Opportunities in Software Engineering Research for Web API Consumption

WAPI'17

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Part 1: Web APIs and challenges for consumption

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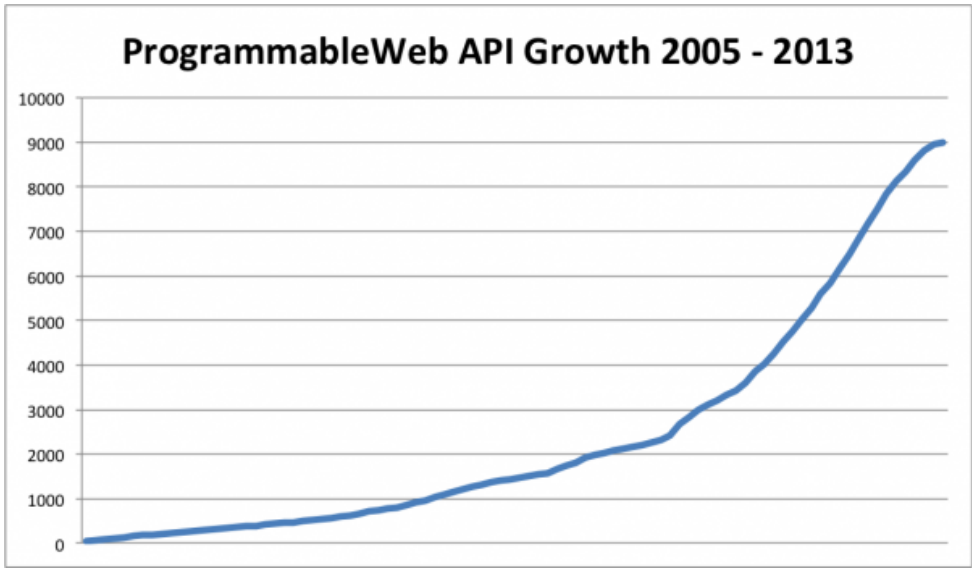
Web APIs are ubiquitous

- The number of web APIs is continuously growing
- Enable programmatic interaction with remote resources
- …using of existing, ubiquitous Web technologies (mostly HTTP + JSON / XML)
- APIs are of great importance for industry to create application ecosystems
- Focus on simplicity & flexibility – few conventions or rules (contrast with SOAP/WS-*)



Source: ProgrammableWeb.com, now > 17k

apigee

IBM API Connect

StrongLoop

mashape

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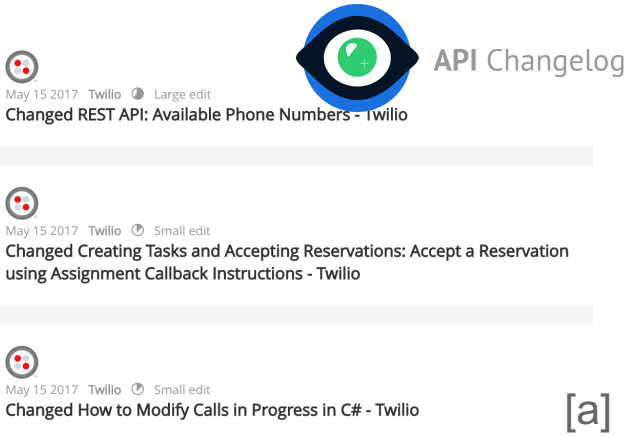
Consumption is challenging, though

String-based interface; no type-checking

```
request({
  url: 'http://api.example.com/v1/events',
  method: 'post',
  body: JSON.stringify({name: 'WAPI \'17'})
}, (err, response, strData) => {
  let responseData = JSON.parse(strData)
  // ...
})
```

