HEADS
Heterogeneous and Distributed Services for the Future Computing Continuum

# Typescript support for Intel Edison
# Why, how, Expected benefits

HEADS Project
Olivier Barais
INRIA
barais@irisa.fr


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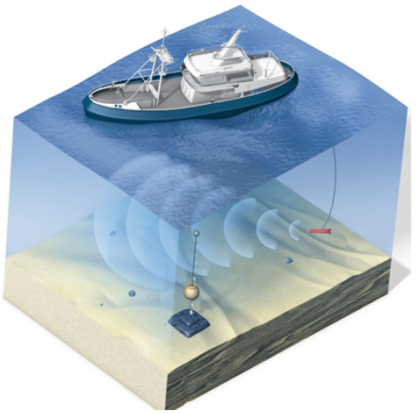
http://heads-project.eu

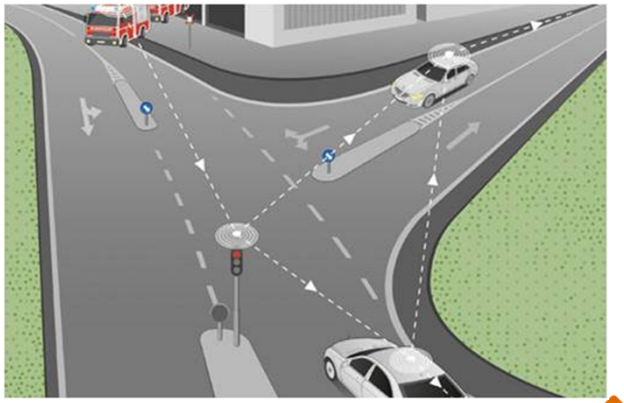
# HD-Services

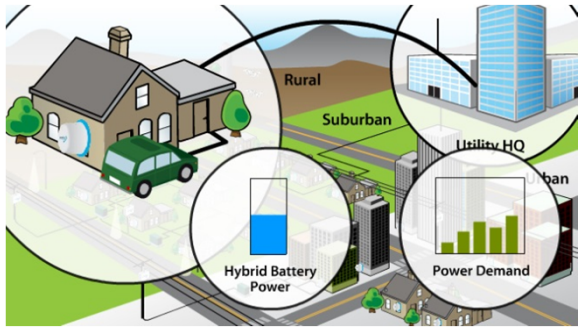
- Heterogeneous and Distributed Services
  - **Heterogeneous:** The infrastructure on which the service runs is composed of a set of different nodes and networks.
    - The "Future Computing Continuum" which ranges from microcontroller based sensors and devices to cloud.
  - **Distributed:** The implementation of the services is composed of a set of independent processes communicating asynchronously.
    - Truly distributed services implementation is required in order to provide useful and reliable services which take advantage of the infrastructure.

# Examples

- Health domain and ambient assisted living
- Energy domain and smart grids
- Environmental monitoring and oil and gas
- Safety in hazardous environments
- Intelligent Transport Systems (ITS)
- …

