SLA-driven governance for RESTful systems

Antonio Gámez Díaz

ISA Research Group - University of Seville

Agenda

- **Where do I come from?**
- What is my research focus?
- What am I currently doing?
- Why am I in Lugano?

Who am I ?

Antonio Gámez Díaz

Soft. Eng. MSc. Predoctoral researcher

> *Applied Software Engineering* (ISA) Research Group

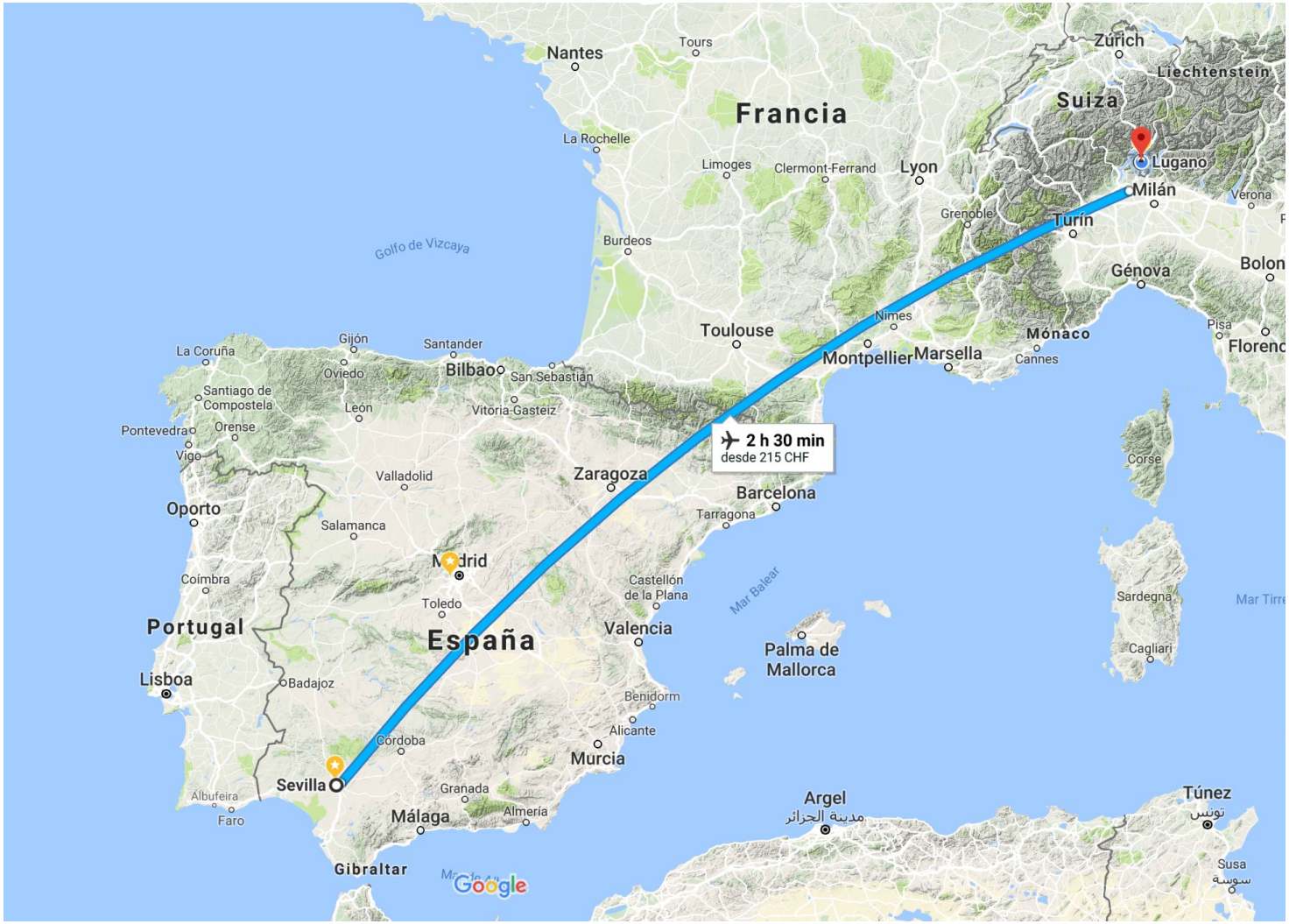
> Universidad de Sevilla

> Docker Campus & Auth0 Ambassador

>> **mailto**: agamez2@us.es

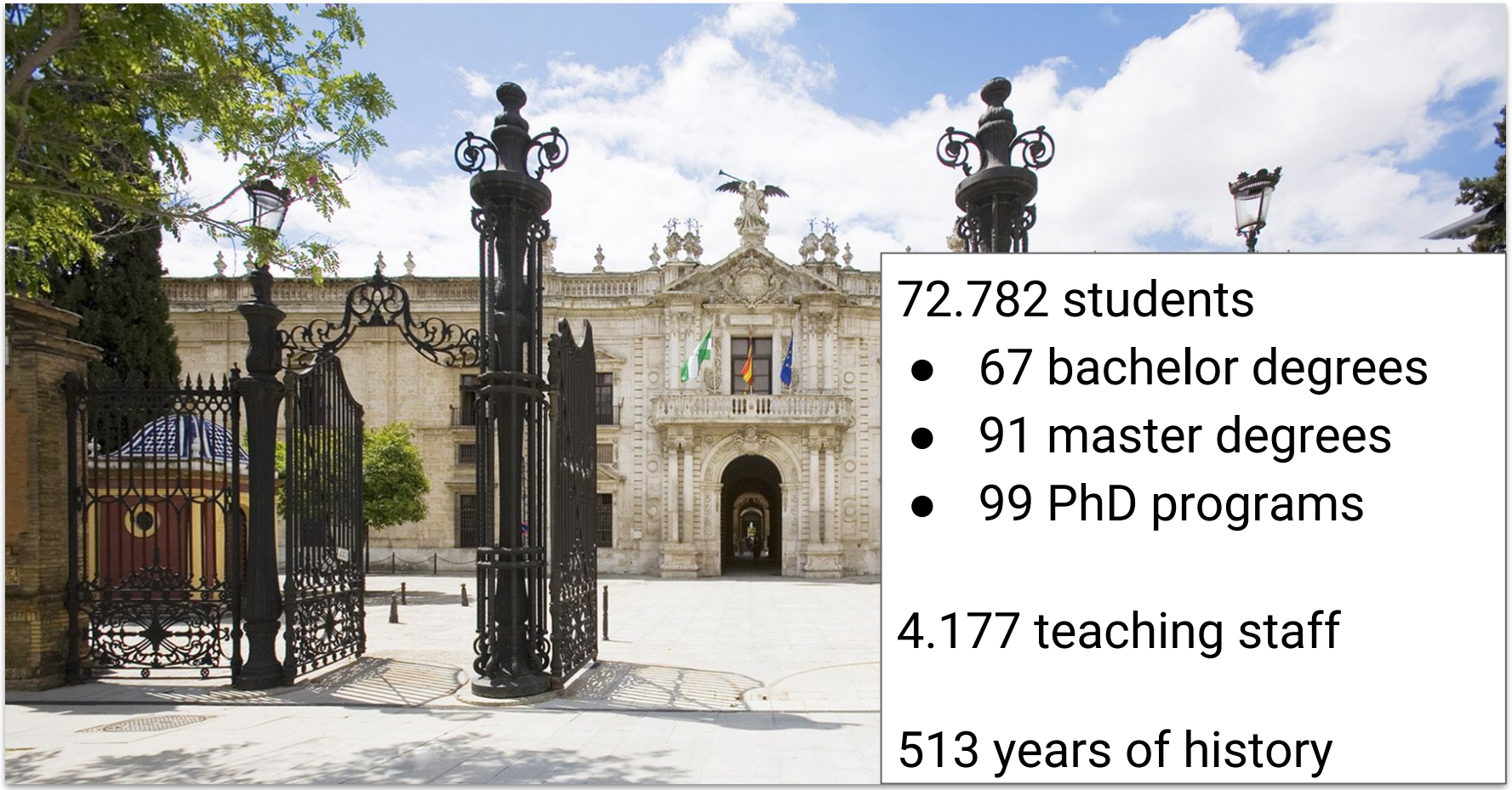
>> **href**: personal.us.es/agamez2

Where am I from?



Seville

University of Seville



72.782 students

- 67 bachelor degrees
- 91 master degrees
- 99 PhD programs

4.177 teaching staff

513 years of history

High Technical School of Computer Engineering

725 new students annually

- 5 bachelor degrees
- 3 master degrees
- 1 PhD program

294 teaching staff

33 years of history

Escuela Técnica Superior de
Ingeniería Informática

ISA Research Group

22 members

- 18 senior research staff
- 4 predoctoral researchers
- 8 research assistants

- + 200 publications
- + 8200 citations
- 3 international patents
- + 16 software tools
- 5 european research projects
- + 10 national projects
- 5 research networks
- + 35 ICT contracts
- 2 spin-offs

ISA members


Antonio Ruiz HEAD


José A. Galindo


Javier Troya


Ana B. Sánchez


Adela del Río


Amador Durán


Beatriz Bernárdez


Carlos Müller


David F. Benavides


Joaquín Peña


Jose A. Parejo


Alfonso E. Márquez


José M. García


Manuel Resinas


Octavio Martín


Pablo Fernández


Pablo Trinidad


Sergio Segura

18 senior researchers

ISA members

Antonio M. Gutiérrez

Bedilia Estrada

Margarita Cruz

Antonio Gámez

Predoctoral researchers team!

and many international co-advised PhD students

+ 8 research assistants and 24 former ones

now working for Amazon, as CTOs and other important positions in national companies.

