The Serverless Trilemma

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What is serverless computing ?

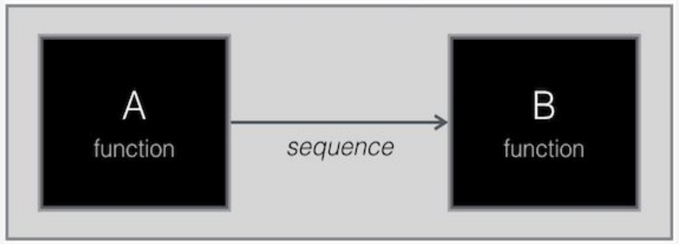
- Build and run applications without thinking about servers
- Functions as a Service
    - Micro-services are offered as separated “actions” or “functions”.
    - One function generates an output (example JSON) that acts as input to any other function.
- Event-driven invocations
    - The function should invoked based on events.
    - For example: When a function build completes, it “triggers” the other function(s).
- Function composition
    - Rather than create a single monolithic function, it is often desirable to separate the concerns of schema alignment and notification.

The problem

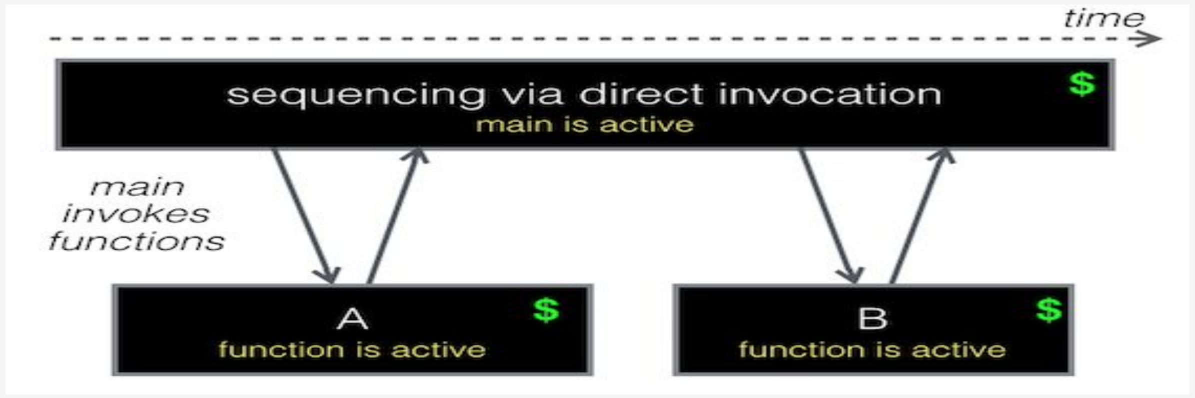
- Composition-as-functions must violate at least one of the 3 constraints:
    - Functions should be considered as black boxes.
    - Function composition should obey a substitution principle with respect to synchronous invocation.
    - Invocations should not be double-billed.

The Serverless Trilemma – I

- This desired sequential combinator as then i.e. a.then(b).then(c) => c (b (a()))



- Composition by Reflective Action Invocation (Double Billing Constraint).



