

ICWE — June 2019

Comparison Matrices of Semantic RESTful APIs Technologies

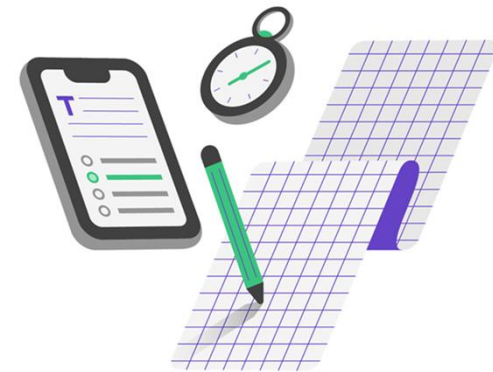
presented by **Antoine Cheron**

inria
inventeurs du monde numérique

 **FABERNOVEL**

ICWE 2019

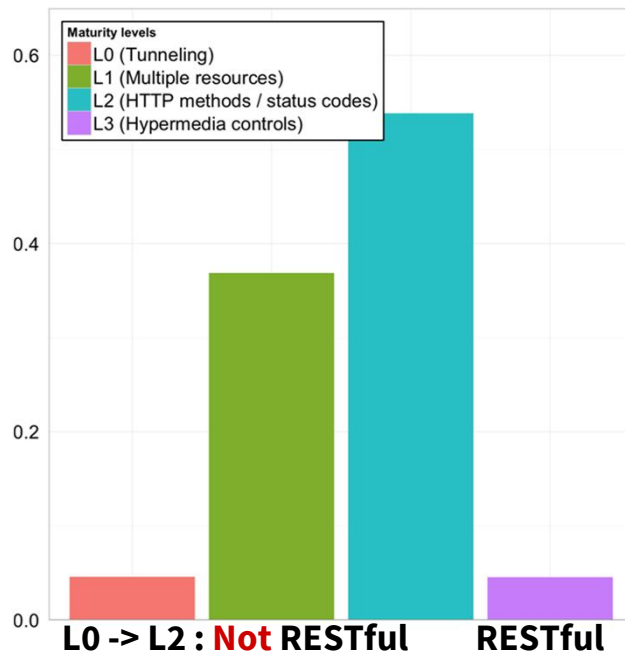
1 The Problem



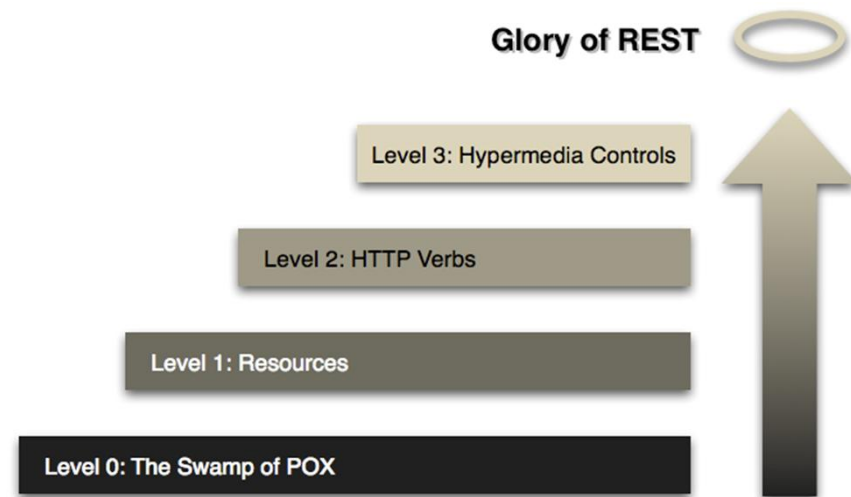
**Today, RESTful APIs
have become the de-
facto standard for
building web
applications.**

THE PROBLEM — ICWE 2019

95% of them are not RESTful.



Source: **Rest apis: A large-scale analysis of compliance with principles and best practices.** by Rodriguez, C., et al. - ICWE 2016



Source: **Richardson Maturity Model** by Martin Fowler on martinfowler.com [\[link\]](#)

THE PROBLEM — ICWE 2019

Standards to build up to Level 2 APIs exist.

0

**SOAP - CORBA - SparQL -
GraphQL - custom protocol**

Send all information in the body of
the HTTP request to a single URL.