ISA research areas

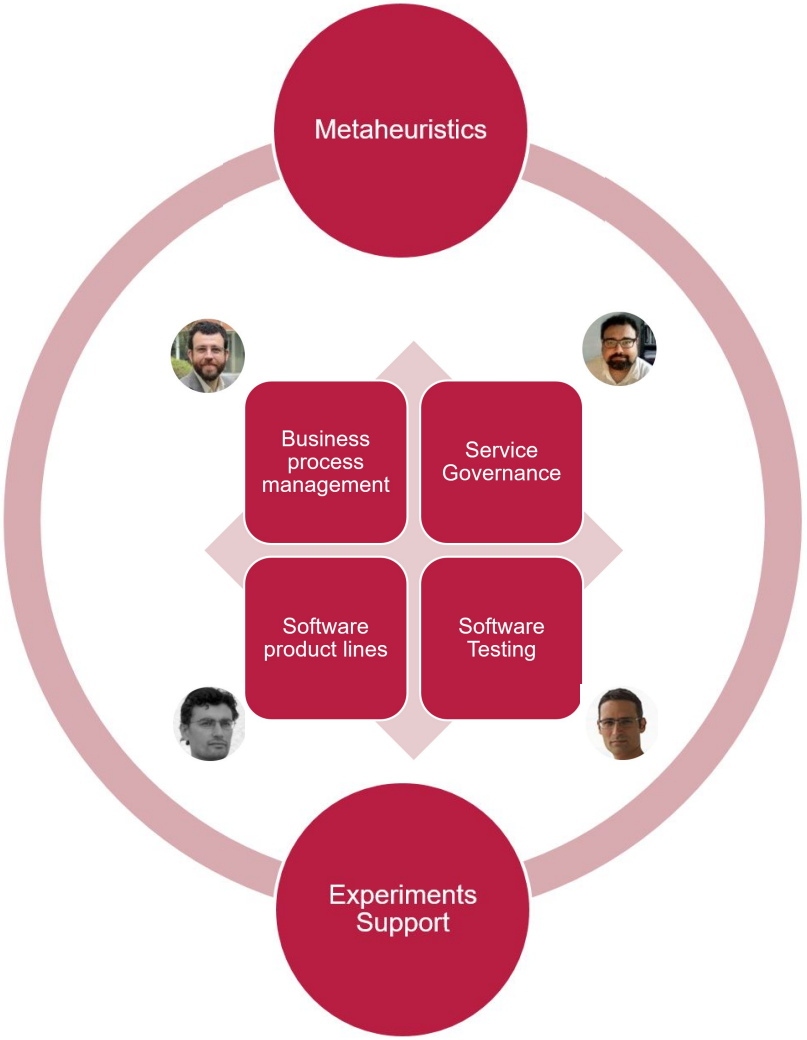

Business process management

Service Governance

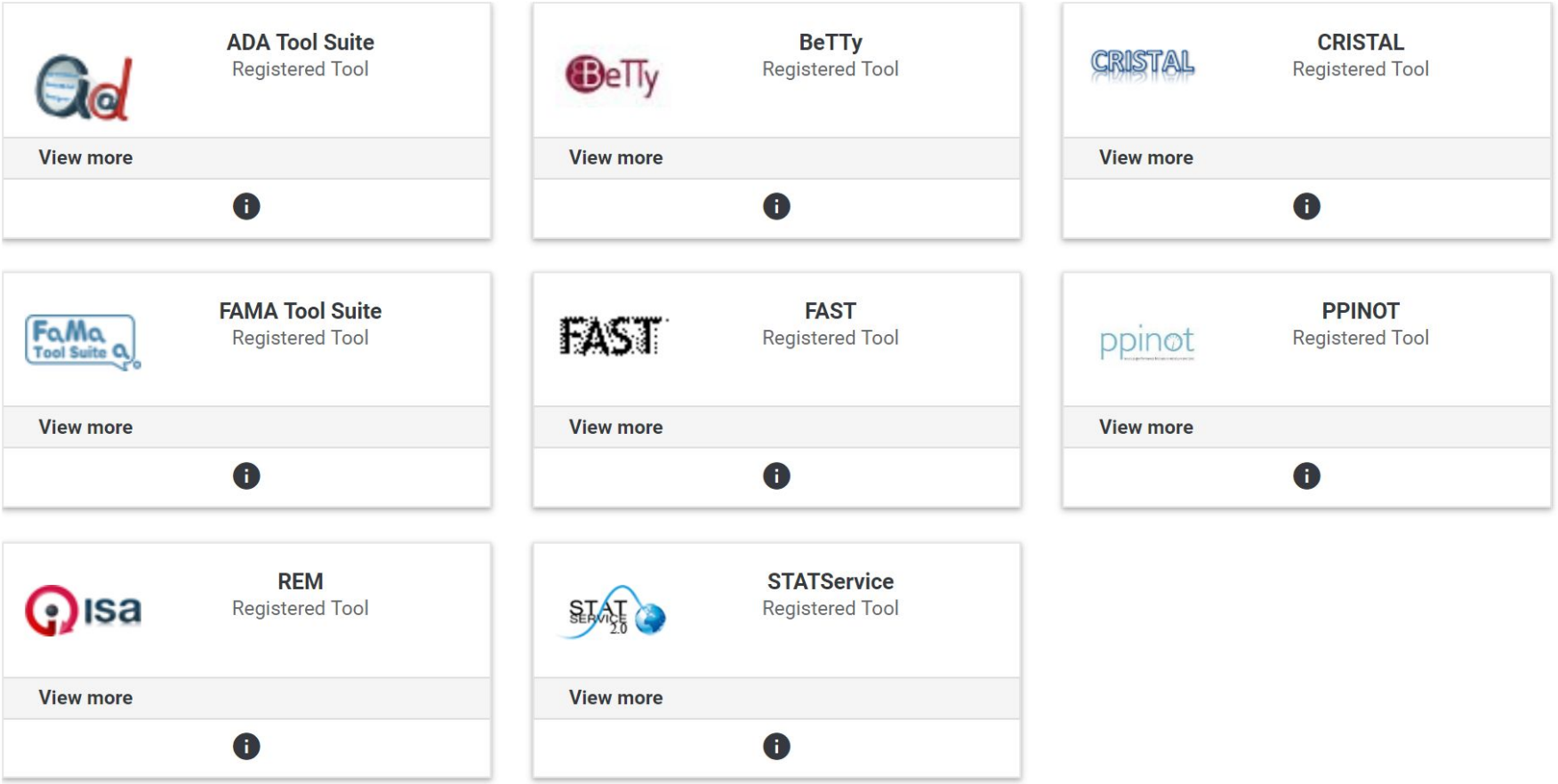
Software product lines

Software Testing

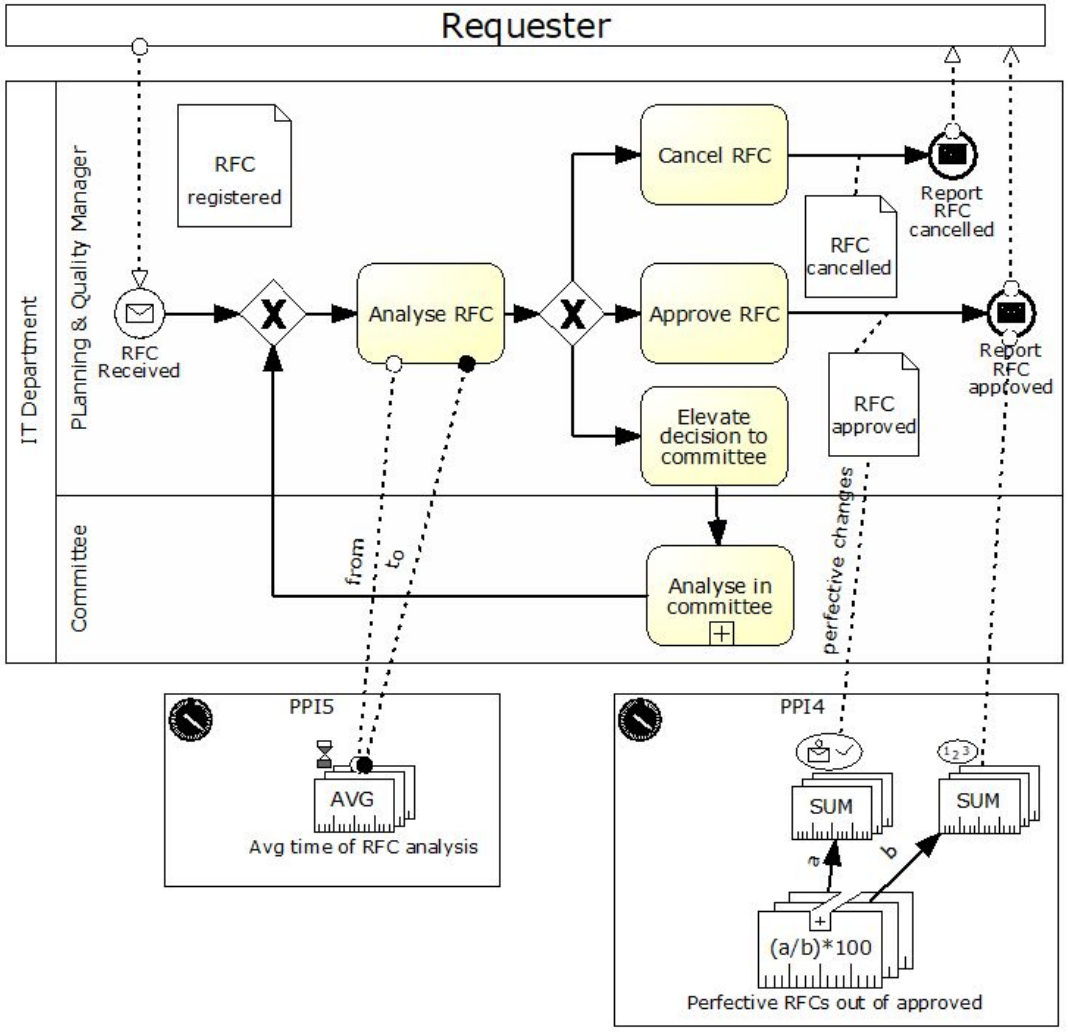

ISA Research areas



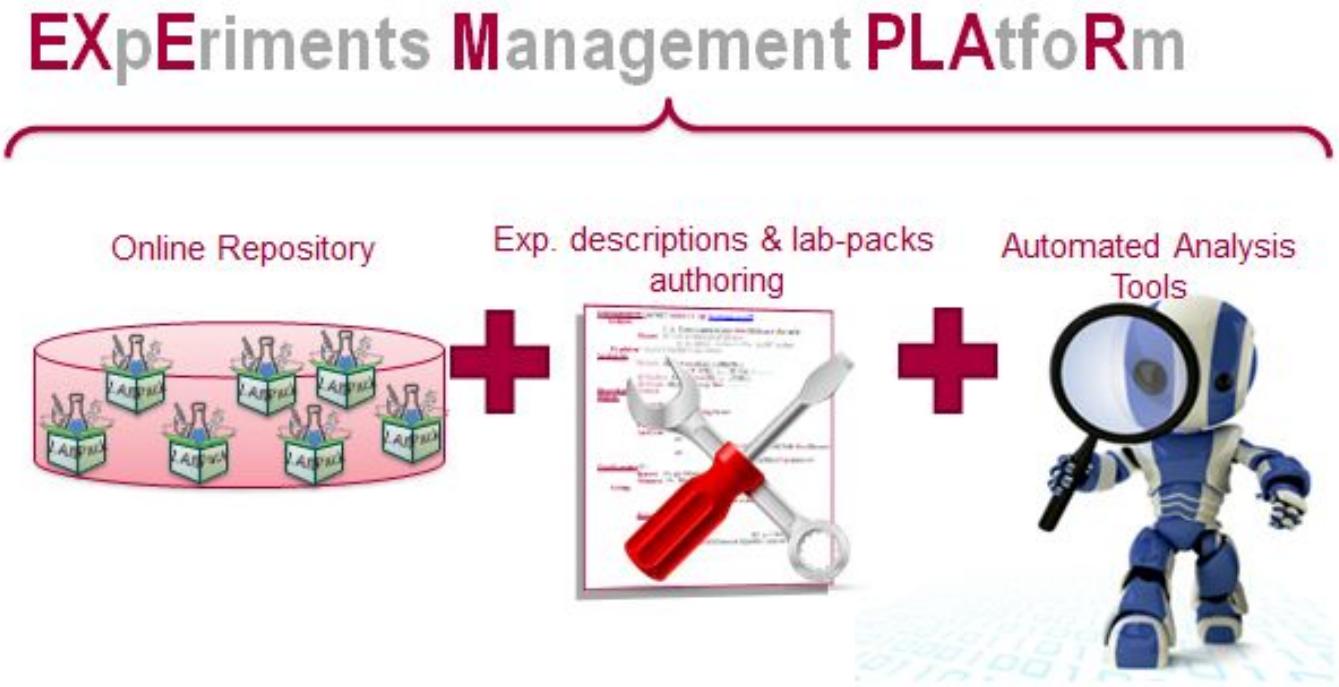
ISA tools


ADA Tool Suite
Registered Tool
View more
BeTTy
Registered Tool
View more
CRISTAL
Registered Tool
View more
FAMA Tool Suite
Registered Tool
View more
FAST
Registered Tool
View more
PPINOT
Registered Tool
View more
REM
Registered Tool
View more
STATService
Registered Tool
View more

ISA Tools - PPINOT



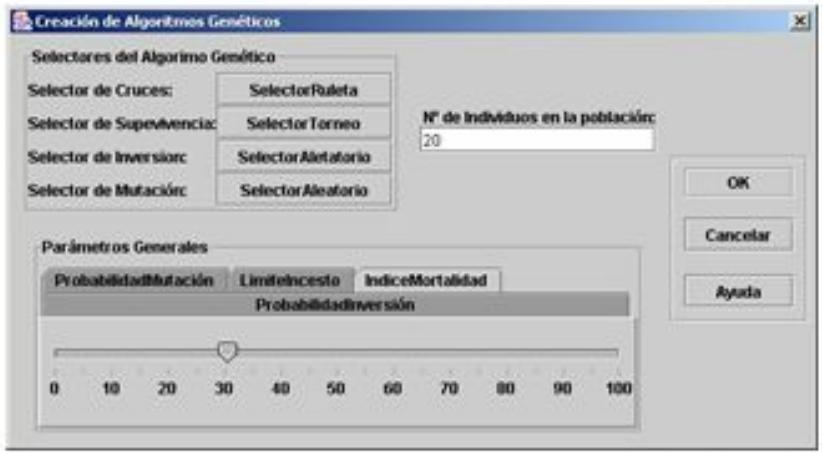
ISA Tools - EXEMPLAR

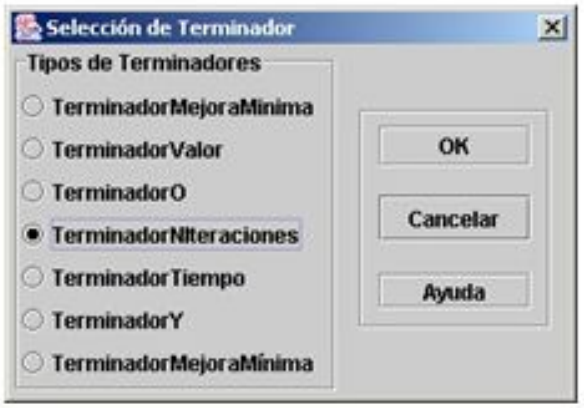


ISA Tools - SMARTEST

- A suite of statistical analysis tools that comprises of:
  - A web portal (that support online analysis of datasets).
  - A set XML/SOAP Web Services.
  - A plugin for MS Excel

ISA Tools - FOM





Agenda

- Where do I come from?
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Evolution of software architectures

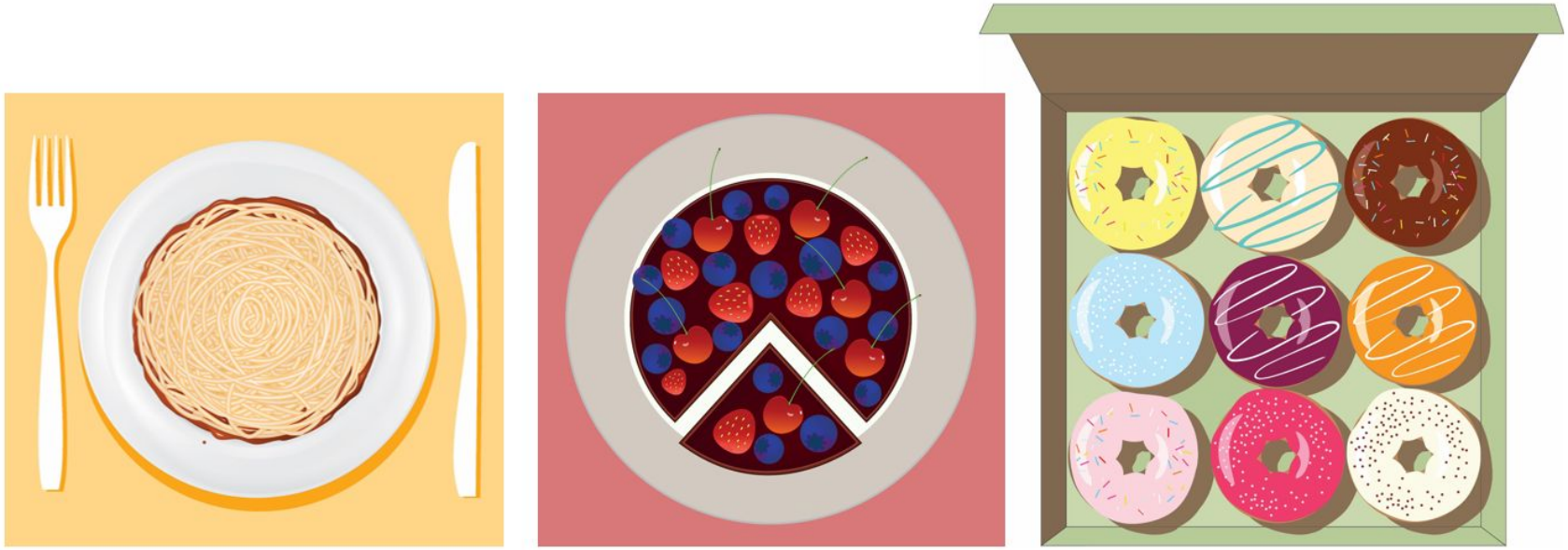
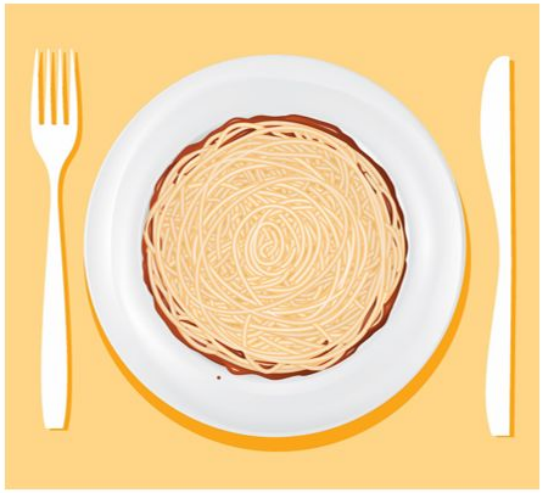