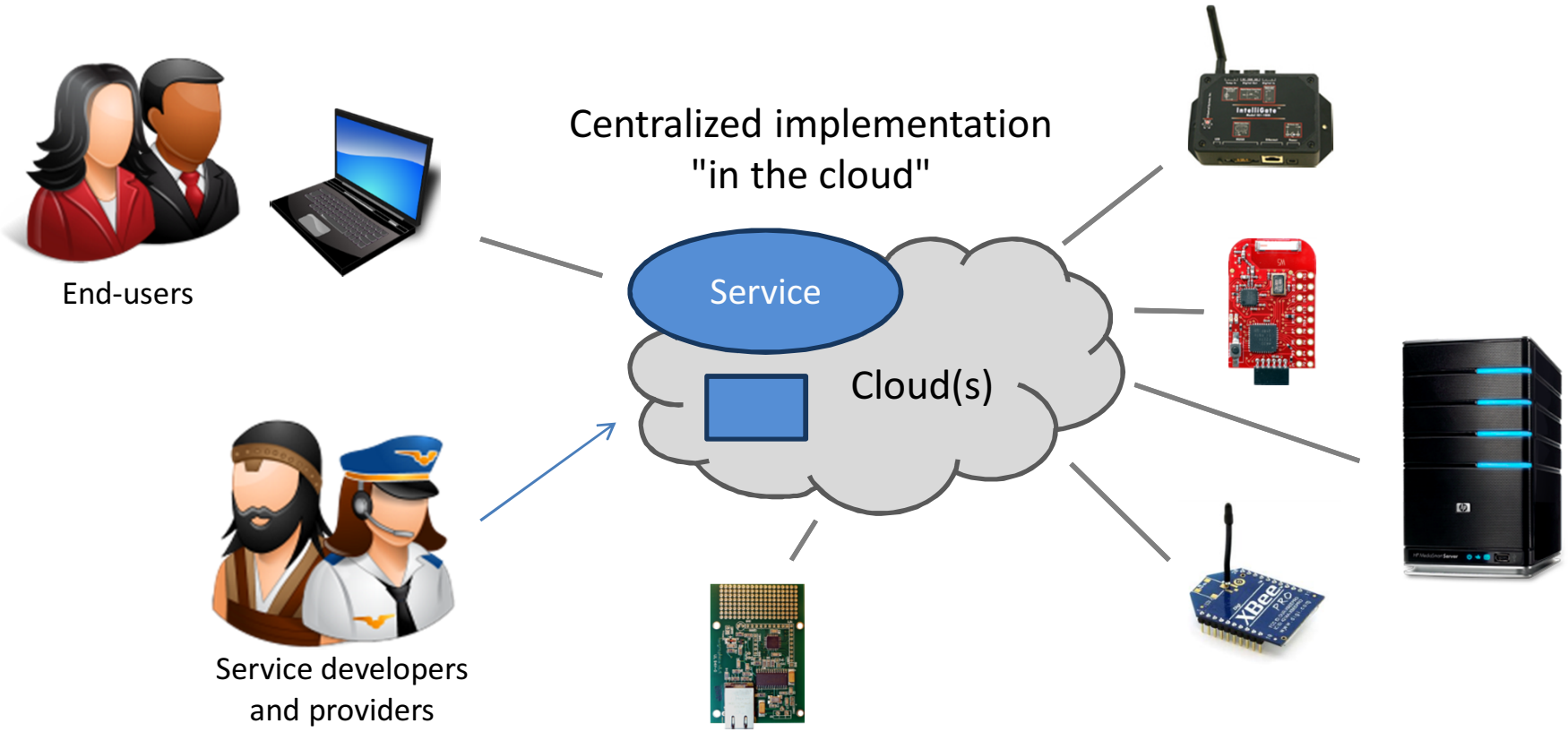






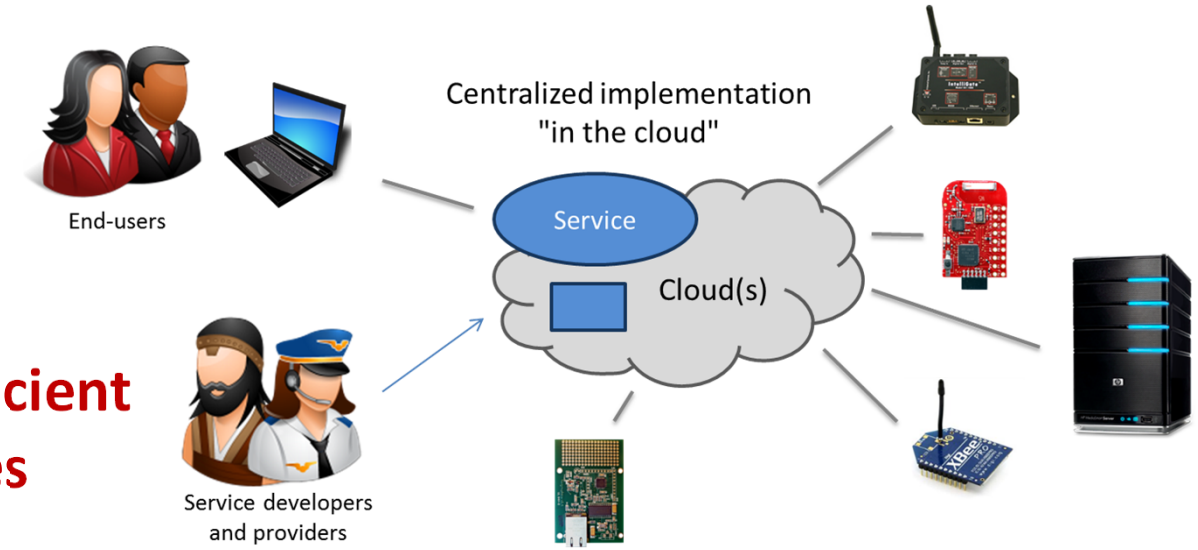
# Why "HD-Services" ?

- Isn't Internet of Things about having everything connected and available in the cloud?



# Limitations of centralized approaches

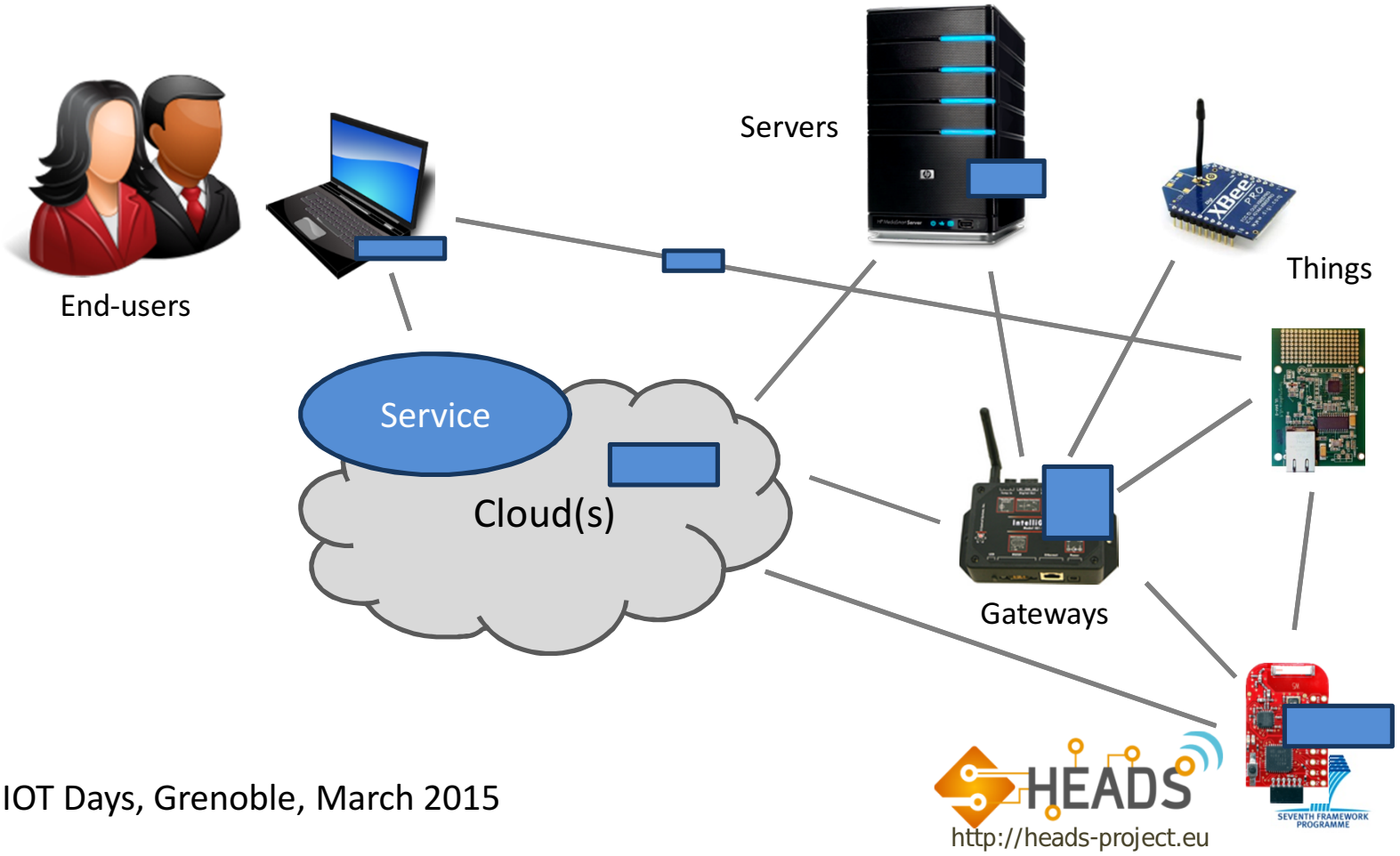
- Very easy to develop, evolve and maintain but…
  - Underexploits "Things" capabilities
  - Does not allow real-time or critical services
  - Not resource efficient (bandwidth)
  - Not robust
  - Does not scale