1

**JSON + Swagger + web
framework**

Each resource has a dedicated
URL and most of the information
goes into the URL.

2

**JSON + Swagger + web
framework**

The HTTP protocol is respected.

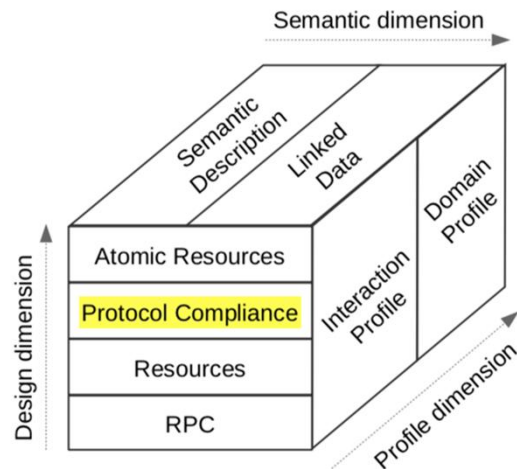
THE PROBLEM — ICWE 2019

No standard to build Level 3 APIs.

- 1 Different interpretations of Level 3 APIs coexist *What is an hypermedia API?*
- 2 **Several** works and visions **propose more constraints than level 2, and 3**



A maturity model for Semantic RESTful APIs (WS3)



Source: I.Savaldori & F.Siquiera - A Maturity Model for Semantic RESTful Web APIs [\[link\]](#)

- + **Design Lvl 3 or 4** = RMM Level 2 API
- + **Interaction Profile** = Machine-processable description of all HTTP operations
- + **Domain Profile** = Machine-processable description of all application domain
- + **Semantic Description** = Machine-interpretable description of properties and operations
- + **Linked Data** = Machine-interpretable description of the relationships among resources

So, lots of technologies have been proposed.

- + Falling under **three categories**: (i) Interface Description Languages, (ii) Data Interchange Formats and (iii) Implementation Frameworks
- + **Some** support **hypermedia controls** partially, or totally, **some** support **semantic description** only
- + We counted **36 technologies**
- + Following **no standard**
- + Each with its **custom**, free-text **documentation**



THE PROBLEM — ICWE 2019

19h16m

to read all documentations

Implementation frameworks excluded (8 technologies)

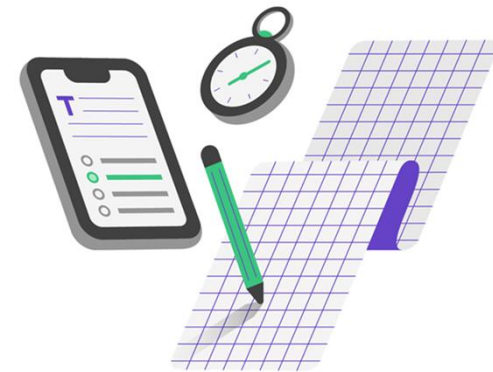
The Problem.



Finding, comparing and choosing the right technologies for a specific project is time-consuming and error-prone.

ICWE 2019

2 This Work



1. Designing precise criteria

Let's go through **2 examples** that **illustrate differences between** data-interchange format **technologies** that Maturity Models are unable to highlight.



EXAMPLE 01

Comparing Mason and Siren

*Both reach **RMM Level 3 & Domain Profile of WS3***

```
{  
  "title": "ICWE 2019 Talk",  
  "description": "Lorem ipsum dolor sit amet",  
  "date": "2019-06-14",  
  "time": "11:45:00",  
  "location": "Daejeon, Korea"  
}
```

Links & Actions

- + ICWE Official Webpage
- + Attend to the talk

Mason

```
{
  "title": "ICWE 2019 Talk",
  "description": "Lorem ipsum dolor sit amet",
  "date": "2019-06-14",
  "time": "11:45:00",
  "location": "Daejeon, Korea",
  "@controls": {
    "icwe": {
      "title": "ICWE Official Webpage",
      "href": "https://icwe2019.\
webengineering.org/"
    },
    "attend": {
      "href": "/talks/1/attend",
      "method": "POST"
    }
  }
}
```

