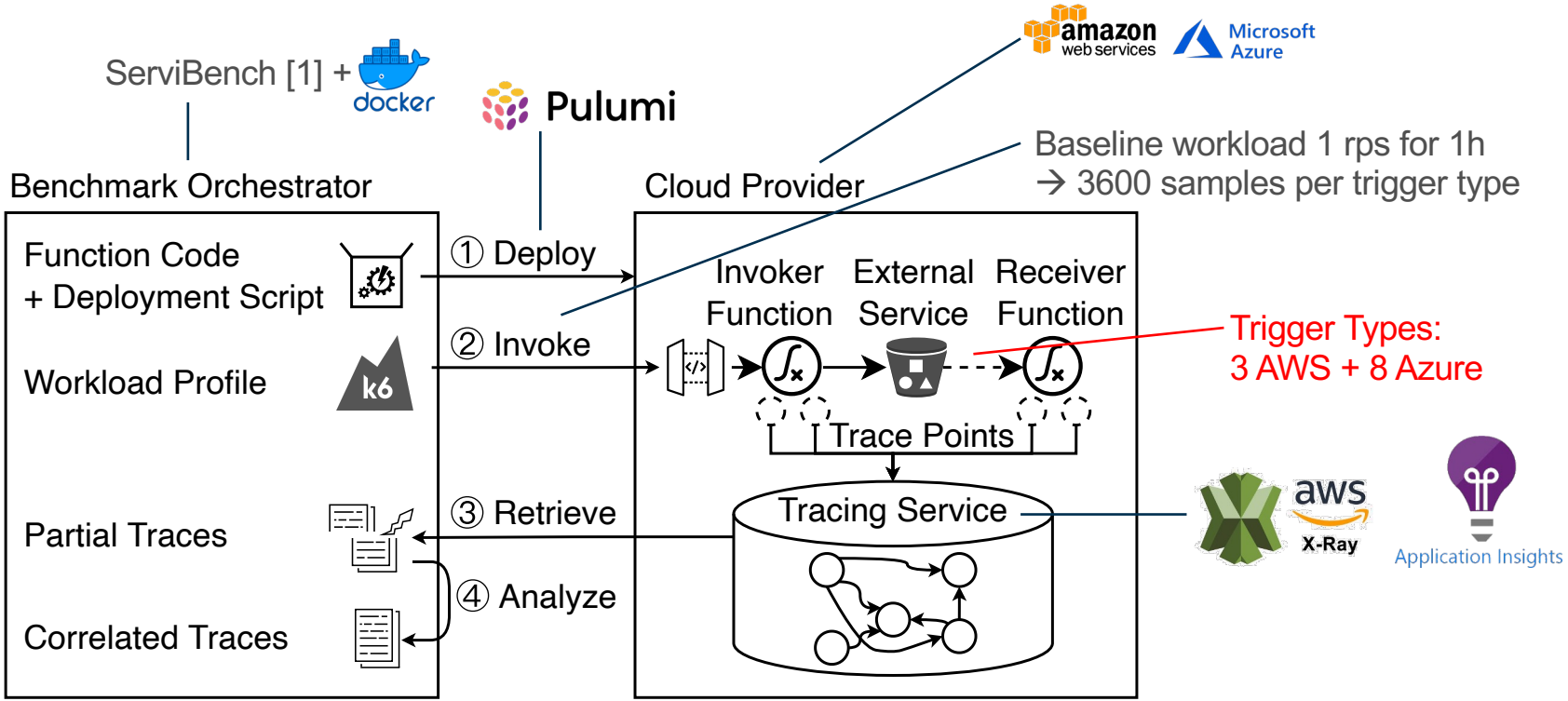
Example AWS X-Ray Tracing Header

```
Root=1-5759e988-bd862e3fe1be46a994272793;
Parent=53995c3f42cd8ad8;
Sampled=1
```