**Good solution when possible but not sufficient in many realistic cases**

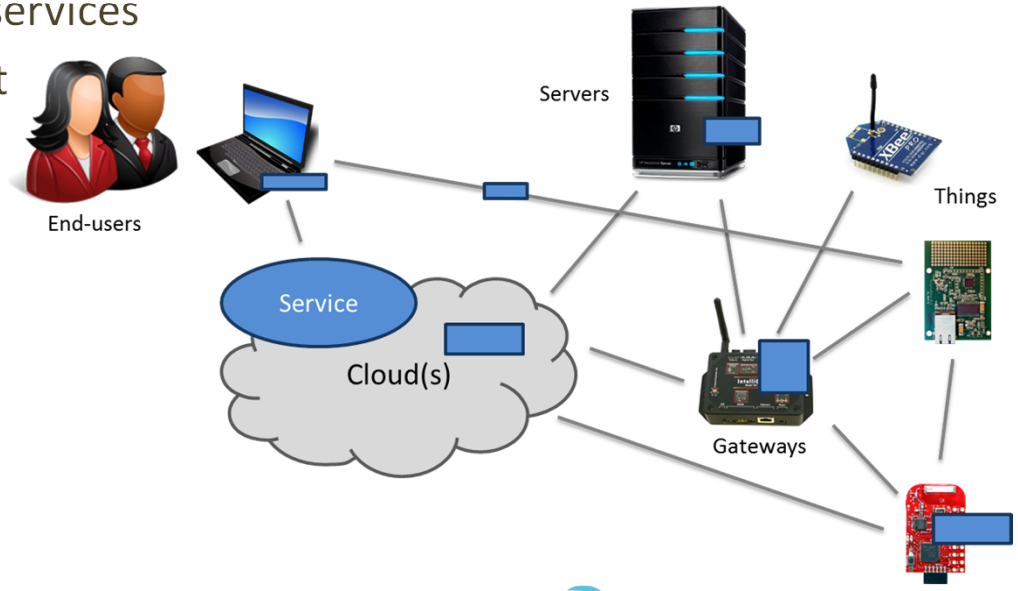
# Distributing the implementation

- The service implementation is distributed to exploit the infrastructure



# Benefits of HD-Services

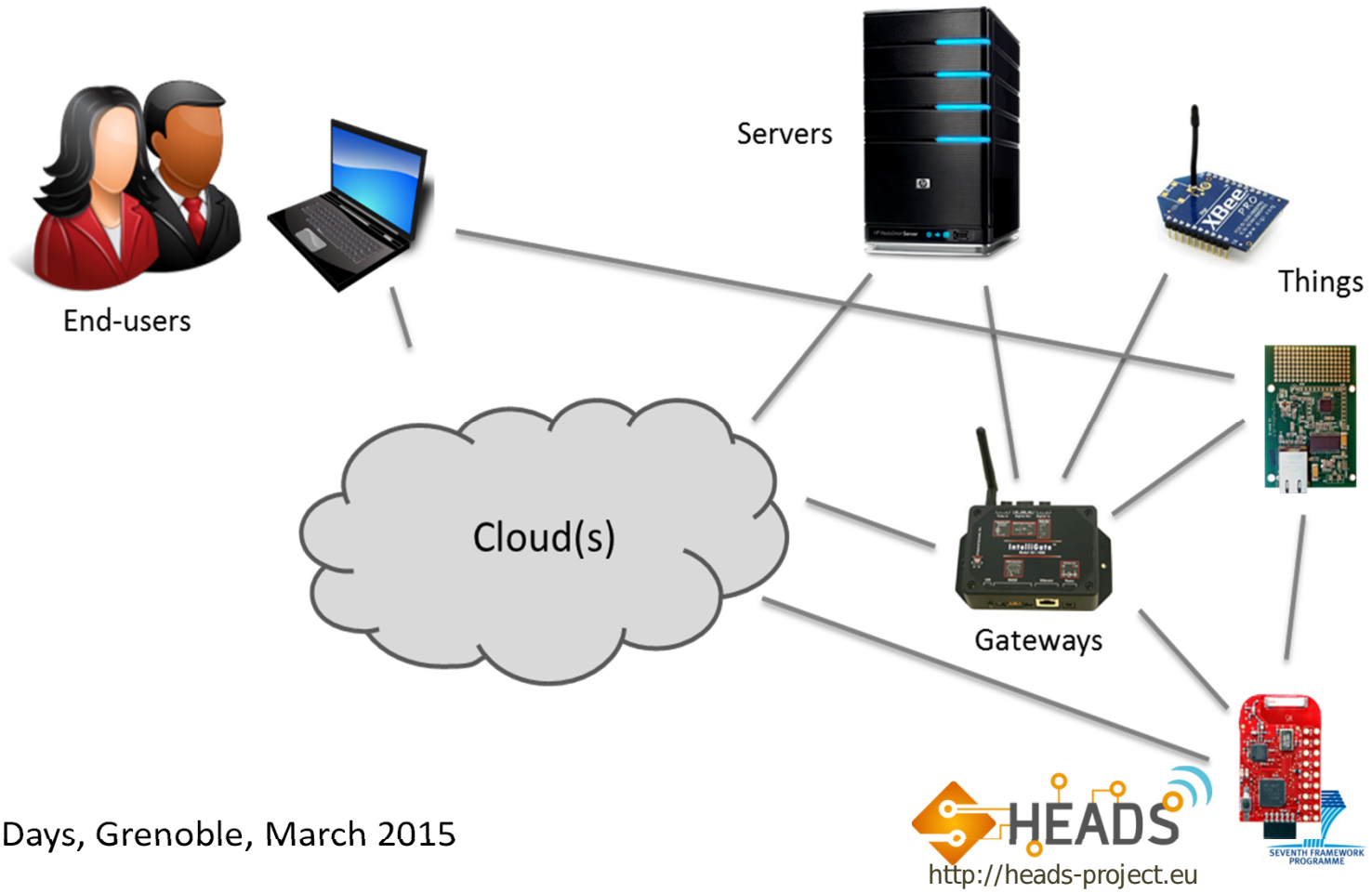
- Complex to develop, lots of different skills involved but…
  - Allows fully exploiting the features of each platforms
  - Allow for local and/or decentralized decision making
  - Robust to partial and/or temporary failures
  - Push processing close to data sources
  - Allow for real-time and critical services
  - Can scale in a "big data" context