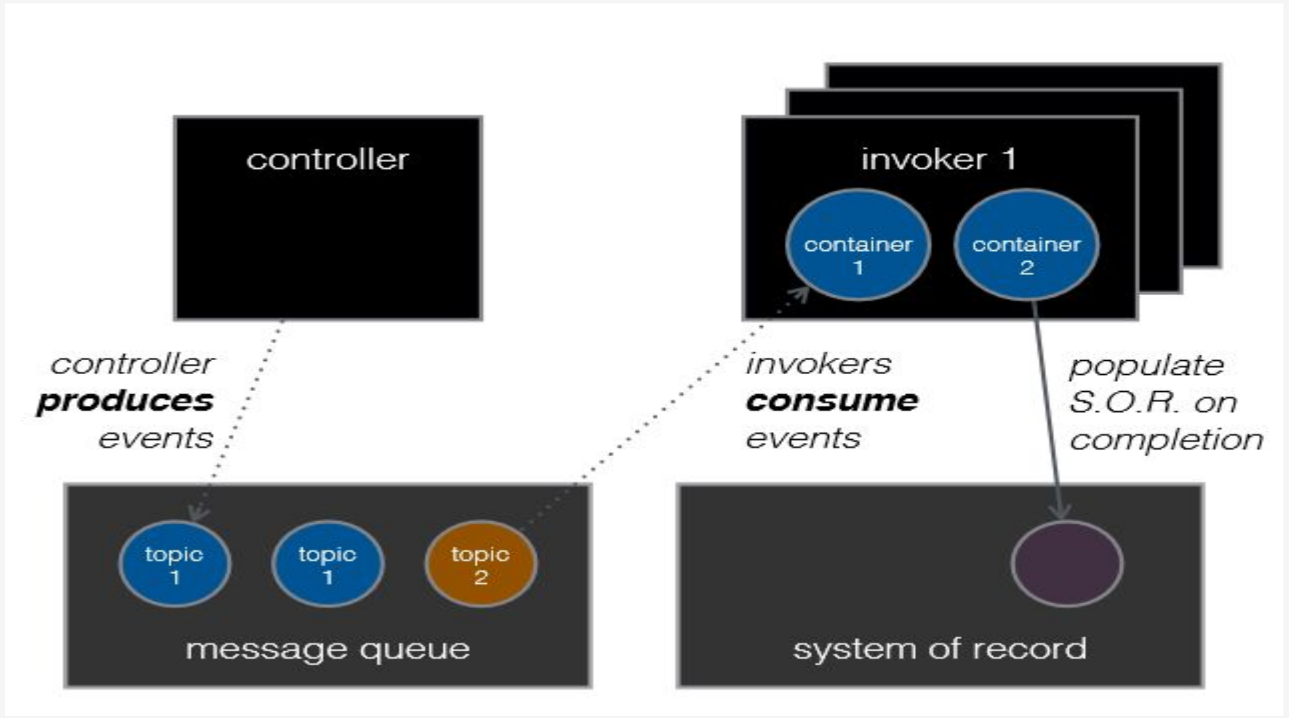
Reference: https://medium.com/openwhisk/composing-functions-into-applications-70d3200d0fac/

The Serverless Trilemma - II

- Composition by Fusion of Actions (Black-Box/Polyglot Constraint)
    - To avoid the double billing, we can infuse all functions in one source code.
    - Challenges: The source to every action is available, and in the same language
- Interlude: The Serverless Substitution Principle
    - Compositions-as-actions conform to the the JSON in, JSON out protocol of actions
    - Implies a single entry-single exit structure
    - Replace it with async/await pattern
- Client-Side Scheduling (Abnegation)
    - since it runs on the Client side scheduler not implemented as an action
    - There is no black box, no double billing
    - Satisfies substitution
    - The approach doesn’t work always

Trilemma-safe Sequential Composition - Overview

- Serverless core must offer more than actions, rules, and triggers to satisfy all the three constraints



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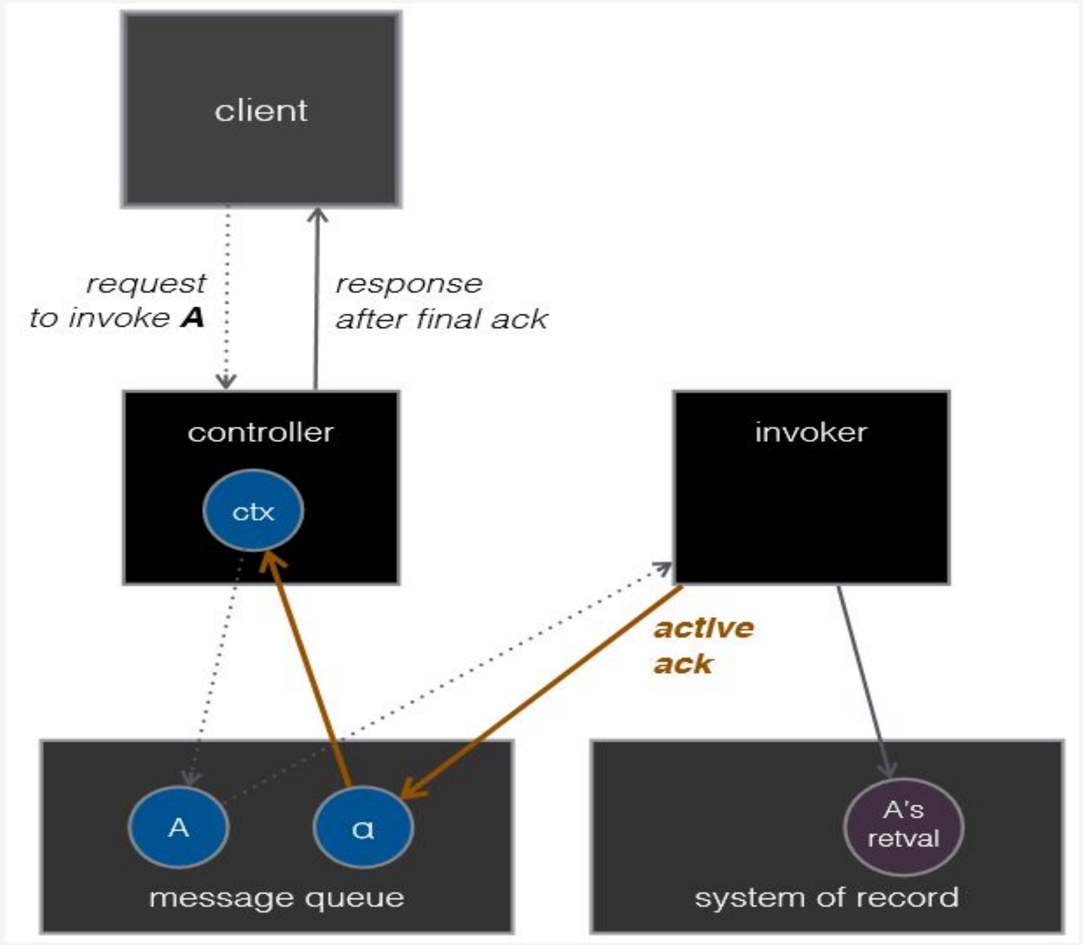
Trilemma-safe Sequential Composition – I



