Event Driven IoT - Serverless Functions for OSGi

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Who is Tim Ward?

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10+ years developing OSGi specifications

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Serverless Computing
Serverless Computing - A Primer

- **Serverless Computing is a “Cloud Service”**
  - You write and deploy the “application” code
  - The Cloud provider hosts, scales, and maintains the infrastructure

- **You can think of Serverless as a “half-way house”**
  - Less maintenance overhead (for you) than “Platform as a Service”
  - You can deploy your own code, unlike “Software as a Service”

- **Different Providers have different API requirements**
Function as a Service

- Serverless applications are usually stateless
  - This is typically known as “Function at a Service”
  - You can use a Data Store (usually provided by your Cloud Provider)

- Some providers let you store “temporary state”
  - A small amount of disk and/or memory shared between executions
  - This can be thrown away by the provider for any reason!

- Define an entry point and “triggers”
  - Http Request, Changes to S3 bucket, MQTT message...
Why is this a good thing for IoT?

- Functions are easy to deploy
  - Cloud Providers have deployment APIs - no scripts to write/maintain
  - Platform updates and security fixes are automatic

- Flexibility of Input and scaling
  - Multiple IoT Device inputs can map to the same trigger
  - Bursts of Events can be handled by scaling the function

- Costs less money (you hope!)
  - “Pay per invocation” when function gets called
  - Using more CPU/Memory increases the cost per call
  - Unexpected load means unexpected bills!
Java Examples
AWS Lambda (Java)

- The “Application” is a JAR file
- “Entry Point” is a method
  - Can implement an interface or be reflectively called
- Dependencies must be packaged into the deployment
  - Recommended to use “shading” to avoid clashes with the runtime
- “Entry Point” and “Trigger” defined in a descriptor file
- Different Providers have different API requirements
  - But broadly similar in Azure, Google, Apache OpenWhisk...
Does this sound familiar?

- Serverless Functions have
  - Nominated entry point
  - Metadata packaged to describe the function
  - Internal Dependencies “managed” separately from the platform

- OSGi services can be good candidates for Functions!
  - OSGi’s Whiteboard pattern is an example of a serverless architecture
OSGi “Function as a Service”

- The “Application” is a Bundle (JAR file)
  - “Entry Point” is a service
  - Dependencies Defined in a manifest

- So for HTTP input...

```java
@Component(service=Upper.class)
@JaxrsResource
public class Upper {

    @Path("rest/upper/{param}"")
    @GET
    public String toUpper(@PathParam("param") String param) {
        return param.toUpperCase();
    }
}
```
Are we done already?

- The example on the previous slide is great for HTTP
  - But what if our input came in from some other source?

- In IoT data comes from all over the place
  - And using *many* different protocols

- OSGi has made it really easy to plug in connectors
  - But should you need to deal with different protocols
  - How many things do you have to write?
Being protocol independent

- **Good Functions should be protocol independent**
  - The function shouldn’t know or care about HTTP/MQTT…

- **Good functions should accept typed data**
  - The input parameters should define a schema

- **Good functions should not directly call other functions**
  - Compose functions through trigger events
  - Better scaling if the function is already running somewhere
Using Functions in OSGi
BRAIN-IoT - Intelligent Decentralised Fog Platform

Part of the European Union Horizon 2020 program

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BRAIN-IoT: Mission Critical City Infrastructure

- Mission Critical Water Utility Infrastructure: location A Coruña, Spain
- Real Time Sensing, AI anomaly detection and Actuation across a sophisticated physical City Infrastructure.
- Robustness and Security paramount.
Architecture of the BRAIN-IoT project

- BRAIN-IoT is built from interacting “Smart Behaviours”
  - A Smart Behaviour consumes and sends “data” events
  - Events may be generated by sensors, users, or by other Smart Behaviours

- A Smart Behaviour can be implemented any way you like
  - Each Behaviour is its own independent decoupled unit

- Smart Behaviours use typed event data
  - This makes it much simpler to develop

- “Unhandled” Events are processed by a “special” behaviour
  - This is used to trigger the dynamic deployment of new Smart Behaviours
OSGi Event Admin

- Event Admin delivers data to Event Handler services
  - Whiteboard Functions with a defined entry point ✔

- It’s easy to map inputs from different sources to events
  - Protocol Independence ✔

- Event Handlers (functions) can also send events
  - Decoupled triggering of other functions ✔

- The Event Admin specification is very mature
  - But also old - Events are opaque Maps of String to Object ❌
Updating OSGi’s Event Admin

- BRAIN-IoT needs the good things from Event Admin
  - Loosely Coupled Whiteboard ✔
  - Asynchronous Delivery ✔

- But also the things that are missing
  - Strongly Typed Event data ❌
  - Monitoring of Event Delivery ❌
  - Notification of “unhandled” events ❌
Updating OSGi’s Event Admin (2)

- Update the Event Admin API to be Type Safe
  - Use OSGi Data Transfer Objects

- Keep the concept of event “topics”
  - Allow the topic to be defaulted based on the type of the event DTO

- Add support for “Handlers of Last Resort”
  - An “untyped” handler called when there is no real handler for an event
Updating OSGi’s Event Admin (3)

- Allow schema conversion
  - The Consumer can have a custom view of the sender’s data

- Add a new Event Monitor API
  - Using a “promiscuous” Event Handler disturbs the system
  - Make use of OSGi PushStreams to provide live event flow data

- Push this back into the OSGi Alliance!
  - https://github.com/osgi/design/tree/master/rfcs/rfc0244

- The proposed changes are compatibility breaking
  - Likely to be a new specification rather than a version 2.0
Putting it all together
(Demo!)
EVALUATE THE SESSIONS

Sign in and vote using the conference app or eclipsecon.org

-1 0 +1