**In practice for more and more real-world services are HD-Services**

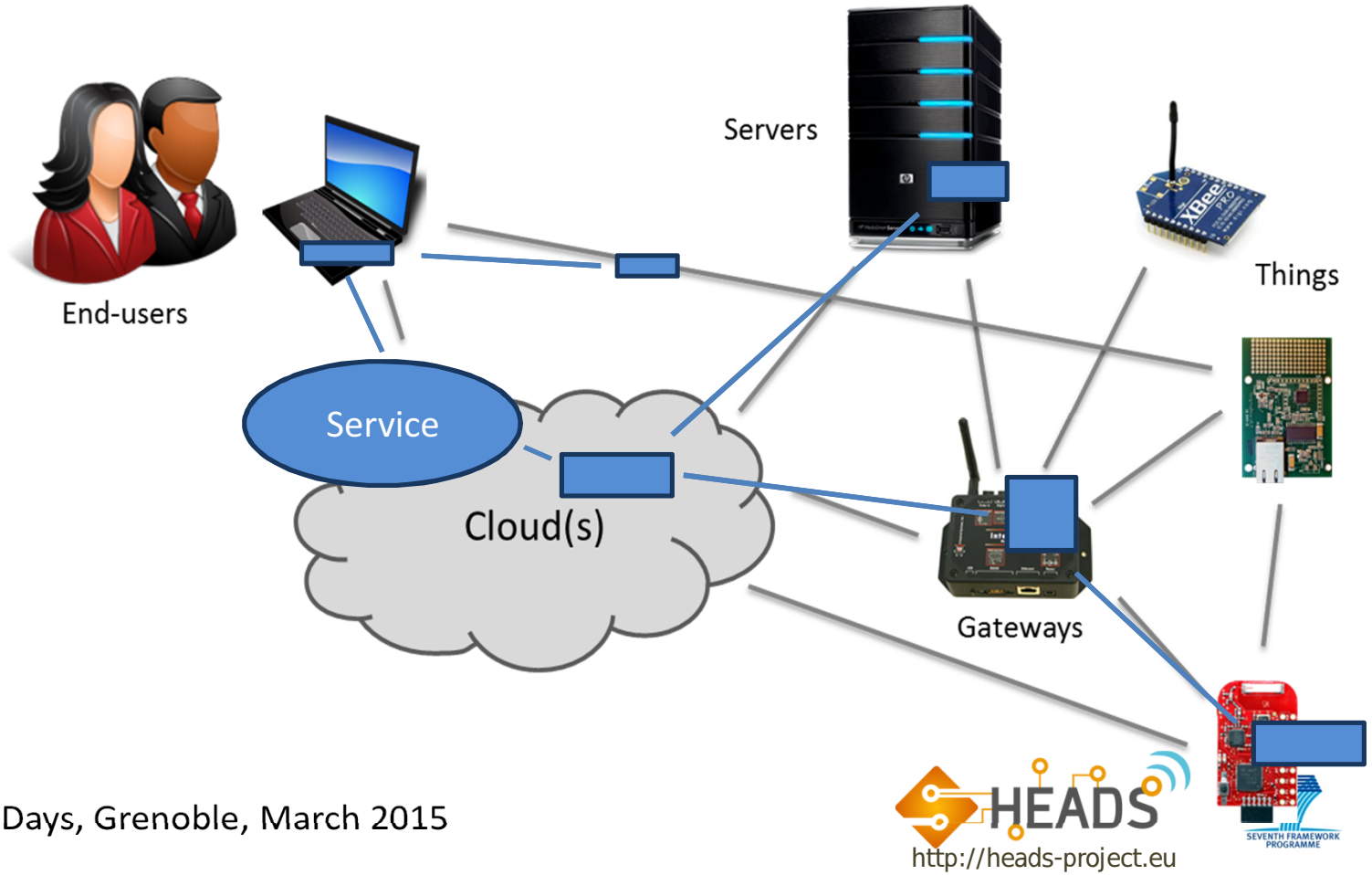
# What are the problems? (1/6)

- Here is an example infrastructure



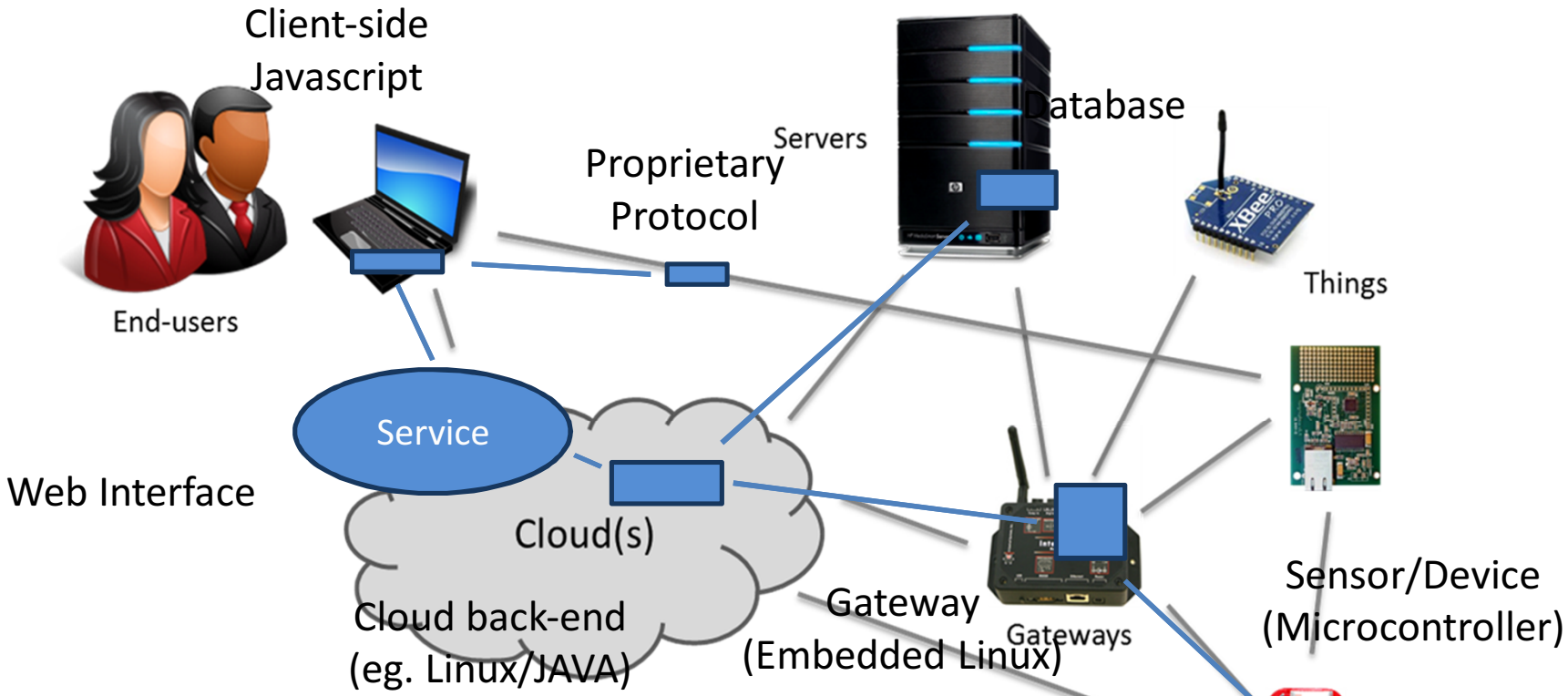
# What are the problems? (2/6)