Illustration by Kanban Solutions

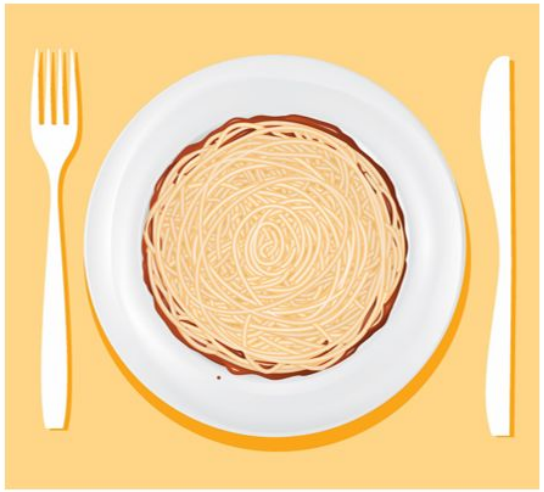
Evolution of software architectures

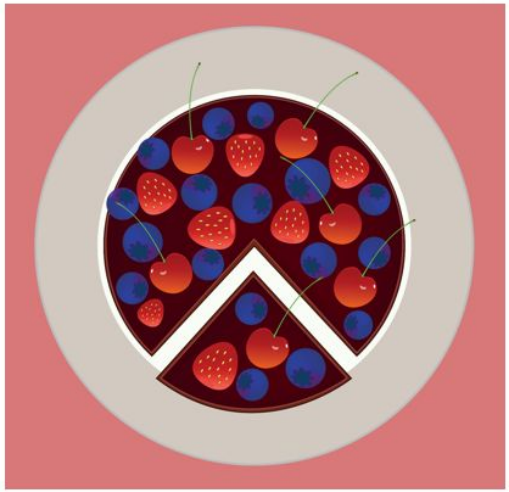


90’s

Illustration by Kanban Solutions

Evolution of software architectures





90’s

00’s

Illustration by Kanban Solutions

Evolution of software architectures

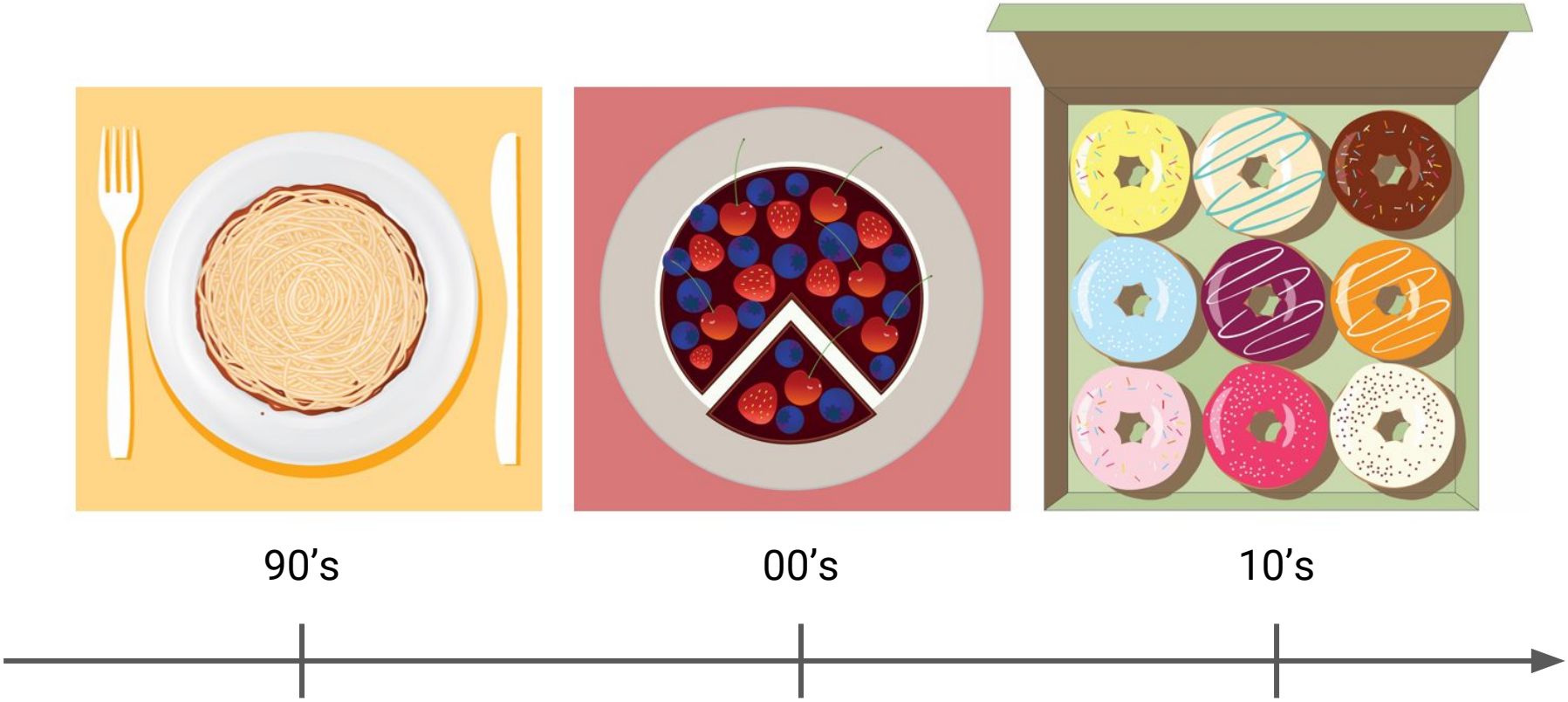
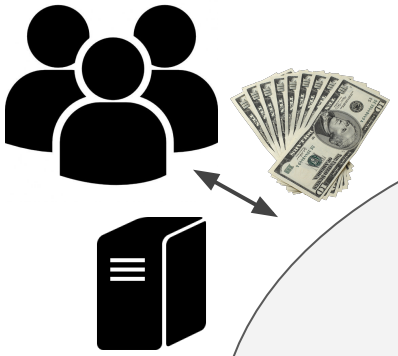
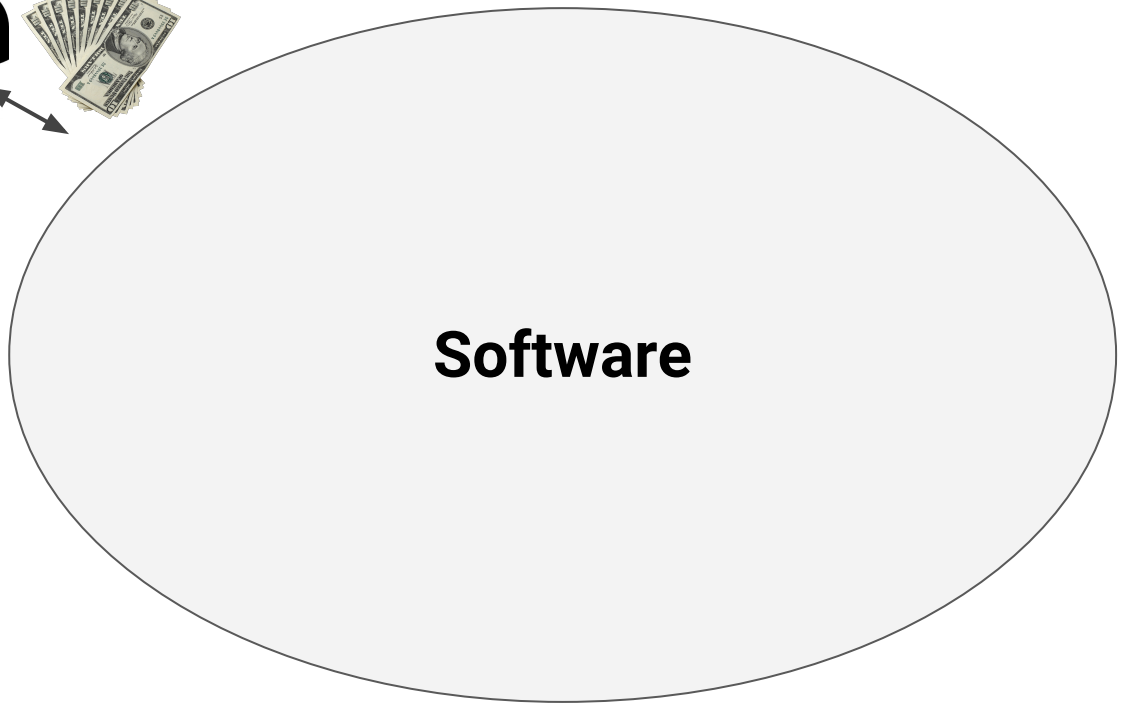