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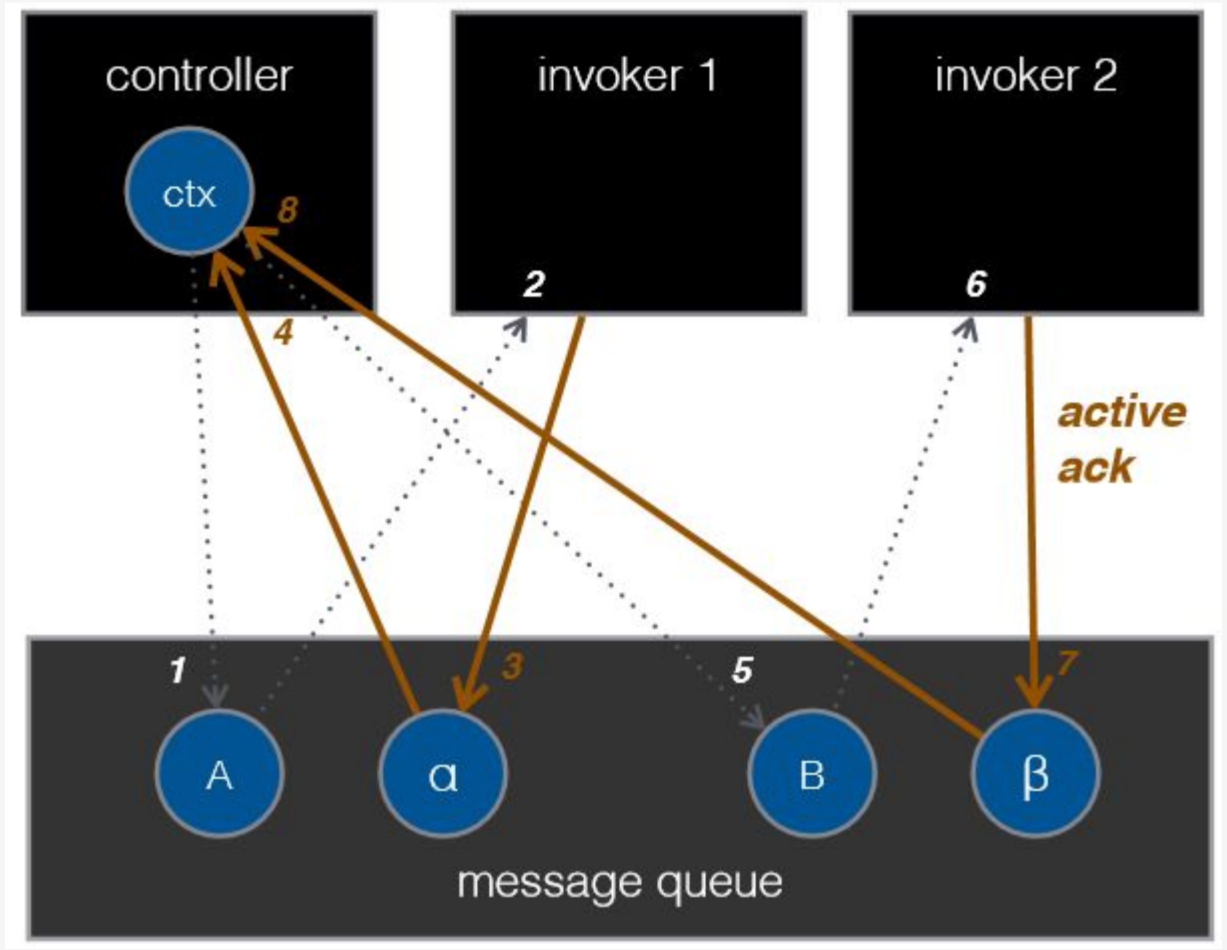
Trilemma-safe Sequential Composition – II