- Here is the software components needed for the service



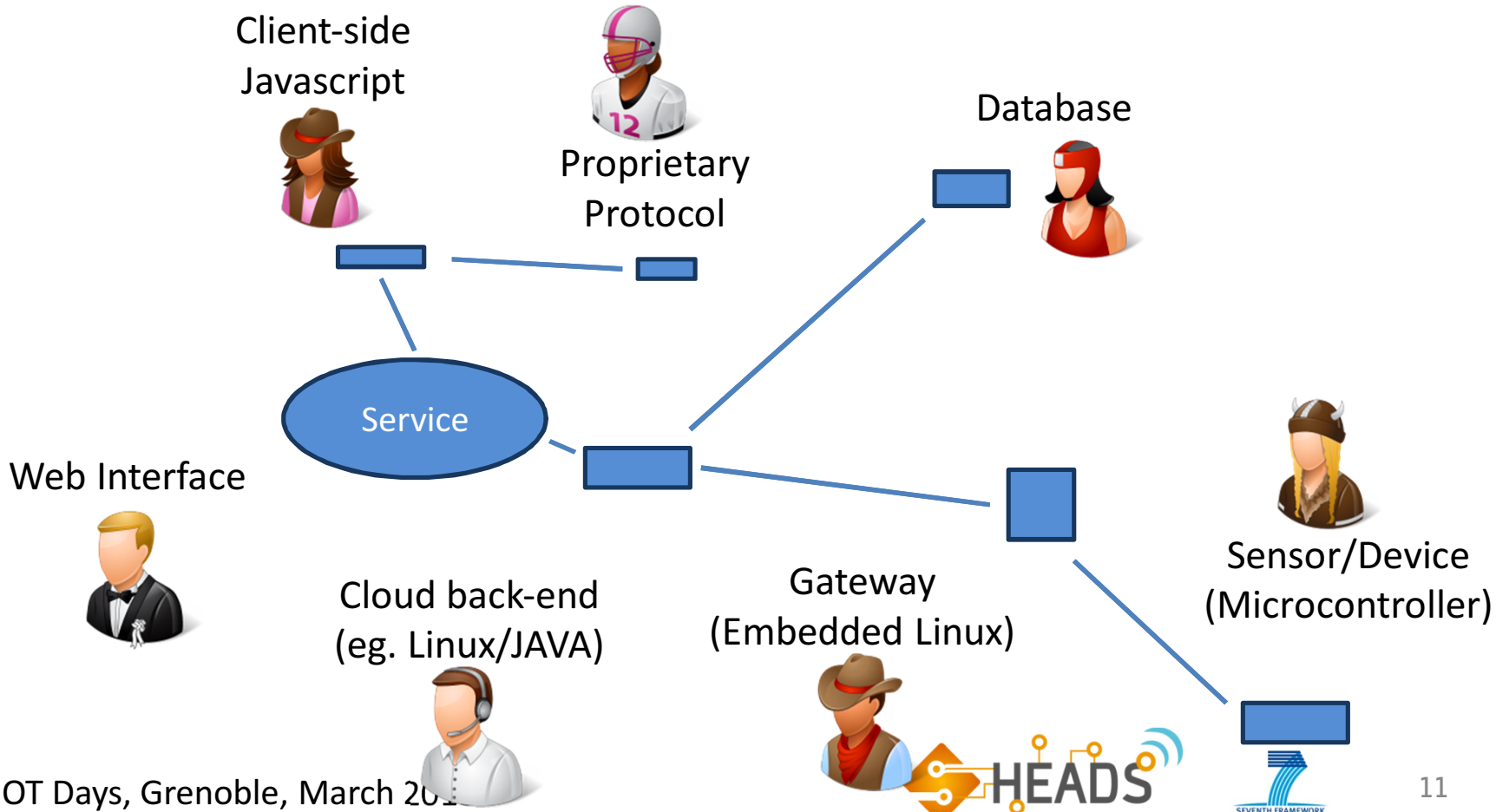
# What are the problems? (3/6)