Siren

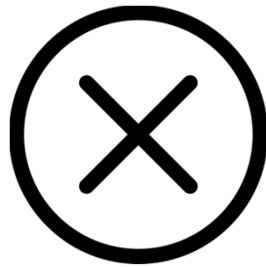
```
{
  "class": ["talk"],
  "properties": {
    "title": "ICWE 2019 Talk",
    "description": "Lorem ipsum dolor sit amet",
    "date": "2019-06-14",
    "time": "11:45:00",
    "location": "Daejeon, Korea",
  },
  "links": [
    {
      "rel": "icwe",
      "href": "https://icwe2019.\
webengineering.org/"
    }
  ],
  "actions": [
    { "name": "attend",
      "href": "/talks/1/attend",
      "method": "POST"
    }
  ]
}
```

1. Designing precise criteria

Same structure as plain JSON? whatever the maturity level



Mason



Siren

EXAMPLE 02

Description richness

*Technologies: **HAL**, **Collection+JSON** and **Mason***

*All **RMM Level 3***

```
{
  "title": "ICWE 2019 Talk",
  "description": "Lorem ipsum dolor sit amet",
  "date": "2019-06-14",
  "time": "11:45:00",
  "location": "Daejeon, Korea"
}
```

Links & Actions

- + ICWE Official Webpage
- + Attend to the talk

THIS WORK — ICWE 2019

HAL

```
{
  "title": "ICWE 2019 Talk",
  "date": "2019-06-14T11:45:00",
  "_links": {
    "icwe": {
      "href": "https://icwe2019.webengineering.org/",
      "type": "text/html; charset=UTF-8"
    },
    "attend": {
      "href": "/talks/1/attend"
    }
  }
}
```

It provides vocabulary to:

- + Provide hyperlinks
- + Document the available media types for read requests

Collection+JSON

```
{
  "collection": {
    "items": [{
      "title": "ICWE 2019 Talk",
      "date": "2019-06-14T11:45:00"
    }],
    "links": [
      {"rel": "icwe", "href": "https://icwe2019.\
webengineering.org/"},
      {"rel": "attend", "href": "/talks/1/attend"}
    ],
    "template": {
      "data": [
        { "name": "title", "value": "" },
        { "name": "date", "value": "" },
        { "name": "speaker", "value": "" },
      ]
    }
  }
}
```

It provides vocabulary to:

- + Provide hyperlinks
- + Document the properties of the resource

Mason

It provides vocabulary to:

- + Provide hyperlinks
- + Document the available media types for read & update requests
- + Document HTTP verbs
- + Document the properties of the resource
- + Overall document HTTP operations & hypermedia controls

```
{
  "title": "ICWE 2019 Talk",
  "date": "2019-06-14T11:45:00",
  "@controls": {
    "icwe": {
      "href": "https://icwe2019.\
webengineering.org/"
    },
    "attend": {
      "href": "/talks/1/attend",
      "method": "POST",
      "accept": ["application/json"],
      "output": ["application/vnd.mason+json"],
      "schema": {
        "type": "object",
        "properties": {
          "name": { "type": "string" }
        }
      }
    }
  }
}
```

1. Designing precise criteria

	HAL	Collection+JSON	Mason
Read mediatypes	X		X
Update mediatypes			X
HTTP verbs			X
Resource properties		X	X
HTTP operations			X
Hyperlinks	X	X	X
WS3 Levels	Domain Profile	Domain Profile	Interaction & Domain Profile