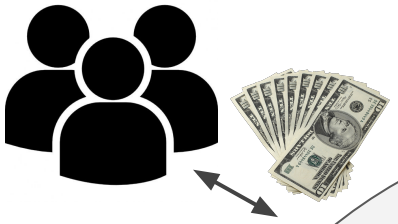
Illustration by Kanban Solutions

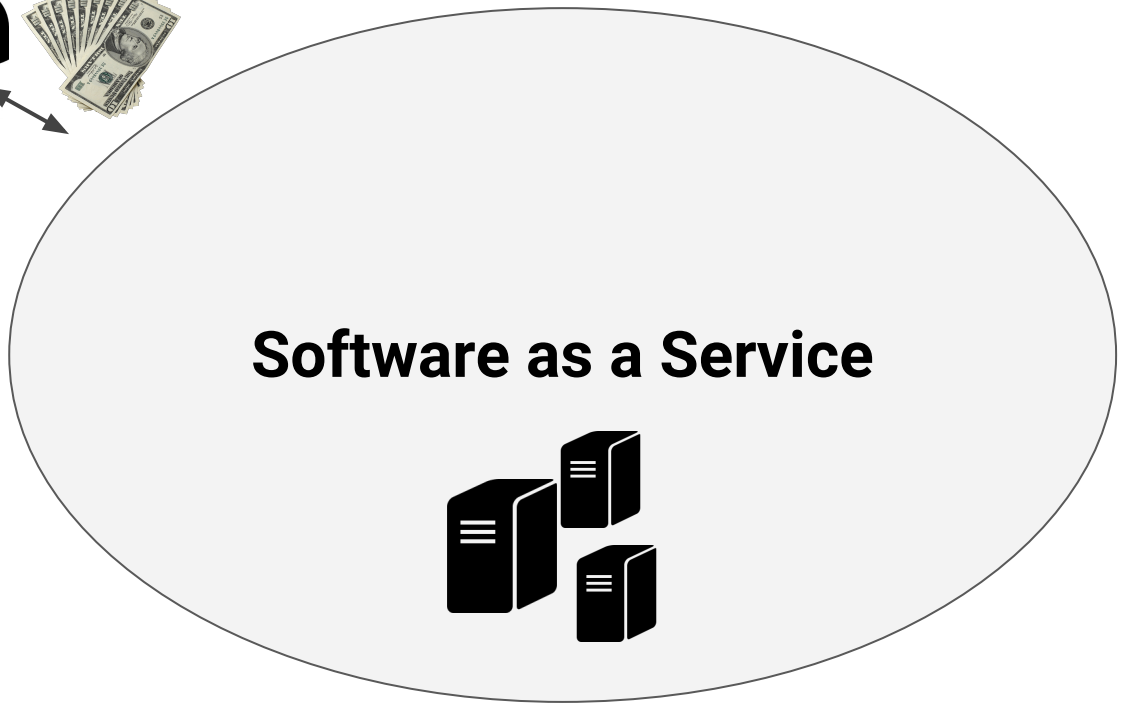
Software delivery evolution



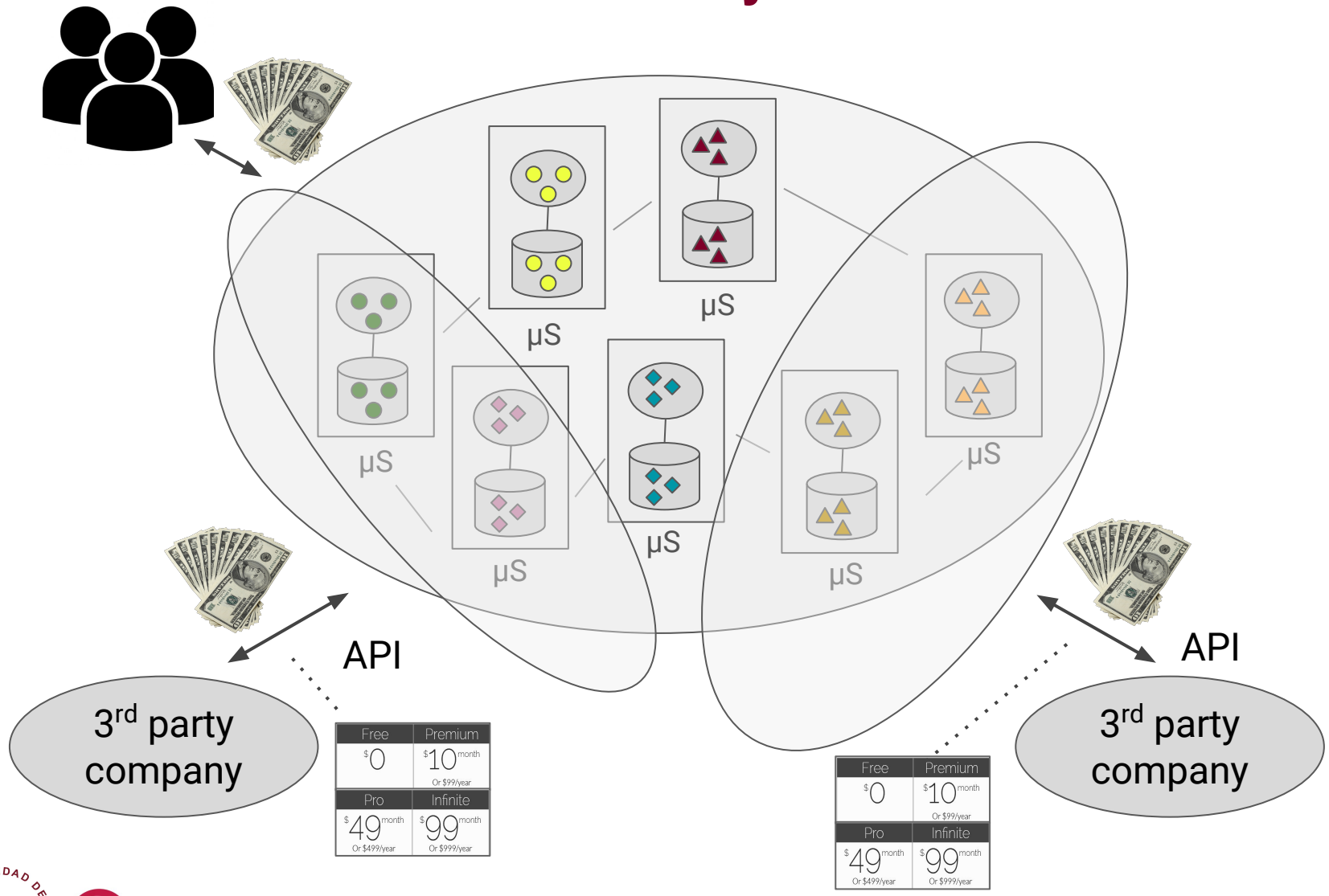


Software delivery evolution





Software delivery evolution



SLAs in APIs

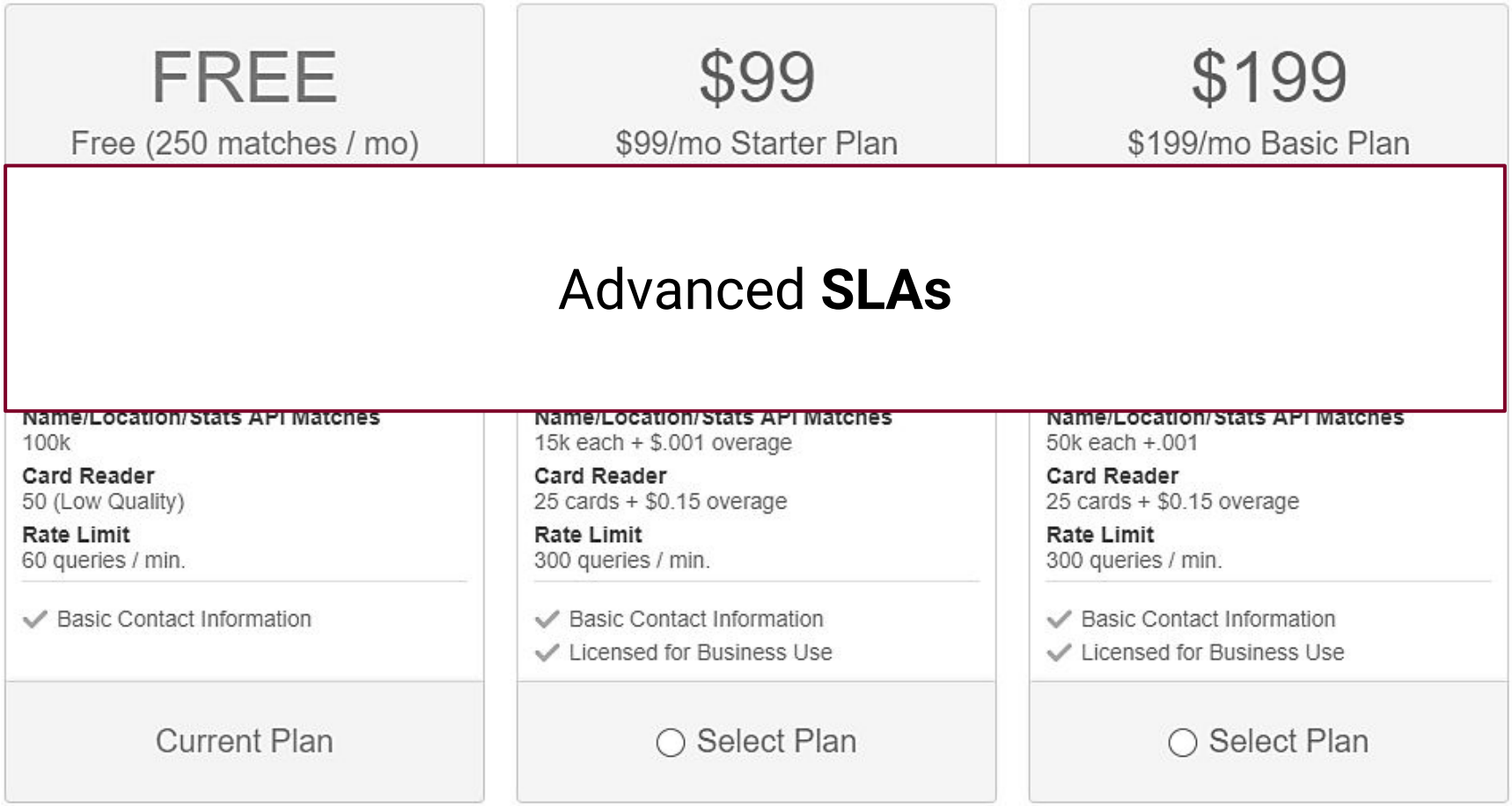


Illustration by FullContact

SLAs in APIs

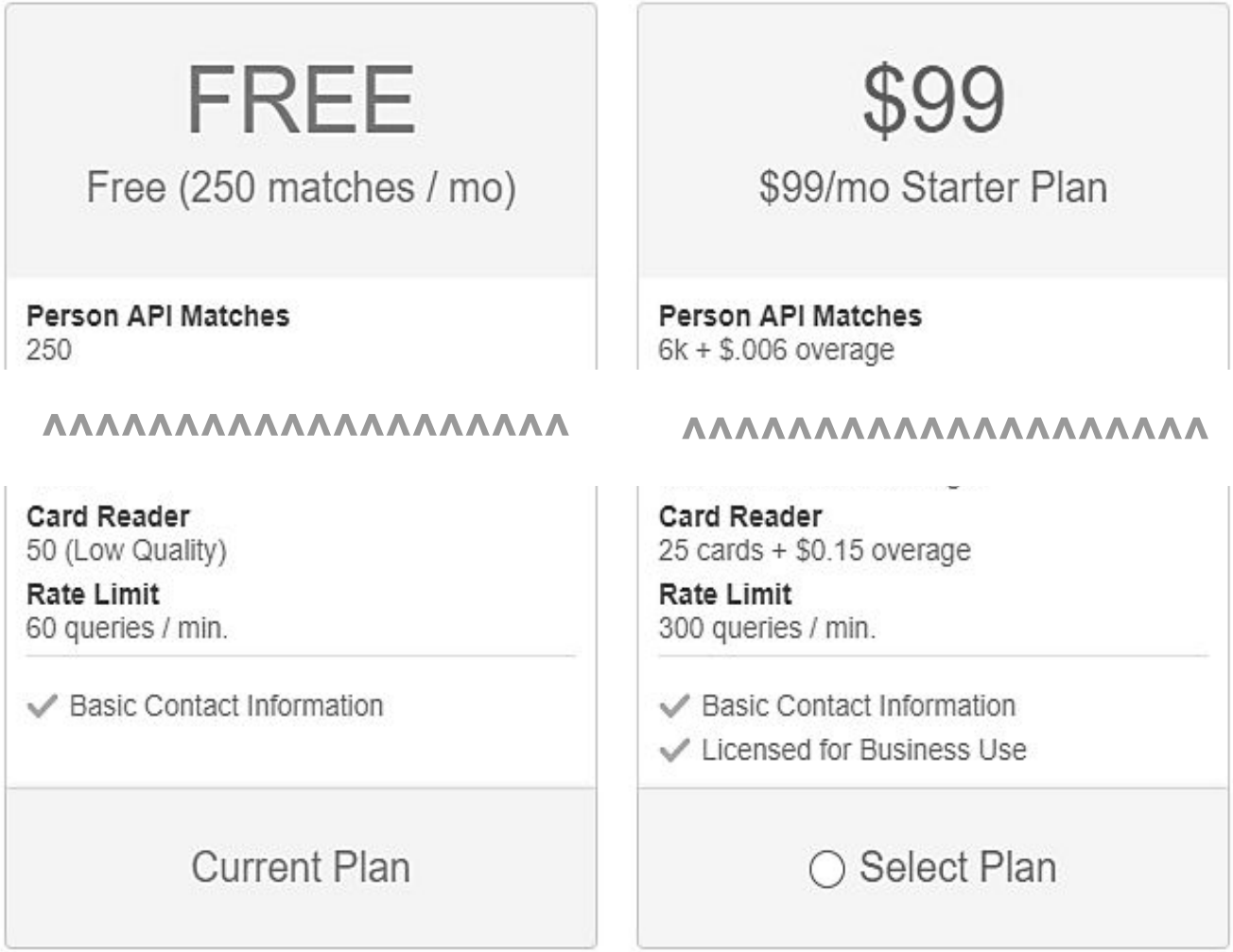
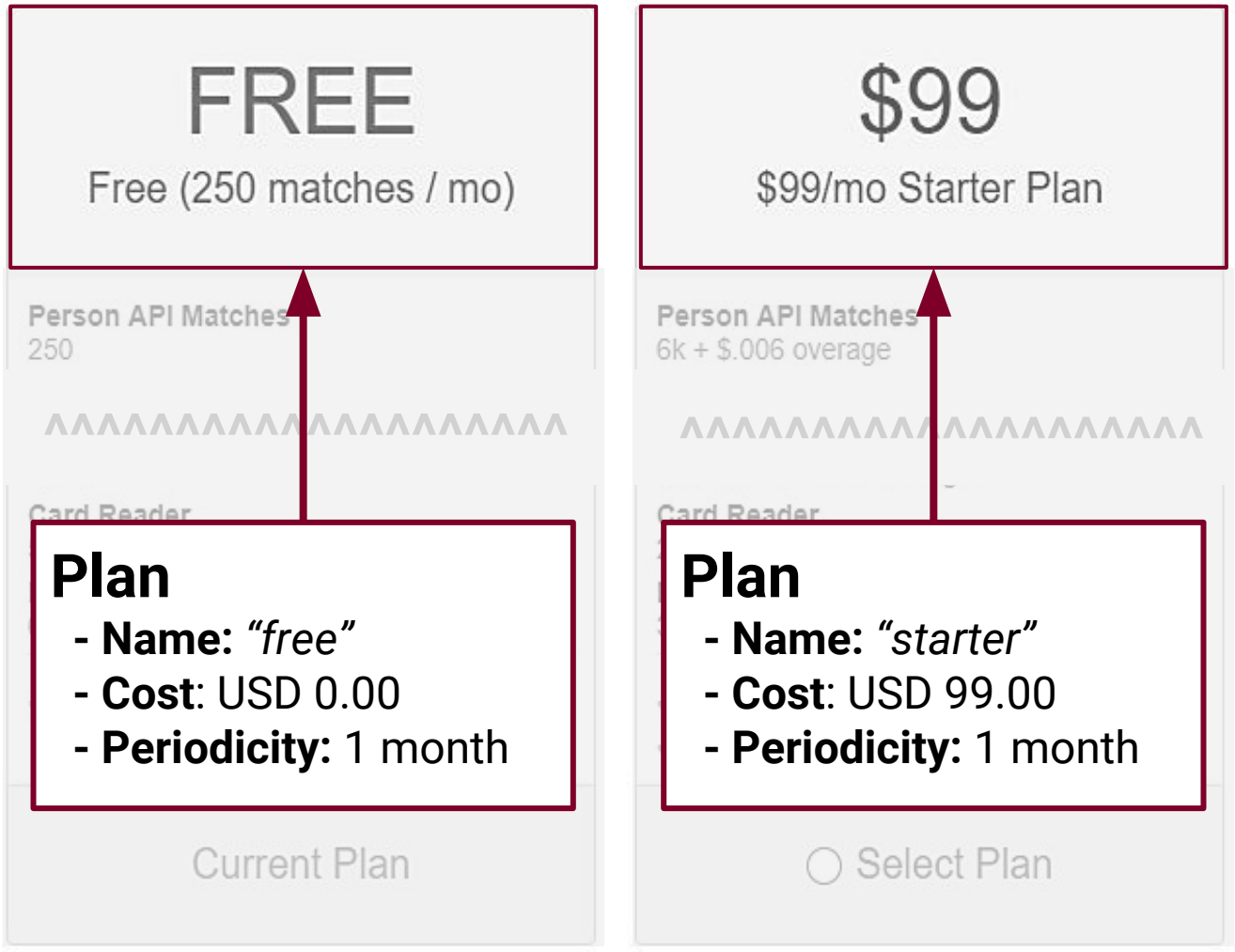


Illustration by FullContact

SLAs in APIs


FREE
Free (250 matches / mo)
$99
$99/mo Starter Plan
Person API Matches
250
Person API Matches
6k + $.006 overage
Card Reader
Card Reader
Plan
- Name: "free"
- Cost: USD 0.00
- Periodicity: 1 month
Plan
- Name: "starter"
- Cost: USD 99.00
- Periodicity: 1 month
Current Plan
Select Plan