- Heterogeneous infrastructure and technologies are needed



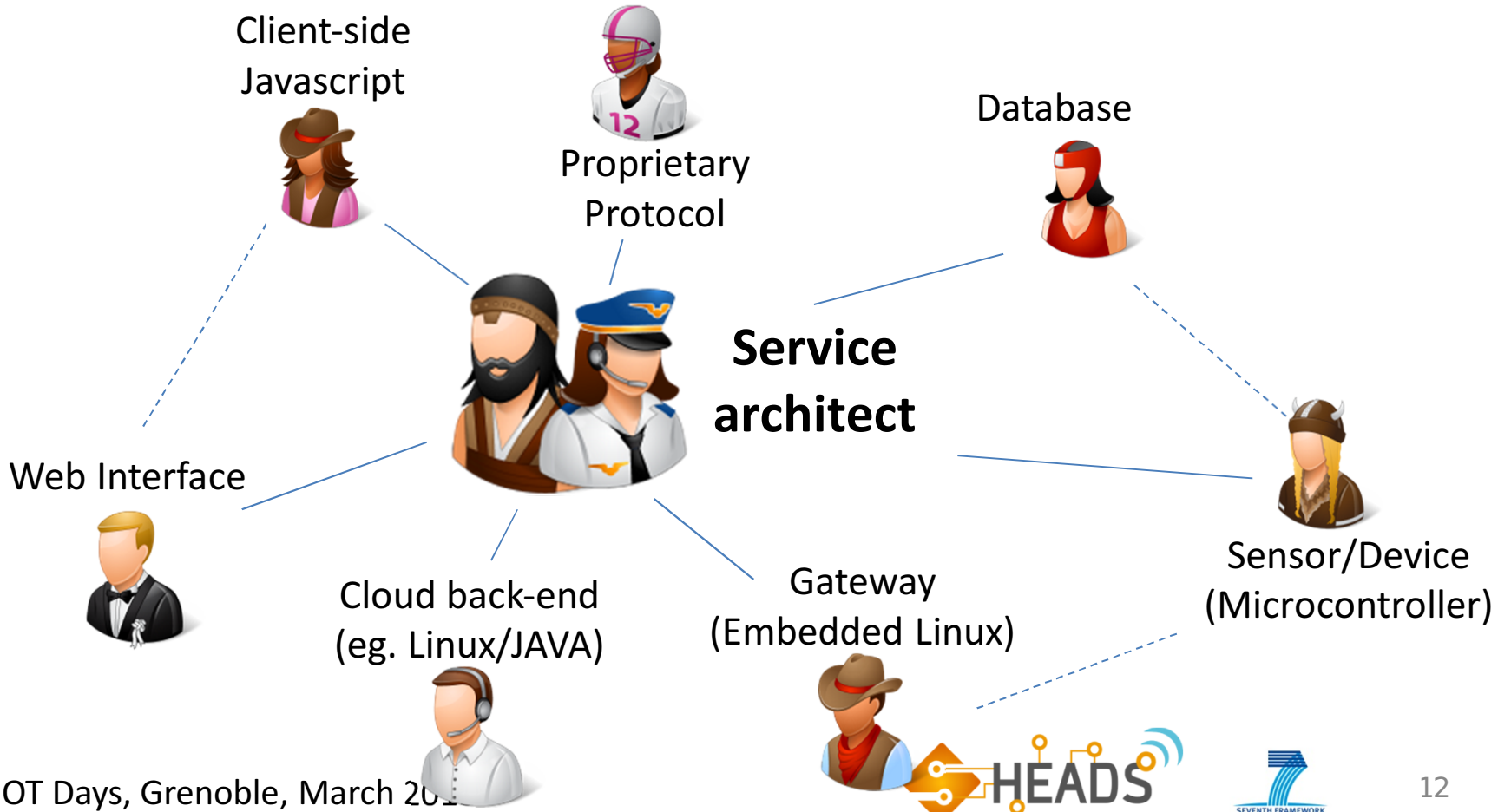
# What are the problems? (4/6)

- A lot of different expertise are needed
  - Both for development and runtime deployment/maintenance



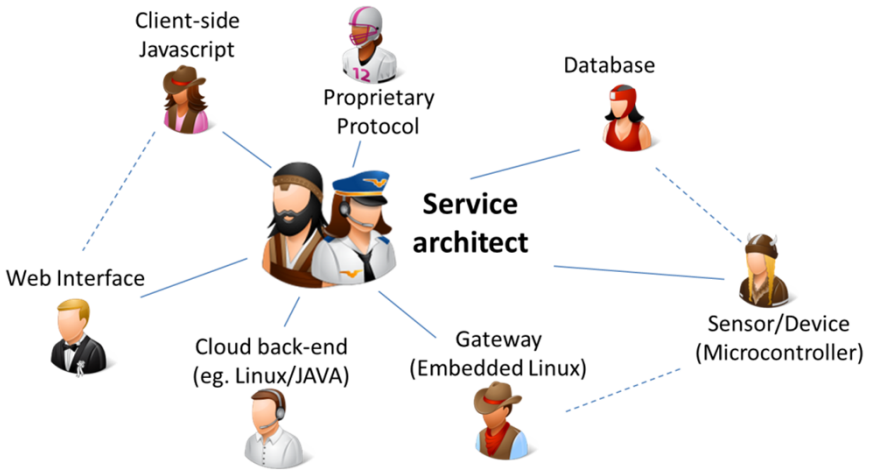
# What are the problems? (5/6)

- Someone needs to coordinate all experts
  - Design the different components, their functionality and interactions



# What are the problems? (6/6)

- Large heterogeneous teams need to collaborate
  - A service architect / developer
  - Many "platform experts"
  - Complex and expensive
  - Unavailable to small actors
- Service maintenance and evolutions
- Infrastructure is dynamic
  - Constant evolution/adaptation
- (Early) Validation?
- Software reuse?




**Challenging and expensive**

# Challenges

- **Provide a support for a multi-views point approach for IoT on top of Eclipse**
  - **A kind of Eclipse Polarsys Capella for IoT ;)**
- **Viewpoints examples**
  - **Manage development of large applications**
    - **Typescript example** ***TODAY***
  - **Manage the deployment and evolution of large scale distributed applications** ***TODAY***
    - **Kevoree example (www.kevoree.org)**
  - **Event streaming management**
  - **Reactive programming (ThingML.org)**

# HEADS Goal

- Provide tools and methods
  - For each actor to concentrate on his task
  - For decoupling the tasks of different actors
  - Using **state of the art software engineering practices**
    - Modularity, reusability, runtime deployment, continuous integration, validation, etc…
  - Cost efficient and practically usable
    - No large overhead, integrated with legacy systems, etc…

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# Using **state of the art software engineering practices**