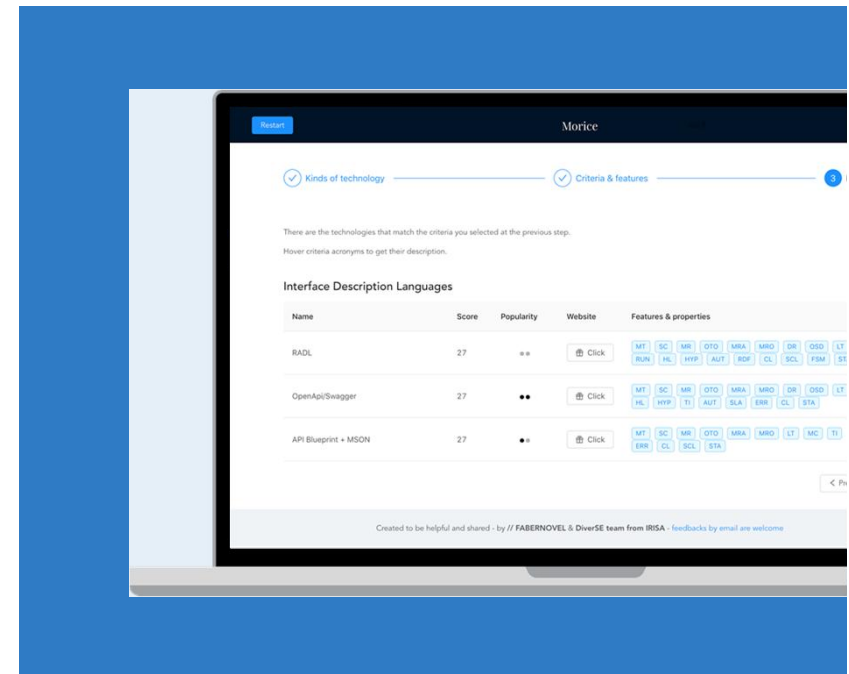
2. Evaluating available technologies

- From their documentation or official specification
- One matrix per category of technologies
- Criteria split into the levels of Maturity Model for Semantic RESTful Web APIs

Technologies	JSON	HAL	Collection+JSON	Siren	Other	MaSON	JSON-API	Atom	Turtle	RDF/XML	CDATA JSON format	JSON-LD	JSON-LD + Hydra	Section 5 example
Criteria														
Popularity (/2) - highest is better	2	1	0	0	0	0	1	1	2	0	1	1	0	
Profile														
1 - Interaction Profile														
Describes templated URIs														<input checked="" type="checkbox"/>
Describes media types for Read requests														<input type="checkbox"/>
Describes media types for Update requests														<input type="checkbox"/>
Describes operations' HTTP verbs														<input checked="" type="checkbox"/>
Describes resources' properties														<input checked="" type="checkbox"/>
Describes HTTP operations														<input checked="" type="checkbox"/>
Pagination description														<input type="checkbox"/>
2 - Domain Profile														
Hyperlinks to other resources														<input checked="" type="checkbox"/>
Hypermedia controls														<input checked="" type="checkbox"/>
Models business constraints														<input type="checkbox"/>
Non functional properties description														<input checked="" type="checkbox"/>
Models errors														<input checked="" type="checkbox"/>
Semantic														
1 - Semantic Description														
Addition of other RDF vocabularies														<input checked="" type="checkbox"/>
2 - Linked Data														
Links with human-interpretable semantic meaning														<input checked="" type="checkbox"/>
Links with RDF semantic meaning														<input checked="" type="checkbox"/>
Others														
Human Readability														
JSON-based format														<input checked="" type="checkbox"/>
Same structure as original JSON														<input type="checkbox"/>
Designed for human readability														<input type="checkbox"/>
Support for Curies														<input checked="" type="checkbox"/>
Entity-centric document														<input checked="" type="checkbox"/>
Prefixed keywords														<input type="checkbox"/>
Support several meta-data levels														<input type="checkbox"/>
Machine reasoning														
Designed for machine readability														<input type="checkbox"/>
Operations with "target URI" field														<input type="checkbox"/>
Criteria met (/24)	4	11	9	13	11	20	8	5	4	3	11	8	16	20

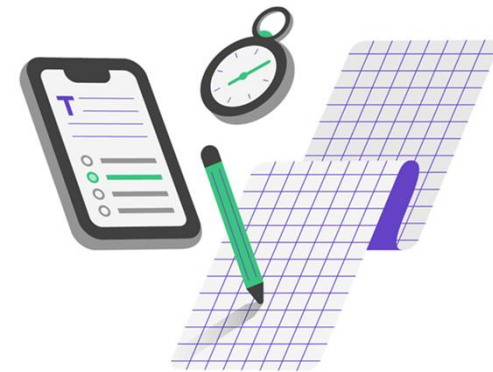
3. Online wizard

- 1 Choose the **kinds of technologies** you are looking for
- 2 **Select** required criteria **and score** each **criteria** importance
- 3 Read **results**, access the technology's documentation



ICWE 2019

3 How To Use? by example



EXAMPLE 01

Insurance Company

*Let's look at an example where the system needs to
offer advanced features*



Insurance Company Example

RESOURCES



Contracts



Warranties



Cases



Services



Third-Parties (customers or contractors)