SLAs in APIs

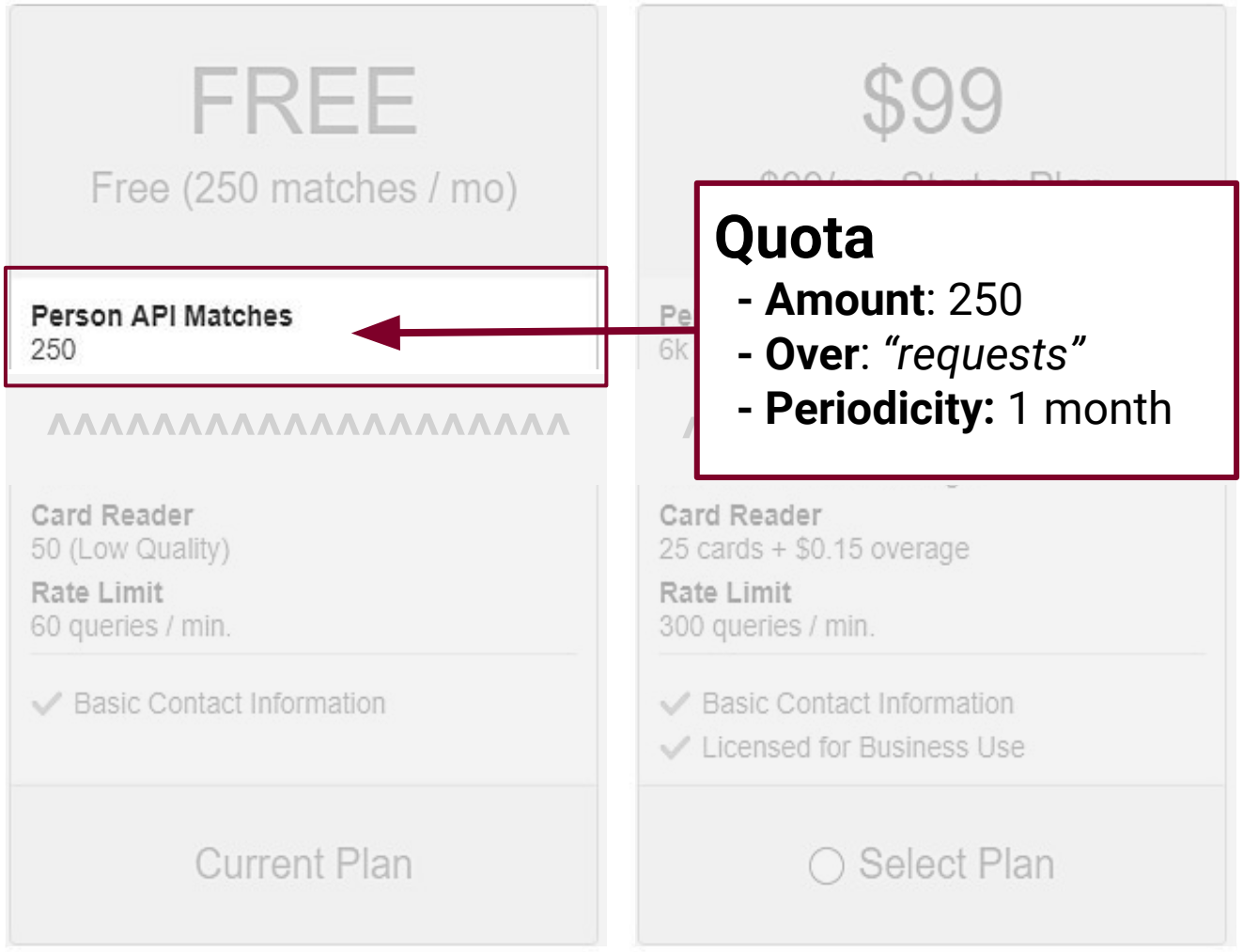


Illustration by FullContact

SLAs in APIs

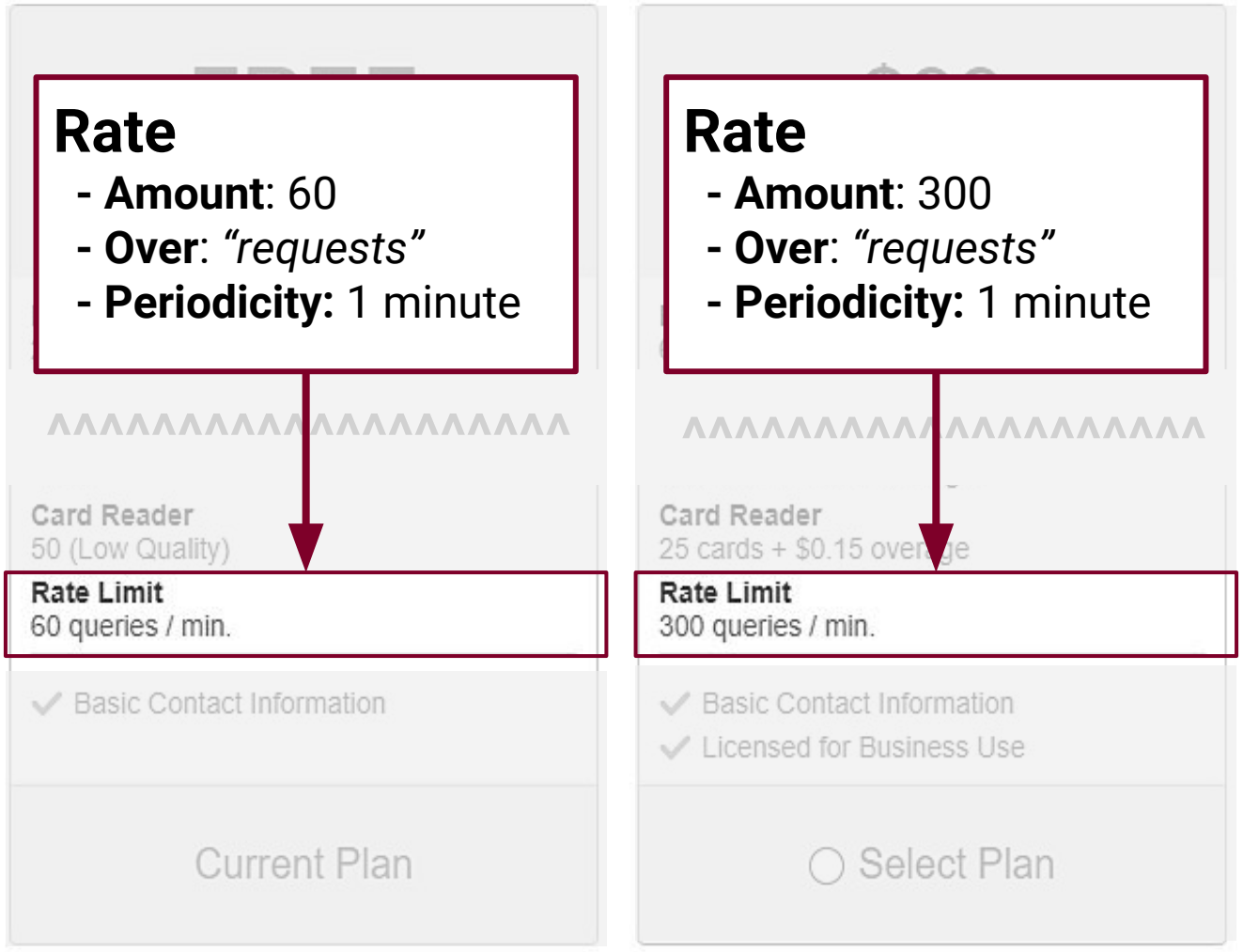
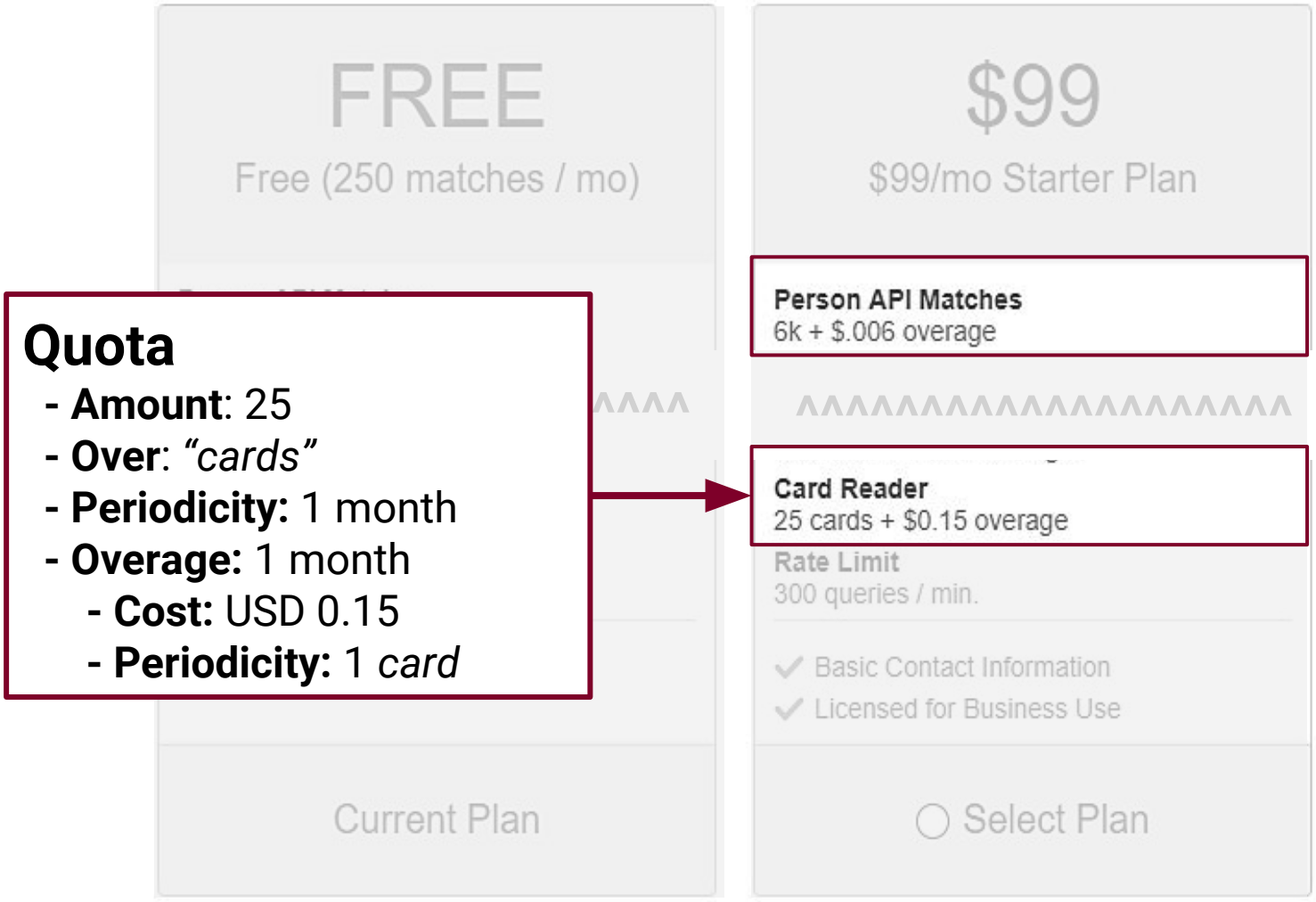


Illustration by FullContact

SLAs in APIs



Quota
- **Amount**: 25
- **Over**: *"cards"*
- **Periodicity:** 1 month
- **Overage:** 1 month
  - **Cost:** USD 0.15
  - **Periodicity:** 1 *card*

Illustration by FullContact

Agenda

- Where do I come from?
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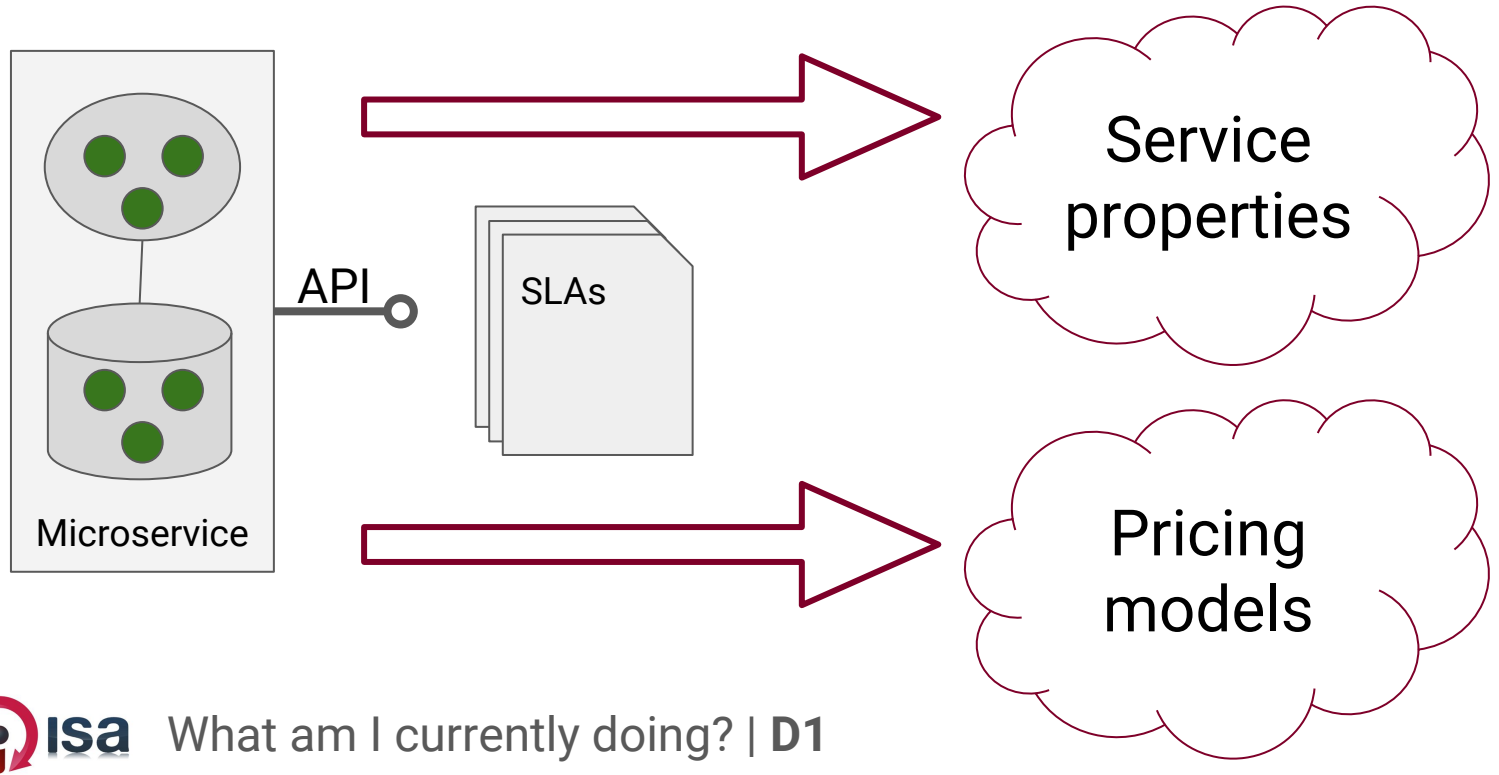
Research challenges - D1

D1: Establishing a sufficiently **expressive specification** for the description of **RESTful microservices** regulated by advanced **SLAs**



Research challenges - D1

- A systematic **analysis of 69 APIs** in the industry from **two API data sources:**

ProgrammableWeb: largest API directory.