## A support of typescript for Intel Edison

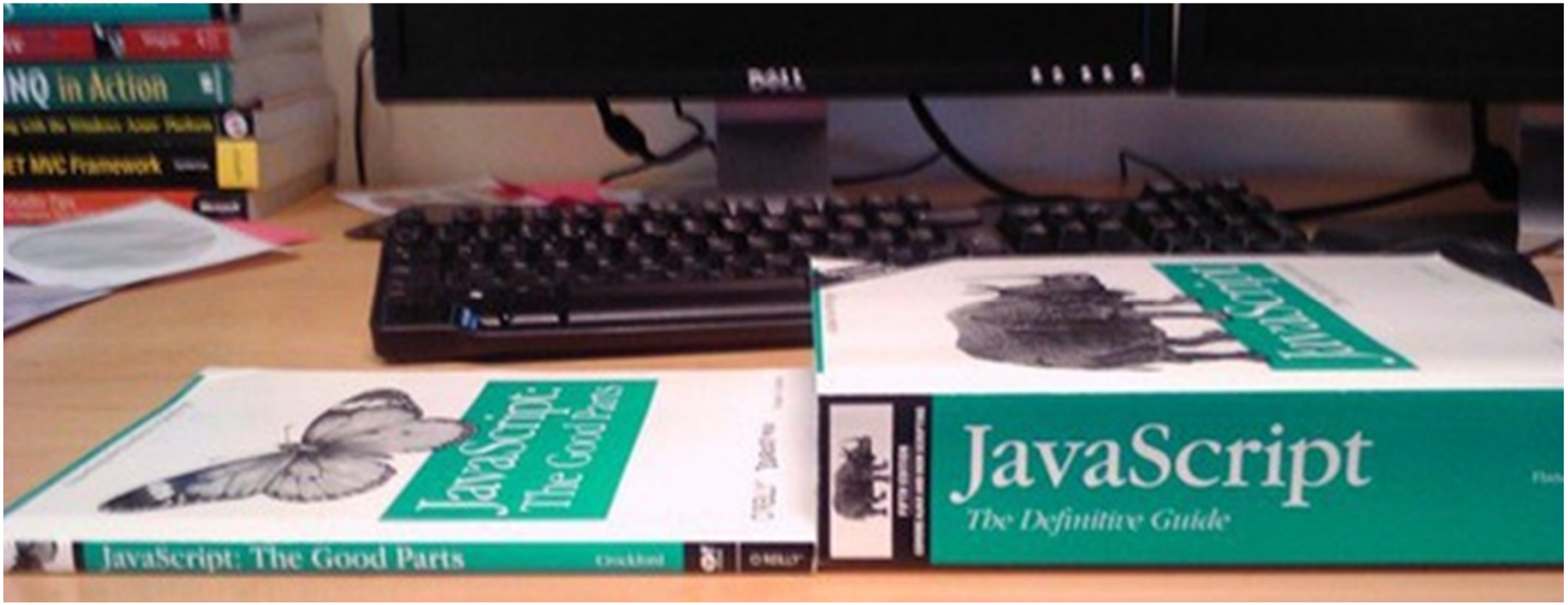
### A viewpoint for service developer

# What is TypeScript?

- Free and open source, strongly supported by Microsoft
- Based on ecmascript 4 + ecmascript 6
- Created by the father of C# Anders Hejlsberg
- A superset of JavaScript
- To answer why we need JavaScript+, we need to understand what's wrong with vanilla JavaScript

# What is the problem ?

- Why do people hate working in JavaScript?




Using state of the art software engineering practices ;)

# What is the problem ?

- JS is designed for small things
- We now use to do big things
- But JavaScript is not suited for building large applications

- Your JavaScript code gets complex; it becomes extremely unwieldy

# Let's look at TypeScript

- To get started with TypeScript, grab it from http://typescriptlang.org

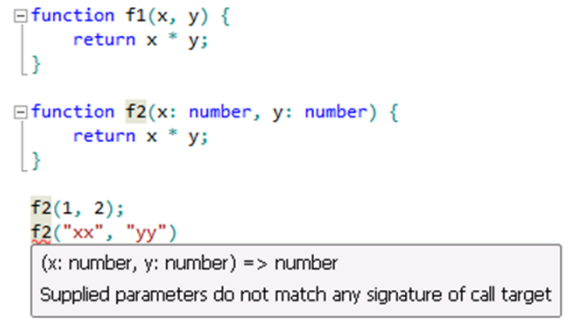
- Let's look at TypeScript, first the core concept…

# TypeScript - first glance - optional strong type checking

- ```
  // js
  function f(x, y) {
     return x * y;
  }
  ```

- ```
  // ts
  function f(x : number, y : number) : number {
     return x * y;
  }
  ```

```
// Type information is enforced in design and
// compile time, but removed at runtime
```



# TypeScript features

- Static Type Checking
- Modules and Export
- Interface and Class for traditional Object Oriented Programming

- Works with all your existing JavaScript libraries
- Low learning overhead compared to similar JavaScript systems (*CoffeeScript* or *Dart*)

- Amazing Visual Studio, eclipse or IntelliJ tooling
- Outstanding team and refactoring scenarios

# Summary - why TypeScript

- Have to learn one more thing - there is a learning curve, very easy if you already know JavaScript, or if you know C# or Java very well.
- You still have to learn JavaScript - Understanding how TypeScript converts to JavaScript will teach you better JavaScript
- Some definition files don't exist or incomplete, but I think this will vanish very quickly. These aren't hard to write if you really need something.

- Modules and classes enable large projects and code reuse
- Compile-time checking prevents errors
- Definition files for common JavaScript libraries makes them very easy to work with, and provides strong type checking
- Source map debugging makes debug easy

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# How ?

# MRAA

- Libmraa is a C/C++ library with bindings to JavaScript & python to interface with the IO on Galileo, Edison & other platforms, with a structured and sane API where port names/numbering matches the board that you are on

- We need an interface definition for libmraa (mraa.d.ts)
  - Generate mraa.d.ts from .h file

https://github.com/HEADS-project/mraa_hpp2ts_generator

  - Or get it from github

git clone https://github.com/HEADS-project/mraa

# Test it

- First install the node.d.ts

```
> npm install tsd -g  #https://github.com/borisyankov/DefinitelyTyped
```

and next you can download it in typing

```
> tsd query node -a install #Download node.d.ts
```

Use the following command to compile your typescript:

```
> tsc --module commonjs AioA0.ts
```

next you can install mraa in this folder:

```
> npm install mraa
```

finally you can run the samples e.g. AioA0:

```
> sudo node AioA0.js
```

# Using MRAA definition for typescript

```
///<reference path='typings/node/node.d.ts' />
///<reference path='../../src/typescript/mraa.d.ts' />

var m = require('mraa'); //require mraa
console.log('MRAA Version: ' + m.getVersion()); //write the mraa version to the console

var analogPin0 = new m.Aio(0); //setup access analog inpuput pin 0
var analogValue = analogPin0.read(); //read the value of the analog pin
console.log(analogValue); //write the value of the analog pin to the console
```

# More complex example

```
///<reference path='collections/collections.d.ts' />
///<reference path='node/node.d.ts' />
///<reference path='node/express.d.ts' />
///<reference path='mraa.d.ts' />

import fs = require("fs")
import http = require("http")
import path = require("path")
import mraa= require("mraa")
import express = require("express")
import index = require("./routes/index")
import user = require("./routes/user")

var col = fs.readFileSync('./collections/collections.js','utf8');
eval(col);
….
```

# Initial conclusion - if I have to make a decision for you...

- If you see yourself using more JavaScript. You have to look at TypeScript.
- If you and your team has to work on JavaScript together, you have to look at TypeScript.
- Once you've done the initial hard work and converted a project. You can't stand going back.