High-level Benchmarking Approach



Implementation



[1] Let's Trace It: Fine-Grained Serverless Benchmarking using Synchronous and Asynchronous Orchestrated Applications. arXiv:2205.07696

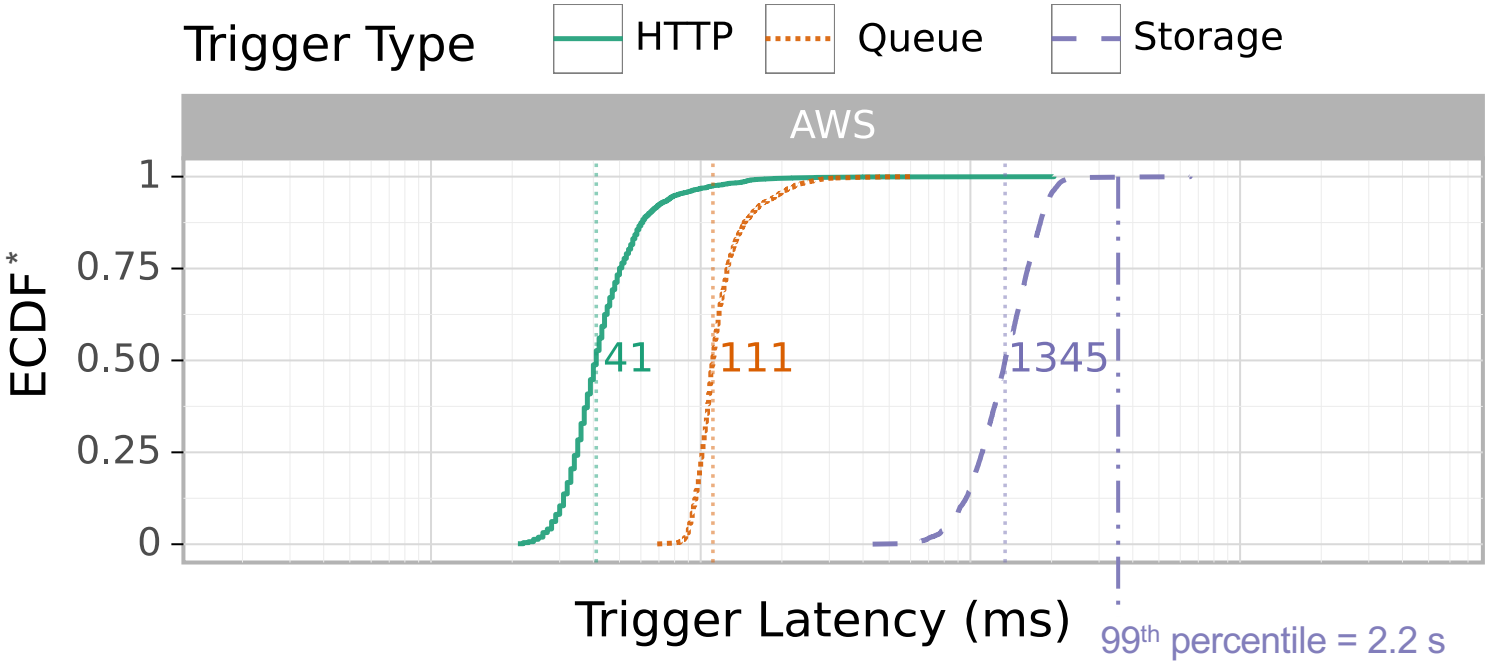
Trigger Types with Provider Mappings

Trigger	AWS Service	Azure Service
HTTP	API Gateway	API Management
Queue	SQS	Queue Storage
Storage	S3	Blob Storage
Database	DynamoDB*	CosmosDB
Event	SNS*	Event Grid
Stream	Kinesis*	Event Hubs
Message	EventBridge*	Service Bus Topic
Timer	CloudWatch Events*	Timer