+ 137 K APIs in 477 categories.

Mashape: largest API marketplace.

+ 7.5K APIs in 18 categories.

- Generating an open dataset of **40 attributes** distributed in **7 areas**.

Research challenges - D1

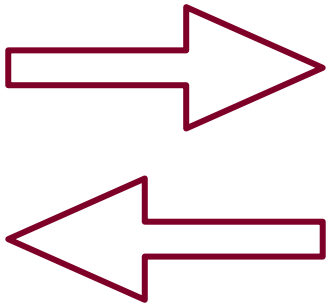
github.com/**isa-group/SLA4OAI-Specification**

```yaml
openapi: 3.0.0

info:
  title: Scopus API
  version: 1.0
  description: See elsevier.com
  x-sla: ./scopus-sla4oai.yaml

paths:
  /search/affiliation:
  /search/author:
    ...
  /search/scopus:
  /abstract/doi/{doi}:
  /abstract/eid/{eid}:
  /abstract/pii/{pii}:
  /abstract/pubmed_id/{pubmed_id}:
  /abstract/pui/{pui}:
  /abstract/scopus_id/{scopus_id}:
  /affiliation/affiliation_id/{
     affiliation_id}:
  /affiliation/eid/{eid}:
  /author/eid/{eid}:
  /author/author_id/{author_id}:
  /abstract/citation-count:
  /abstract/citations:
  /serial/title:
  /serial/title/issn/{issn}:

components:
  schemas:
    scopus:
    affiliation:
    author:
    stream:
```



```yaml
plans:
  non-subscriber:
    pricing:
      cost: ...
    rates:
      ...
      /search/author:
        get:
          requests:
            - max: 3
              period: secondly
    quotas:
      ...
      /search/author:
        get:
          requests:
            - max: 5000
              period: weekly

  subscriber:
    pricing:
      cost: ...
    rates:
      ...
      /search/author:
        get:
          requests:
            - max: 3
              period: secondly
    quotas:
      ...
      /search/author:
        get:
          requests:
            - max: 5000
              period: weekly
```

Research challenges - D2

D2: Develop a catalog of **SLA analysis and management operations** to support the governance of microservice architectures.

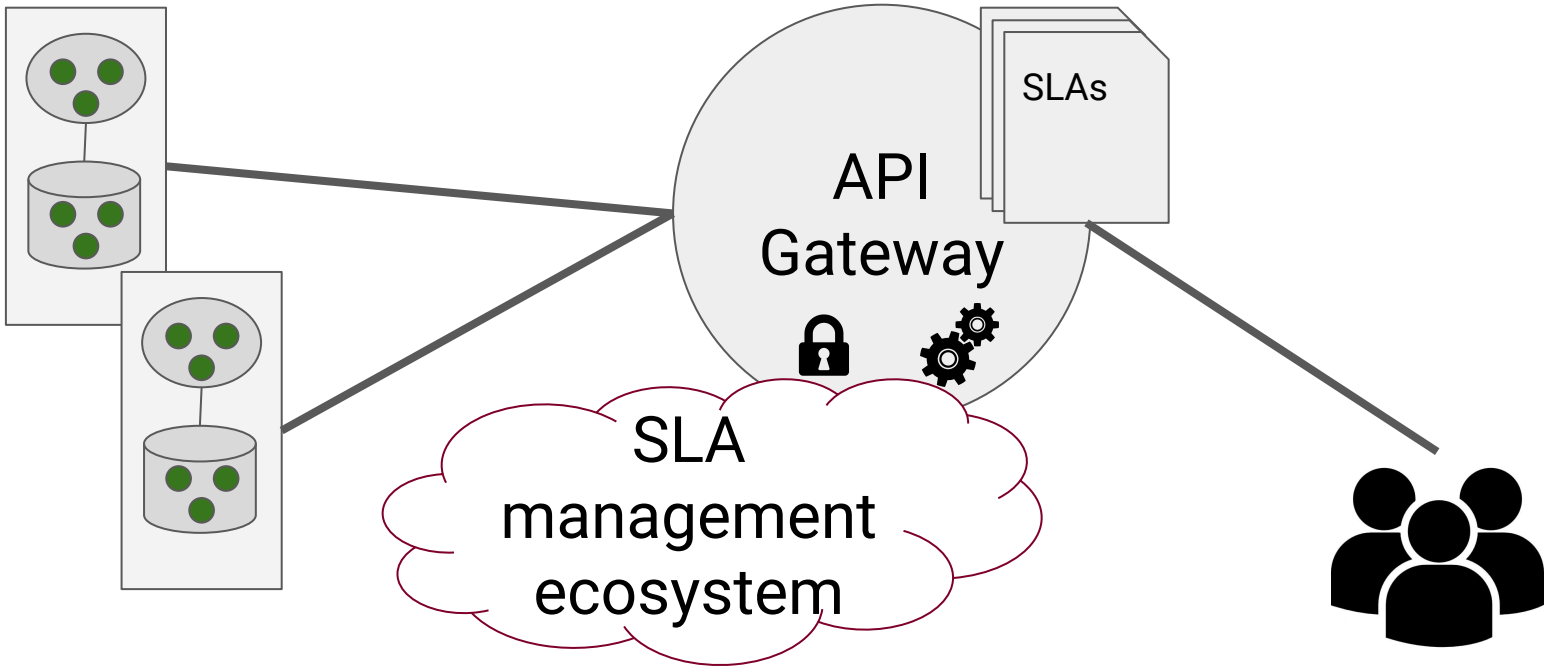
Research challenges - D2

But… how can we make decisions without having the full picture?

Comprehensive RESTful API modeling

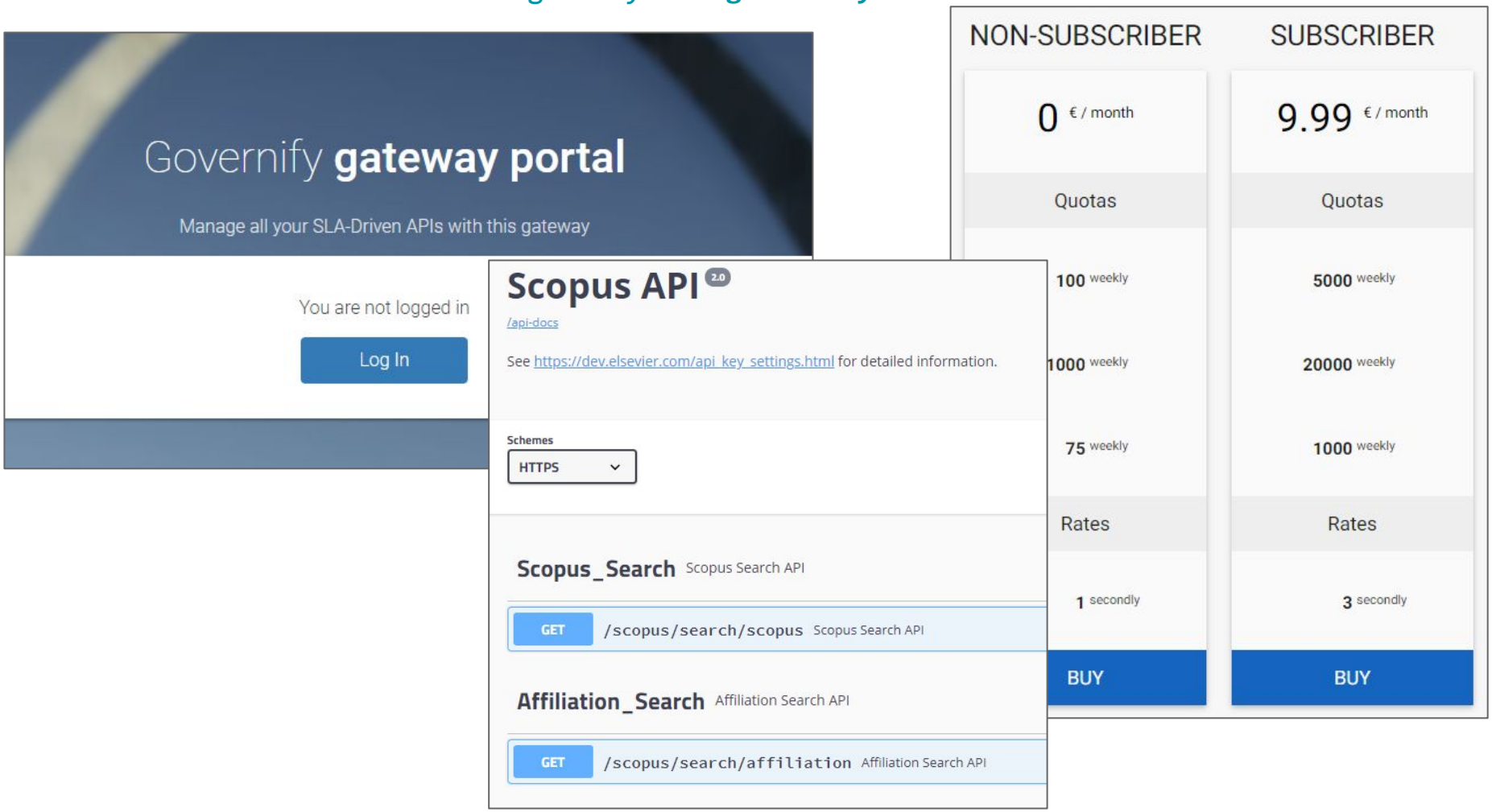
Research challenges - D3

D3: Implement a **SLAs management ecosystem** to support the government of RESTful microservices



Research challenges - D3

gateway.oai.governify.io



Research challenges - D4

D4: Consolidation of the **Governify** platform to **validate the proposal** in industrial environments.

GOVERNIFY

Agenda

- Where do I come from?
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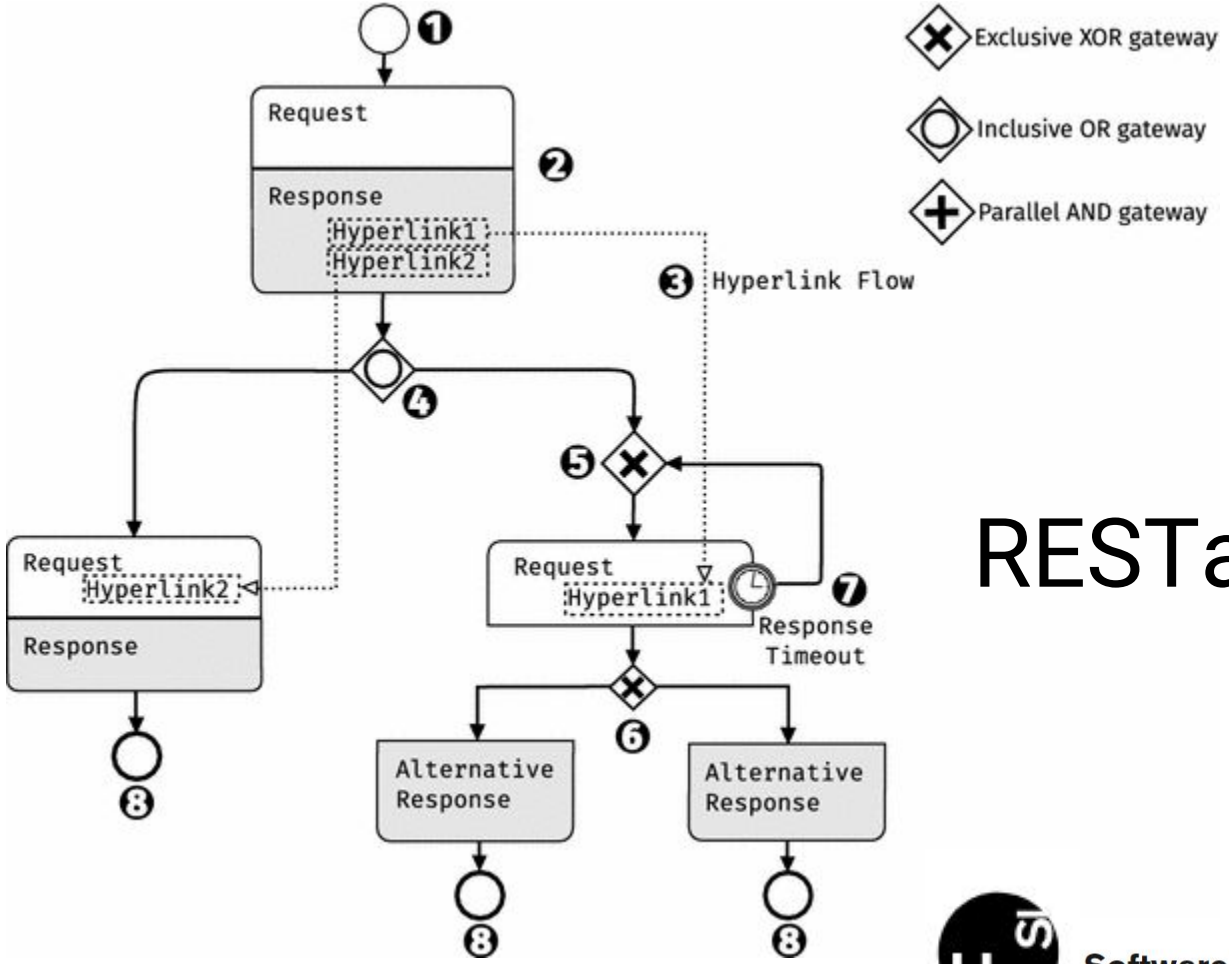
- **Why am I in Lugano?**