The Business Domain

Third-parties enter into **contract** with the insurance company

Contracts include **warranties** from a catalog

1 contract has **N cases**

1 case = claim + **services** provided

Services are provided by contractors (who are **third-parties**)

Technical Constraints

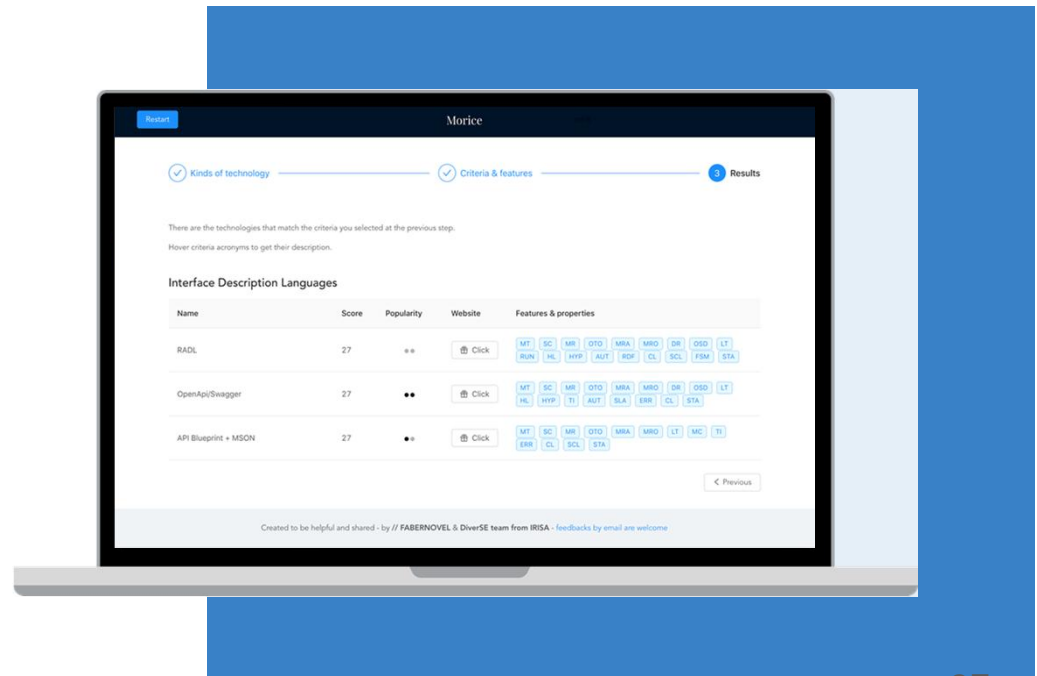
- 1 Communicates with internal & external services
- 2 Uses **HATEOAS** to keep business rules on the server-side only
- 3 Can automatically discover and integrate semantically described services
- 4 Uses **Linked Data** to leverage its technologies
- 5 Documents its resources, properties, operations, URI templates, HTTP verbs, hypermedia controls and errors in a machine-processable way
- 6 HTTP operations are linked to their own input and output because we use the CQRS pattern
- 7 As few differences as possible from plain JSON

HOW-TO-USE — ICWE 2019

Finding the technologies

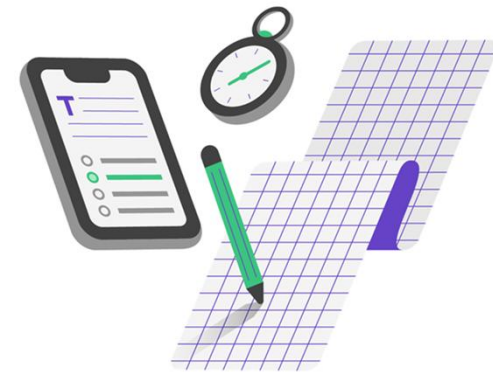
USING...

Morice



ICWE 2019

4 Future Work



Future Work

- 1** Modeling resources as finite state machines in implementation frameworks
- 2** Making automated testing tools and REST clients more intelligent by leveraging the semantic description and advertising of state transitions, along with non-functional properties

MERCI

Q&A

antoine.cheron@fabernovel.com

antoine.cheron@irisa.fr

antoine.cheron@inria.fr