* Not implemented

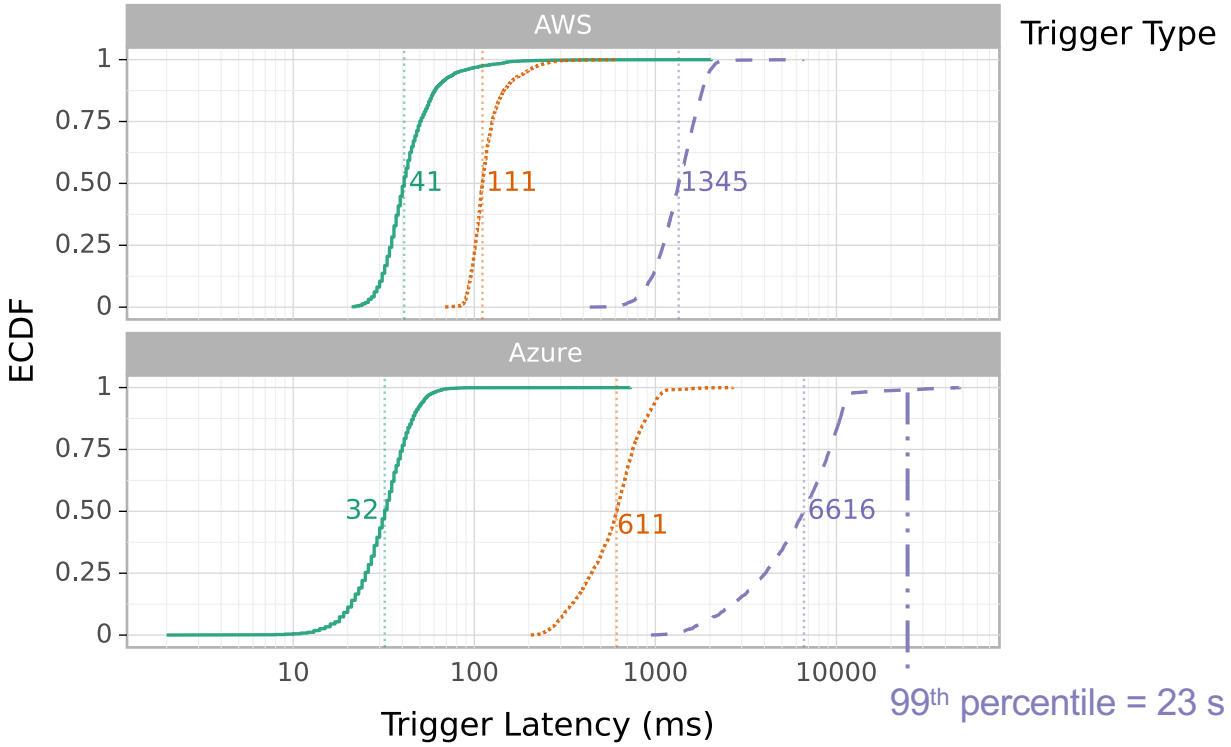
← Most popular app trigger [Eismann, TSE'21]
← Causes 2nd most invocations [Shahrad, ATC'20]
← Most popular service [Eismann, TSE'21]