My research stay in Lugano

1. What is the **best API usage plan** given a conversation?
2. How many instances of conversations can I invoke **until I reach the quota**?
3. How much time should I wait to **not to exceed rates**?
4. How to **set limitations to my clients** if I depends on 3rd party APIs

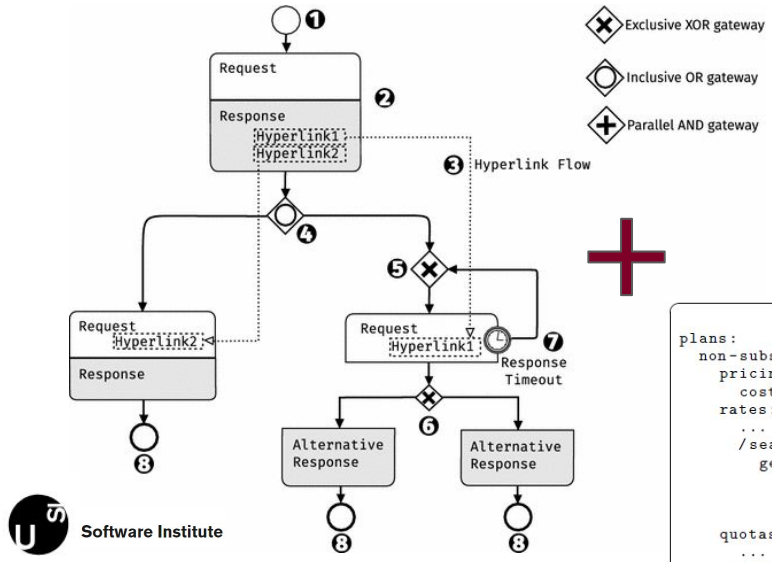
My research stay in Lugano



RESTalk

Software Institute

My research stay in Lugano



+

```
plans:
  non-subscriber:
    pricing:
      cost: ...
    rates:
      ...
      /search/author:
        get:
          requests:
            - max: 3
              period: secondly
    quotas:
      ...
      /search/author:
        get:
          requests:
            - max: 5000
              period: weekly

  subscriber:
    pricing:
      cost: ...
    rates:
      ...
      /search/author:
        get:
          requests:
            - max: 3
              period: secondly
    quotas:
      ...
      /search/author:
        get:
          requests:
            - max: 5000
              period: weekly
```

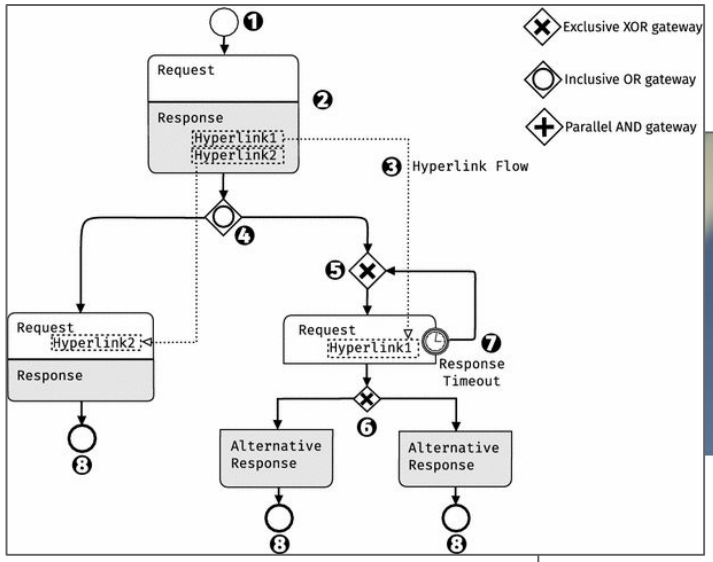
OPEN API INITIATIVE

```
openapi: 3.0.0

info:
  title: Scopus API
  version: 1.0
  description: See elsevier.com
  x-sla: ./scopus-sla4oai.yaml

paths:
  /search/affiliation:
  /search/author:
    ...
  /search/scopus:
  /abstract/doi/{doi}:
  /abstract/eid/{eid}:
  /abstract/pii/{pii}:
  /abstract/pubmed_id/{pubmed_id}:
  /abstract/pui/{pui}:
  /abstract/scopus_id/{scopus_id}:
  /affiliation/affiliation_id/{
    affiliation_id}:
  /affiliation/eid/{eid}:
  /author/eid/{eid}:
  /author/author_id/{author_id}:
  /abstract/citation-count:
  /abstract/citations:
  /serial/title:
  /serial/title/issn/{issn}:

components:
  schemas:
    scopus:
    affiliation:
    author:
    stream:
```

+

isa

My research stay in Lugano



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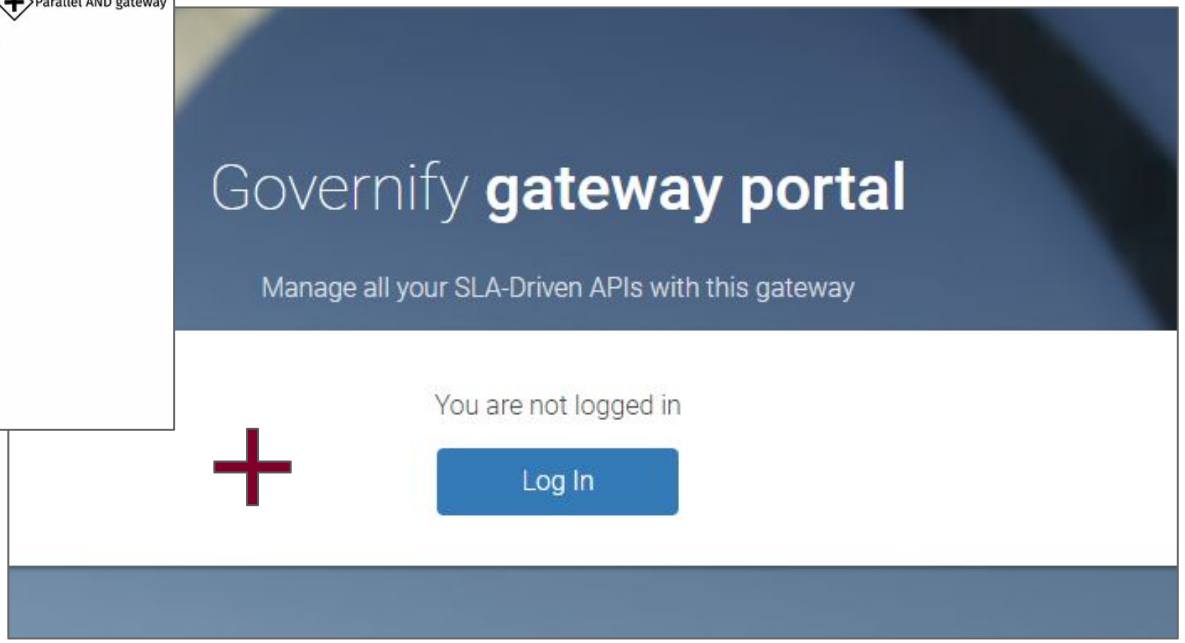

SLA-driven governance for RESTful systems

Thank you

Questions?

Antonio Gámez Díaz

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Extra slides

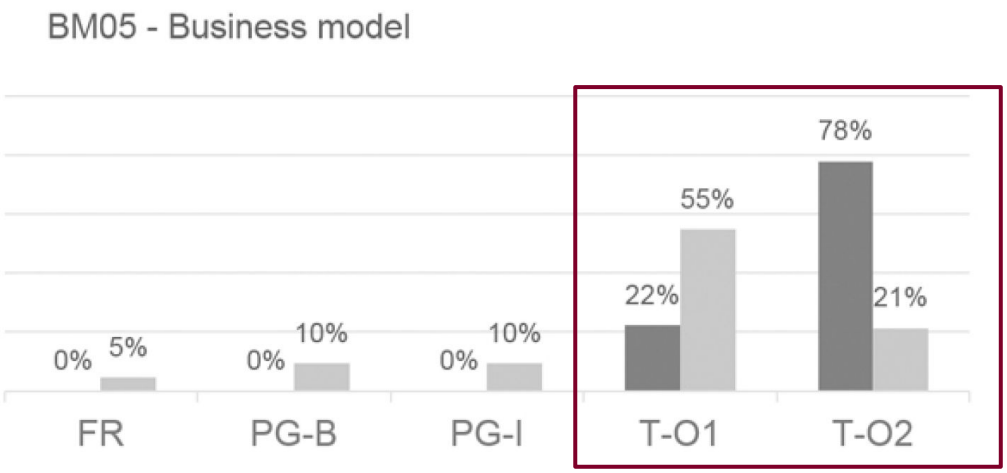
- Results of the ICSOC study
- OAI in a nutshell
- Governify in a nutshell

programmableWeb
mashape

Results: conclusions

RQ-01 What are the most common **business models**?

Most APIs offer a **tiered** plan with or without **overage**.

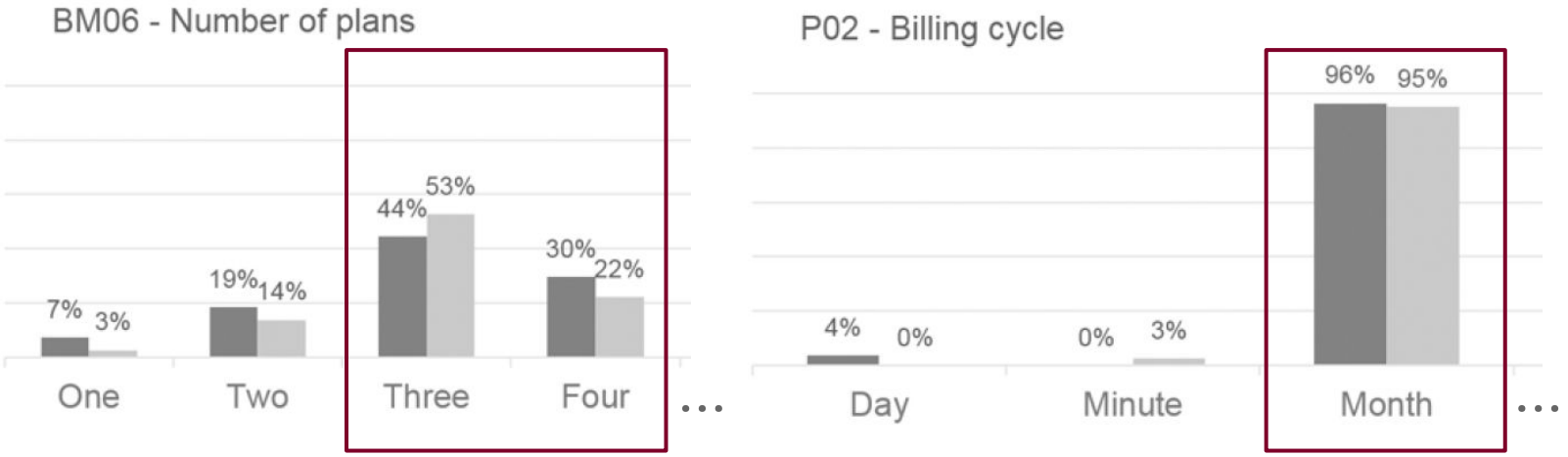


Results: conclusions

RQ-02

How are the plans in terms of the characteristics they have?

Most APIs define between **2-4 plans**, with a **monthly** billing cycle.



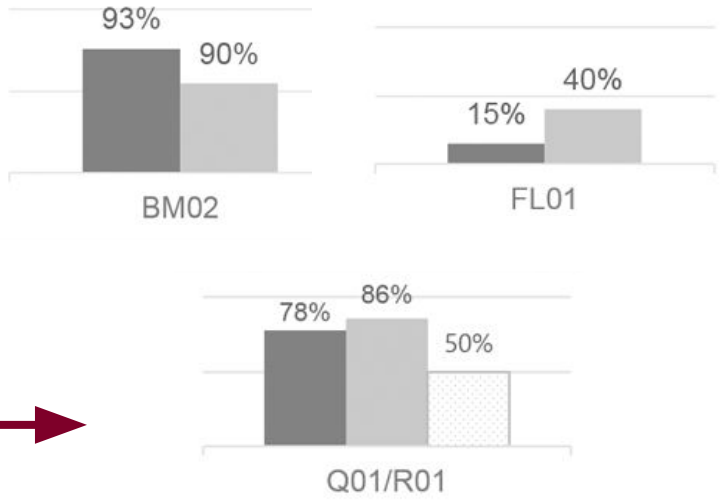
programmableWeb
mashape

Results: conclusions

RQ-03 Which **regulations** do the providers state over the RESTful APIs?

Most API providers **apply limitations** in somehow:

- **Type** of limitations:
  - **Free tier**: restricting the allowed **operations**.
  - **Paid plans**: both **quotas** and **rates** definition.



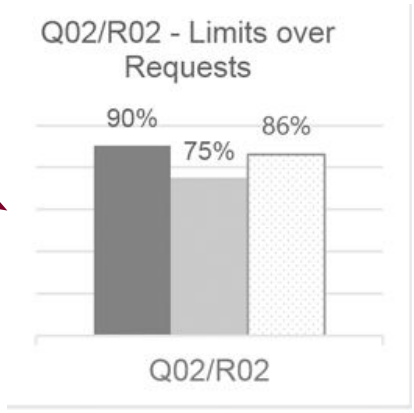
programmableWeb
mashape

Results: conclusions

RQ-03 Which **regulations** do the providers state over the RESTful APIs?

Most API providers **apply limitations** in somehow:

- **Limitations** are usually **scoped** over the number of **requests**.