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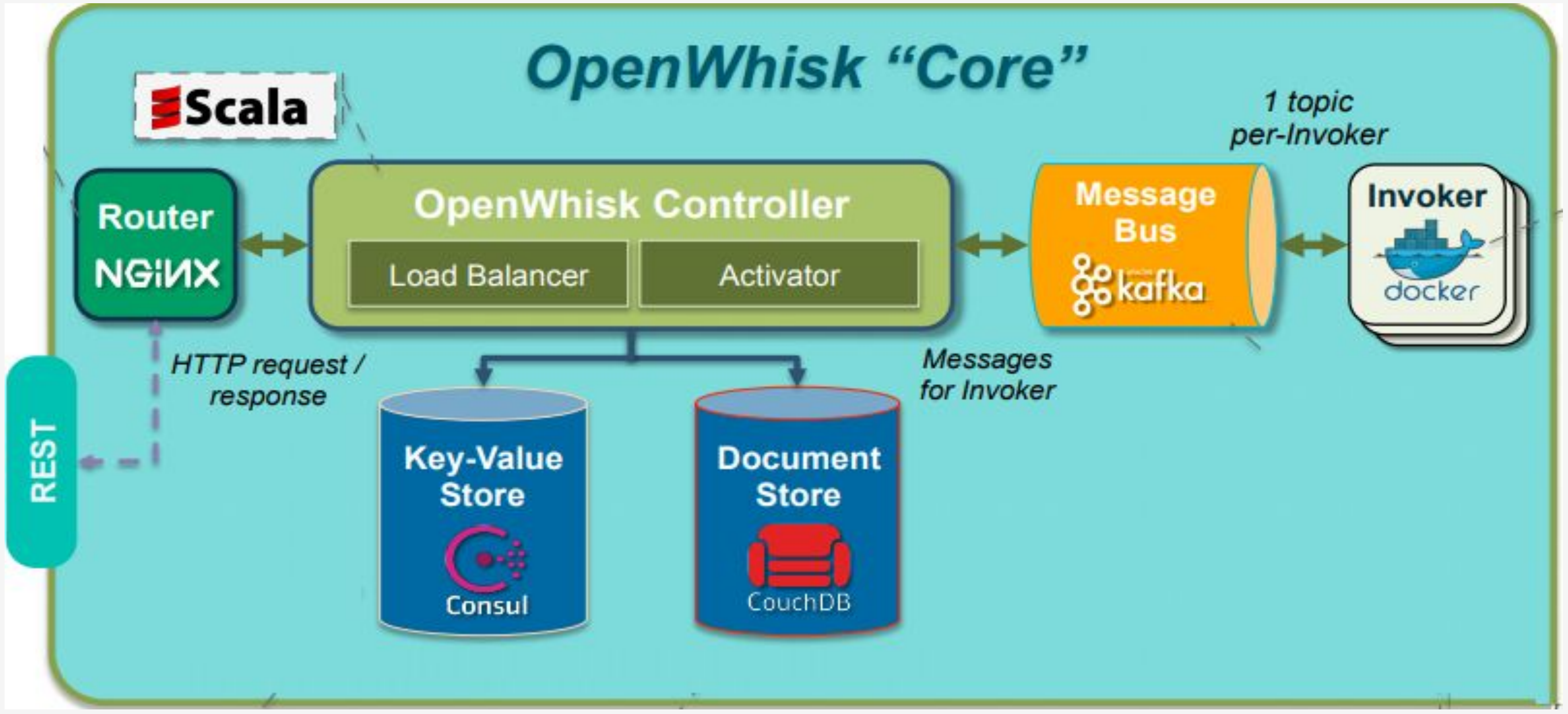
Apache OpenWhisk – Introduction