Results AWS

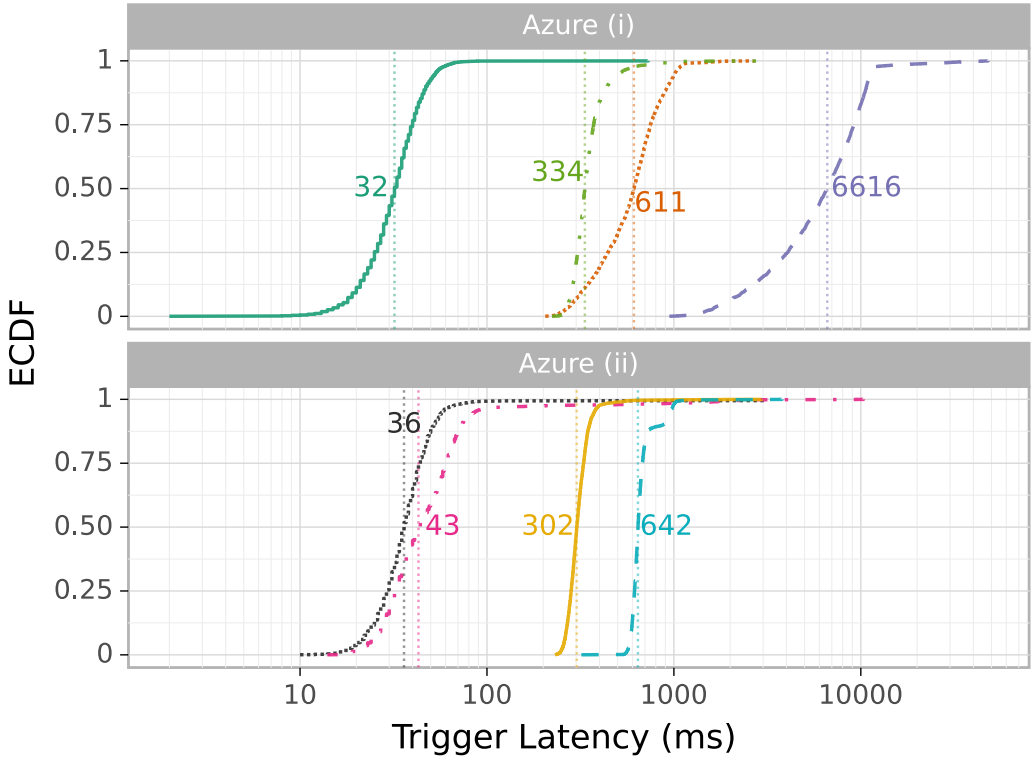


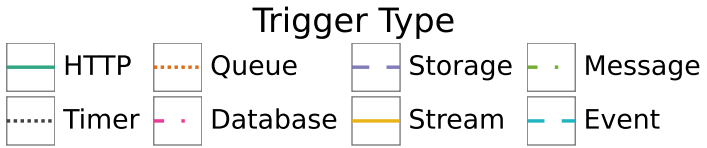
* Empirical Cumulative Distribution Function

Results AWS vs. Azure



More Results for Azure





Summary

- Function triggers suffer from long tail latency
- Synchronous HTTP trigger most suitable for interactive applications
- Storage triggers introduce multi-second delays

Related Work

- Pelle et al. CLOUD'19
  - Different event payload sizes on AWS
- Quinn et al. WoSC'21
  - Comparison of four different control flow methods
- Lee et al. WoSC'18
  - Median throughput of three triggers across four providers

Conclusions

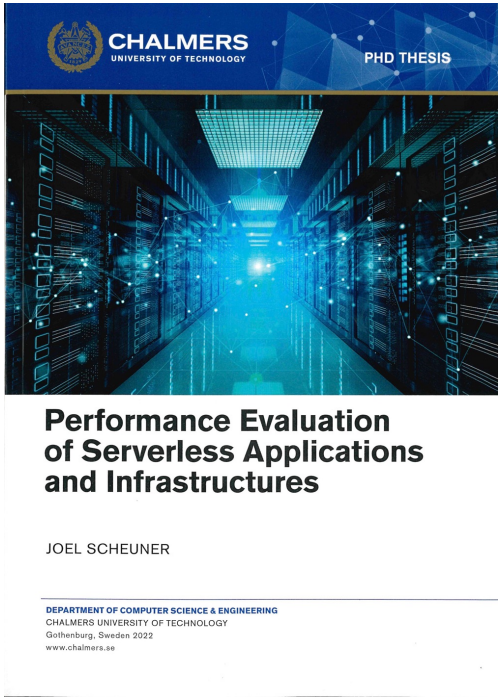
TriggerBench evaluates the latency of function triggers.