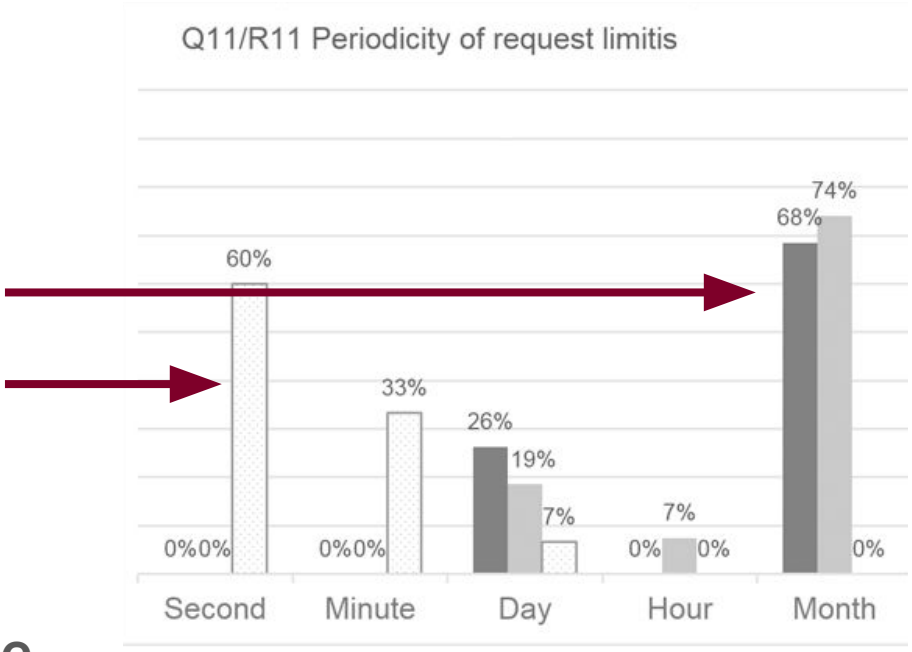
programmableWeb
mashape

Results: conclusions

RQ-03 Which **regulations** do the providers state over the RESTful APIs?

Most API providers **apply limitations** in somehow:

- Periodicity **intervals**:
  - **Quotas**: monthly
  - **Rates**: secondly.



programmableWeb
mashape

Results: conclusions

Extra

Is there any **difference** between the APIs selected from a **marketplace** and the ones selected from a **general directory**?

API plans from general directories have a **higher level of expressivity**.

- For instance:
  - **Rates** definition.
  - **Combined** business models.
  - **Mixing** periodicity for limitations.
  - **Fine-grained** limitations and billing.

Final remarks

What did we do?

- We have **systematically** studied, in an **open** dataset, **40 attributes** in **3** main **areas** in **69 real-world APIs** from the **2** main API **sources**.

What did we find?

- There **exists a wider expressivity** in the **plans** when the API **is not explicitly regulated** by API marketplaces.
- The results can also be useful for **practitioners** who have to **design a new API plan**.

Future work

What do we plan to do?

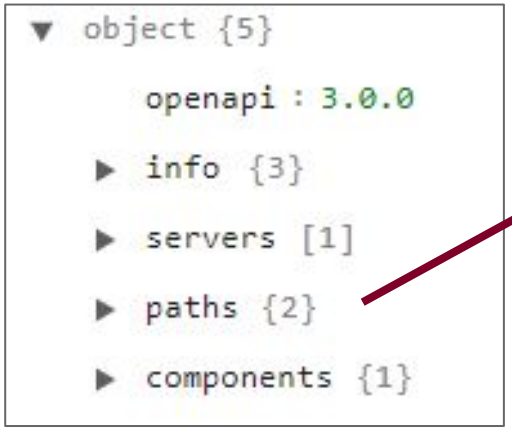
- Identify a **correlation** between the **plan** offered and the **types of limitations**.
- Extend the **analysis** and enlarge the open **dataset**.

Identify a specific **set of requirements** to define a **formal model** to describe **API non-functional** aspects

Extra slides

- Results of the ICSOC study
- **OAI in a nutshell**
- Governify in a nutshell

OAI in a nutshell



OAI in a nutshell

```
▼ /pets/{petId} {1}
  ▼ get {5}
      summary : Info for a specific pet
      operationId : showPetById
    ▶ tags [1]
    ▼ parameters [1]
      ▼ 0 {5}
          name : petId
          in : path
          required : ☑ true
          description : The id of the pet
        ▼ schema {1}
            type : string
    ▼ responses {2}
```

```
▼ responses {2}
  ▼ 200 {2}
      description : Expected response to a valid
    ▼ content {1}
      ▼ application/json {1}
        ▼ schema {1}
            $ref : #/components/schemas/Pets
  ▶ default {2}
```

OAI in a nutshell

OAI Petstore 1.0.0

[Base URL: petstore.openapis.org/v2]

This is a sample server Petstore server.

pet Everything about your Pets — Find out more: http://openapis.org

- POST /pet Add a new pet to the store
- PUT /pet Update an existing pet
- GET /pet/findByStatus Finds Pets by status
- ~~GET /pet/findByTags~~ Finds Pets by tags

Extra slides

- Results of the ICSOC study
- OAI in a nutshell
- **Governify in a nutshell**


governify.io
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isa

01/04/2017 – 30/04/2017

Incidencias cerradas

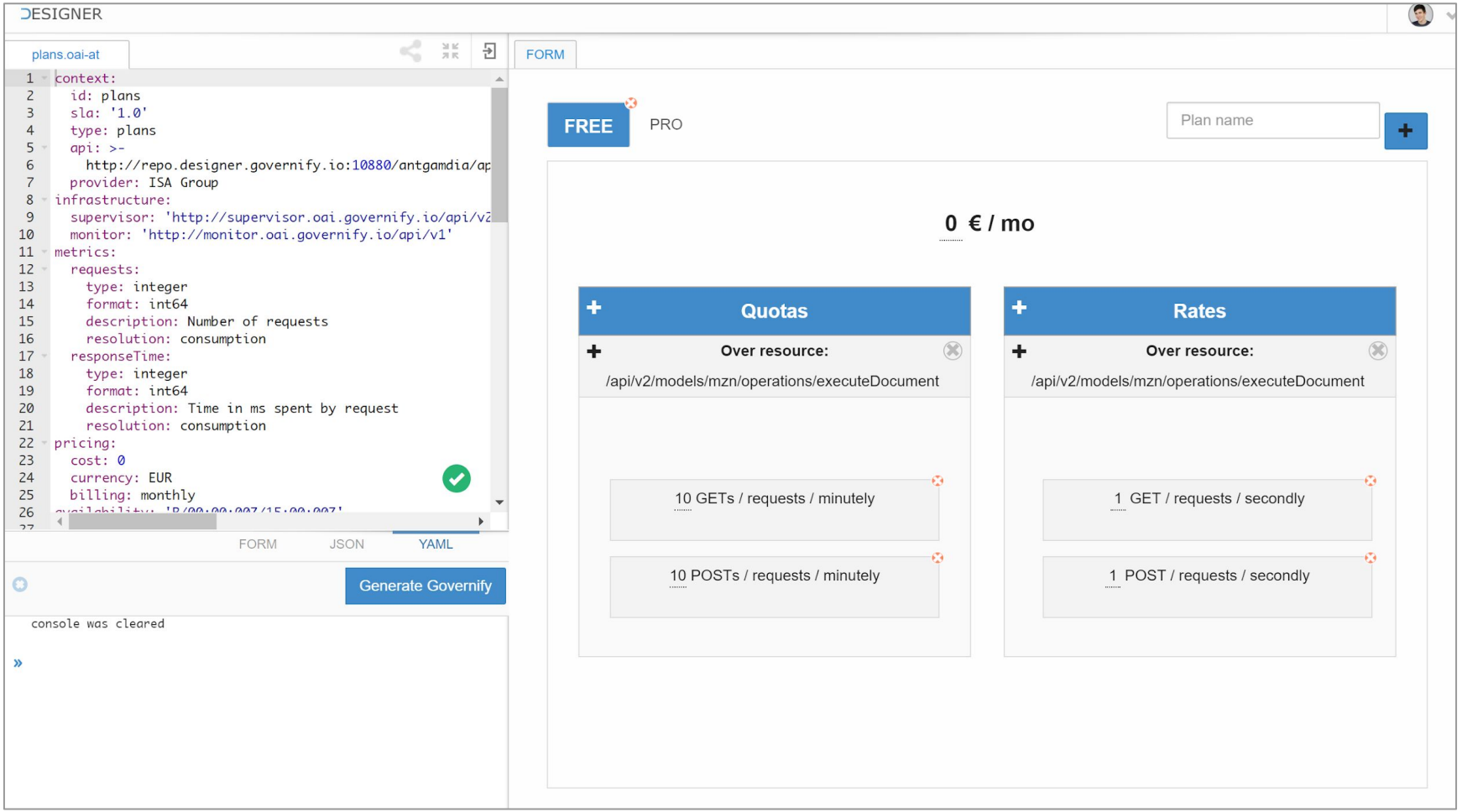
INDICADOR INCIDENCIAS	PRIORIDAD	UMBRAL	SATISFACCIÓN			OCURRENCIAS	EVALUADOS	INCUMPLIDOS	FALSOS POSITIVOS	RESULTADO (media)
			Exigida	Alcanzada	Alcanzada x Indicador x Prioridad					
Tiempo de resolución	Crítica (P1)	8h / 72h	90,00%	100,00%	100,00%	1	1	0	0	0h 13min (13min)
	Alta (P2)	30d (240h)			100,00%	1	1	0	0	7h 50min (470min)
	Media (P3)	40d (280h)			100,00%	7	7	0	0	24h 43min (1483min)
	Baja (P4)	40d (280h)			100,00%	9	9	0	0	32h 5min (1925min)
Tiempo de respuesta	Crítica (P1)	2h	90,00%	100,00%	100,00%	1	1	0	0	1h 5min (65min)
	Alta (P2)	7h			100,00%	1	1	0	0	0h 46min (46min)
	Media (P3)	24h			100,00%	7	7	0	0	0h 41min (41min)
	Baja (P4)	24h			100,00%	9	9	1	1	0h 53min (53min)
Pendiente de usuario	Crítica (P1)	3h	50,00%	31,25%	N/A	1	0	0		N/A
	Alta (P2)	6h			100,00%	1	1	0		2h 58min (178min)
	Media (P3)	12h			42,86%	7	7	4		233h 38min (14018min)
	Baja (P4)	24h			12,50%	9	8	7		431h 54min (25914min)

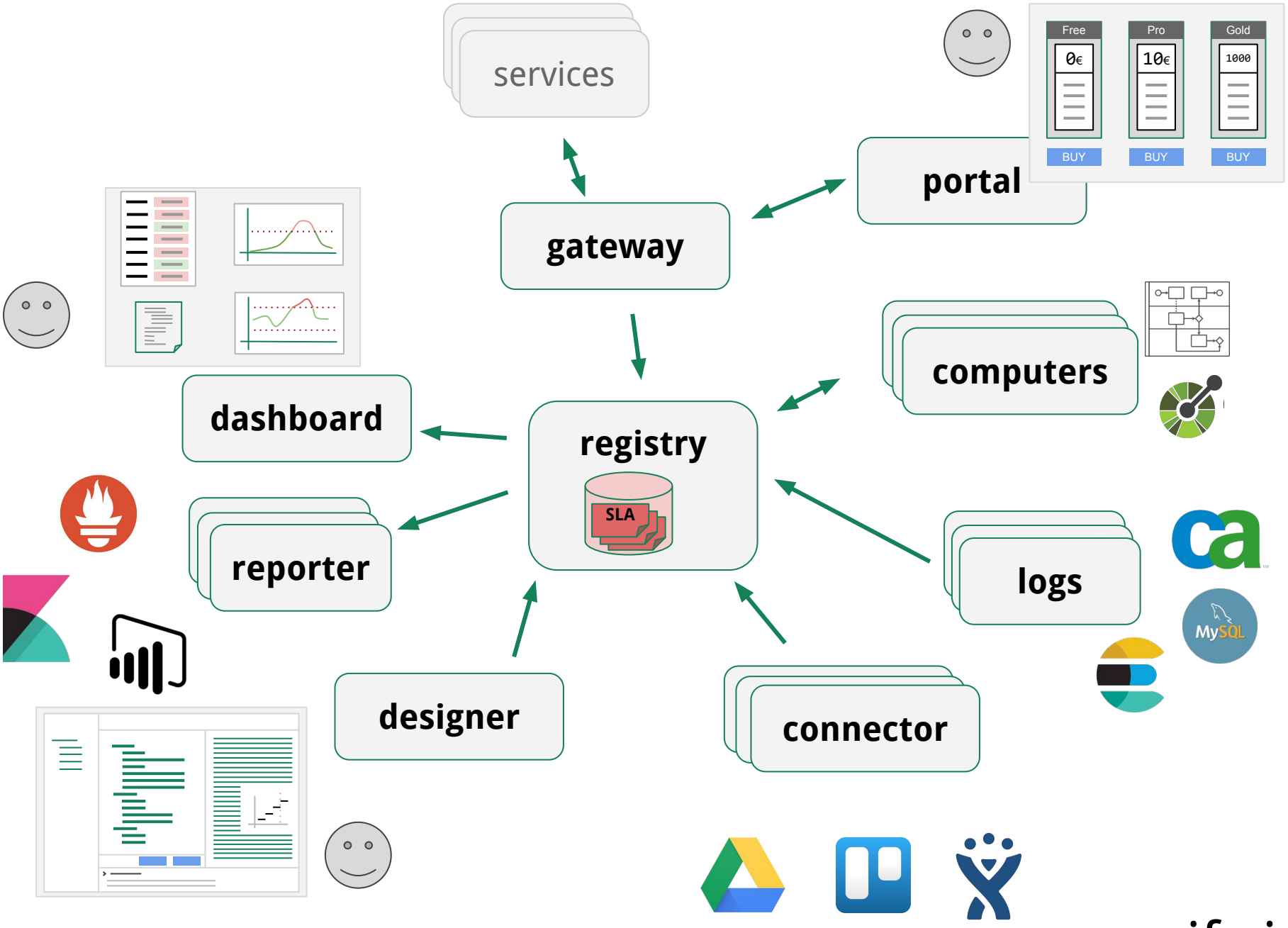
- Response time (TRS)
- Resolution time (TRL)
- User time (PU)

- SCO_TRS

  % Tickets closed in time vs total tickets.

ISA Tools - DESIGNER




services
Free
0€
Pro
10€
Gold
1000
BUY
BUY
BUY
portal
gateway
computers
dashboard
registry
SLA
reporter
logs
MySQL
designer
connector

SLA-driven governance for RESTful systems

Thank you

Questions?

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