- FaaS platform to execute code in response to events
- Available as Open Source via Apache Incubation
- Supports a variety of languages, such as JavaScript, Python, Java, and Swift
- Supports function compositions

OpenWhisk Architecture – Detailed View

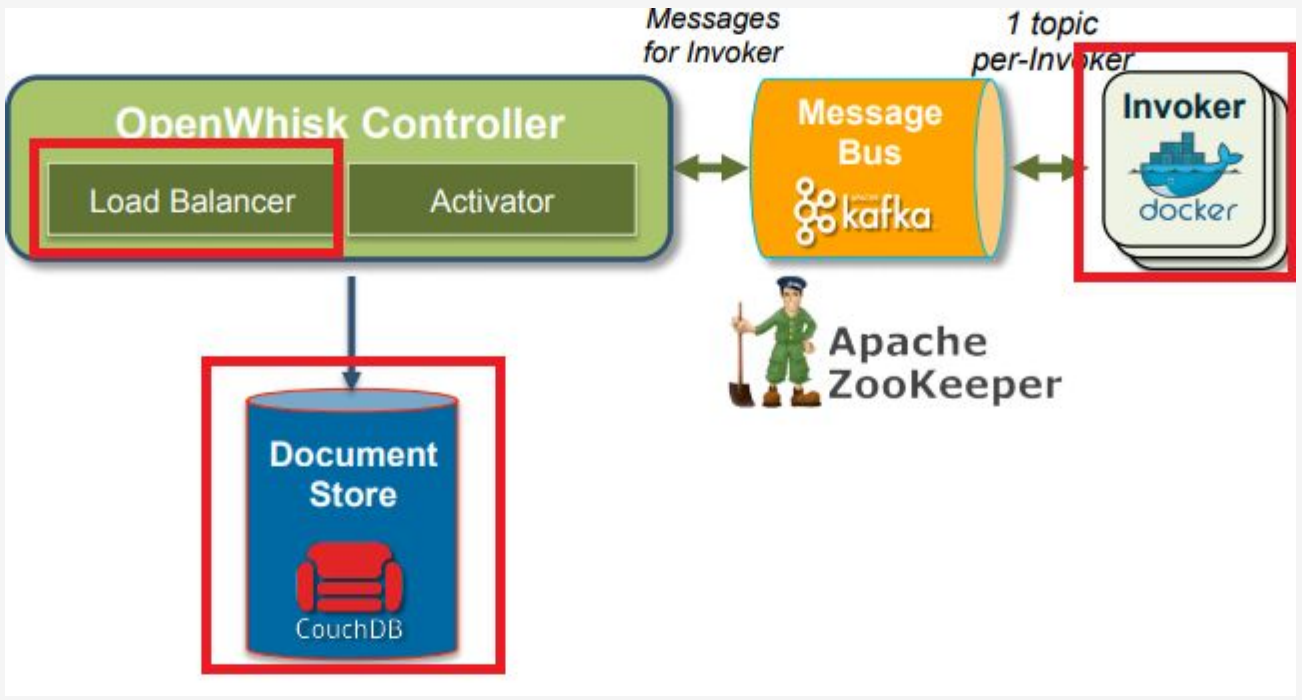


Reference: https://akrabat.com/wp-content/uploads/2019-01-20-ServerlessDaysCardiff-IntroducingOpenWhisk.pdf/

Which changes are necessary to coordinate function compositions that span multiple clusters (e.g., one near the Edge and one in the Cloud)?

OpenWhisk Edge Node Function Composition Solution

- Invokers or functions will be present on the edge node and cloud node depending on the functionality required.
- Load balancer decides which invoker to invoke.
- Finer grain invocation rules for the load balancer based on the requirements.



Reference: https://akrabat.com/wp-content/uploads/2019-01-20-ServerlessDaysCardiff-IntroducingOpenWhisk.pdf/

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Questions?