All artefacts are available





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Threats to Validity

- Construct validity: Limited observability due to restricted access to serverless environments
- Internal validity: Potentially inaccurate clock synchronization → check for negative timediffs
- External validity: field experiments are not generalizable beyond the studied design
- Reliability: strive for technical reproducibility + replicability of data analysis

Future Work

- Aspects
  - Language runtimes (e.g., Python, Java)
  - Message payload size
  - Bursty workloads
- Longitudinal study
- Extensible: authentication support for other providers

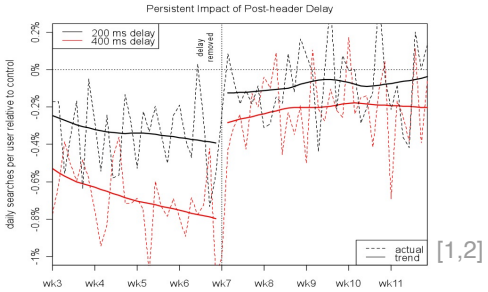
Software Performance Matters

Bing

Delay	Time to Click (increase in ms)
50ms	-
200ms	500
500ms	1200
1000ms	1900
2000ms	3100

[1]

Google



[1,2]

+200ms delay → -0.29% searches
+400ms delay → -0.59% searches

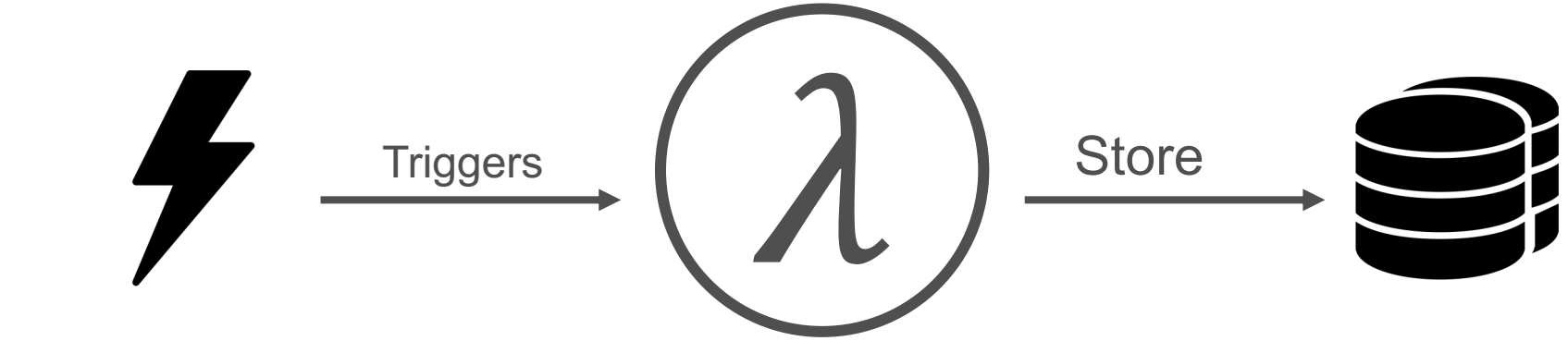
amazon

+100ms response time in page load

→ -1% sales [3]

[1] B. Forrest. Bing and Google Agree: Slow Pages Lose Users, Online: http://radar.oreilly.com/2009/06/bing-and-google-agree-slow-pag.html. 2009.
[2] J. Brutlag Speed matters for Google web search, Online: https://ai.googleblog.com/2009/06/speed-matters.html. 2009.
[3] R. Kohavi and R. Longbotham. Online experiments: Lessons learned. Computer, 2007.

What is Serverless Computing?



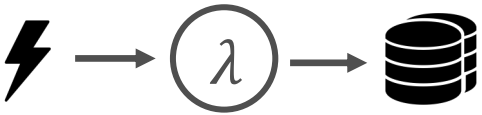
Cloud Event

Function

External Service

(database, queue, …)

Serverless Performance Benchmarking



Right model for my application?

Which platform is best for my application?

How to satisfy performance requirements?

Credits

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