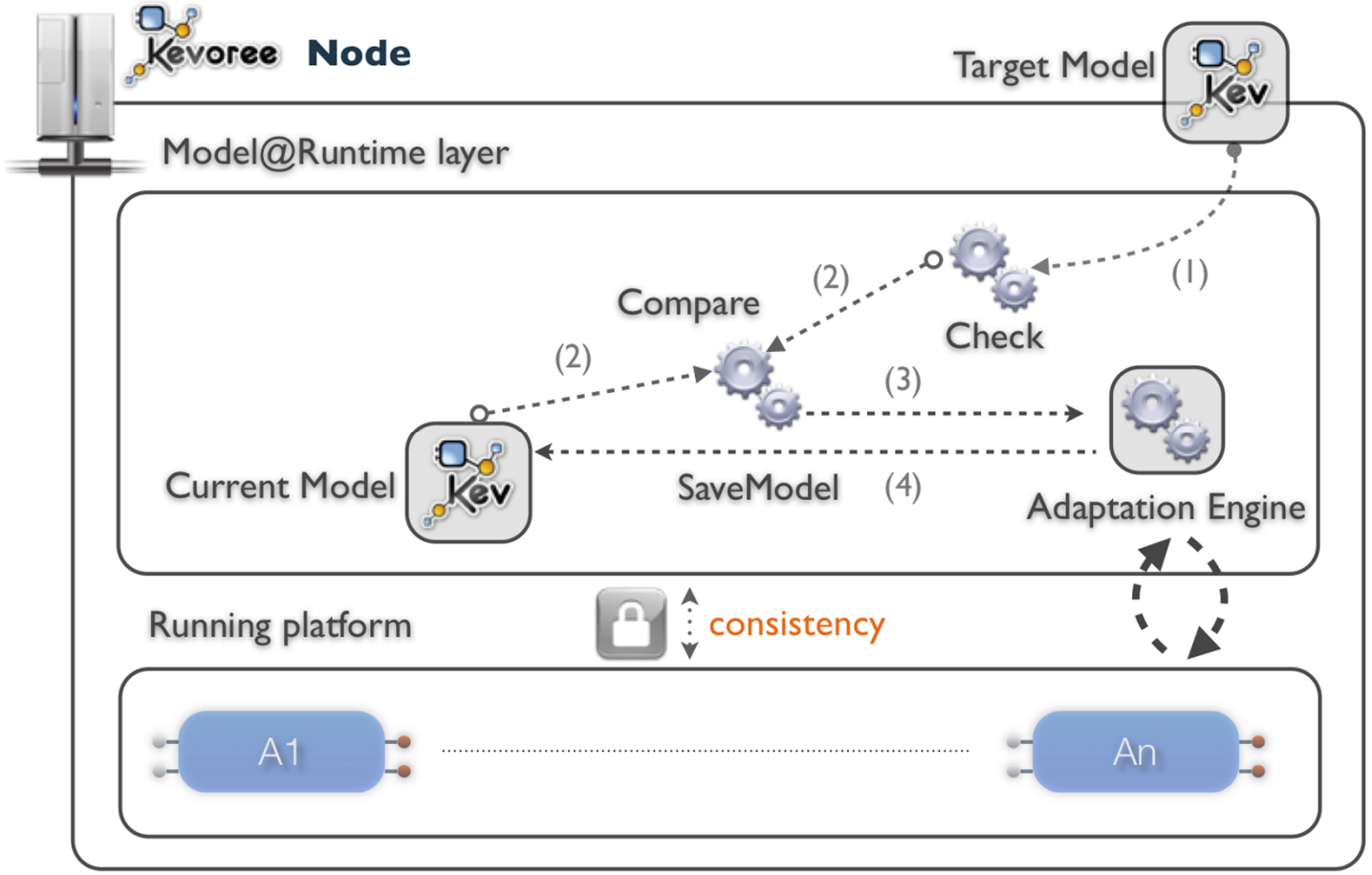
# Next steps

- Complex deployment of HD-Services
  - A configuration language for managing module deployment and reconfiguration

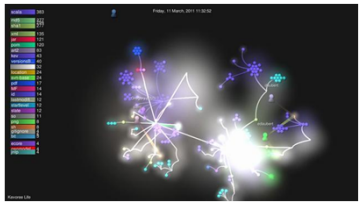
# Kevoree (www.kevoree.org)

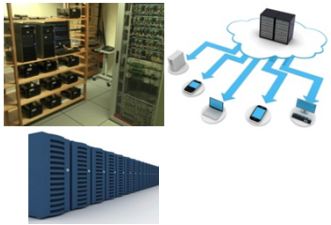
- Kevoree project aims at supporting dynamic adaptation in distributed system (What Benjamin calls Management layer)
  - **MDE@Runtime**
    - Shared model representation for distributed nodes
    - Offline & online operation, *compute@Model* level, apply @Runtime
  - **Component-based**
    - Actor semantics on each ports to closely separate component behavior
    - Communication semantics between component in channel
    - Support component reconfiguration (parametric, architectural, behavioral
  - **Continuous Design, type definition continuous definition**
    - Hot (re-)deploy & provisioning
  - **Heterogeneity management with NodeType**

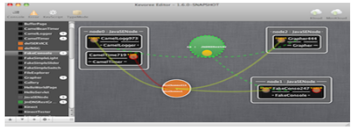
# Kevoree general overview



# An OSGi-like framework for HD-Services







Kevoree

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M@R Runtimes for Distributed and Heterogeneous adaptive systems

http://heads-project.eu

# Time for Demo

# Thank you!

- Questions?