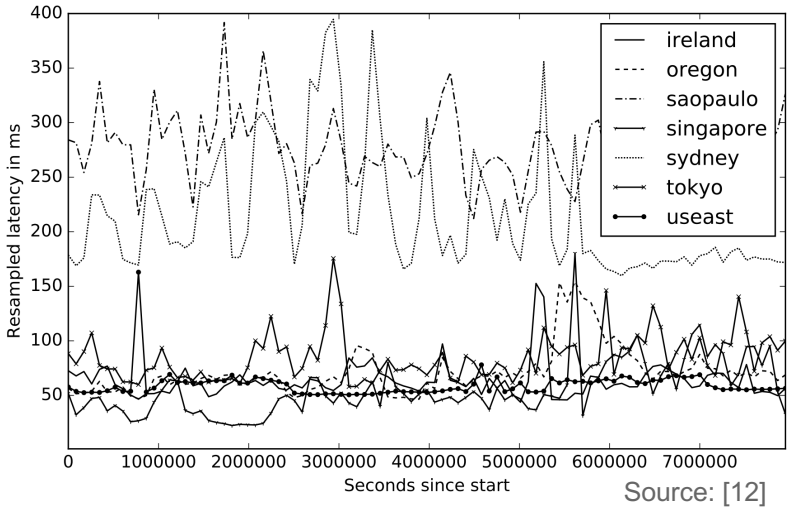
Frequent changes



[a]

APIs are controlled by third-party

Remote calls with varying QoS



Source: [12]

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Opinion: Gap between practice & challenges and software engineering research

stripe

Challenges

twilio

SE research

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Part 2: IDE support for checking web API requests

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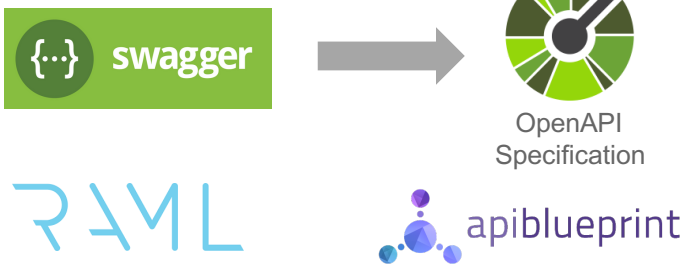
Specifications are central to support web API consumption

- Specifications describe possible interactions with an API – they depict the *contract* between client and API
- Machine-readable
- Various formats:



- They describe…
  - Base URL
  - Endpoints (path template + HTTP method)
  - Data required by / returned from endpoints
  - Additional parameters (e.g. in query)
  - Other constraints like headers, authentication, rate limits…

```yaml
swagger: '2.0'
host: api.twilio.com
basePath: /2010-04-01
schemes:
  - http
paths:
  /Accounts/{userId}/Messages.json:
    post:
      description: 'Send a message'
      parameters:
        - in: path
          name: userId
          required: true
          type: string
        - in: body
          name: body
          schema:
            $ref: '#/definitions/Message'
        - in: query
          name: 'retry'
          required: false
          type: boolean
      ...
definitions:
  Message:
    type: object
    properties:
      from: ...
      to: ...
      body: ...
    required: from, to, body
```

Excerpt of an OpenAPI Specifciation

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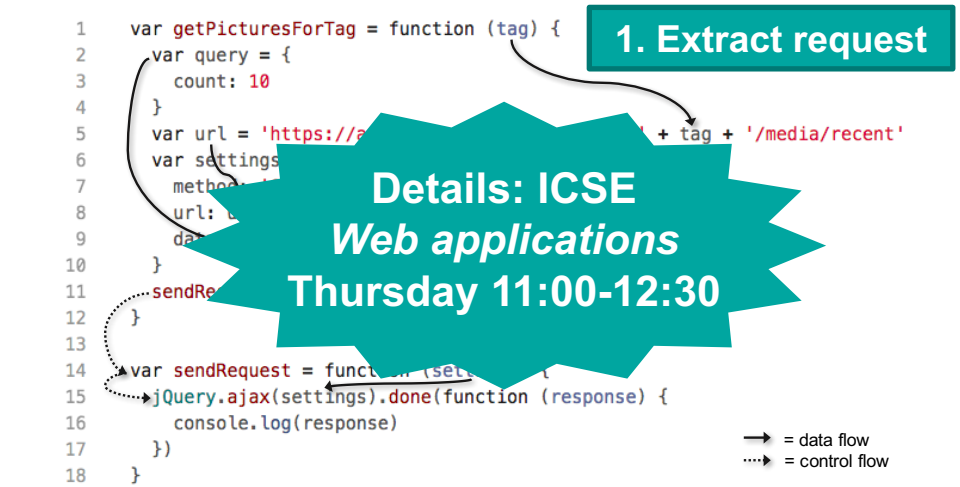
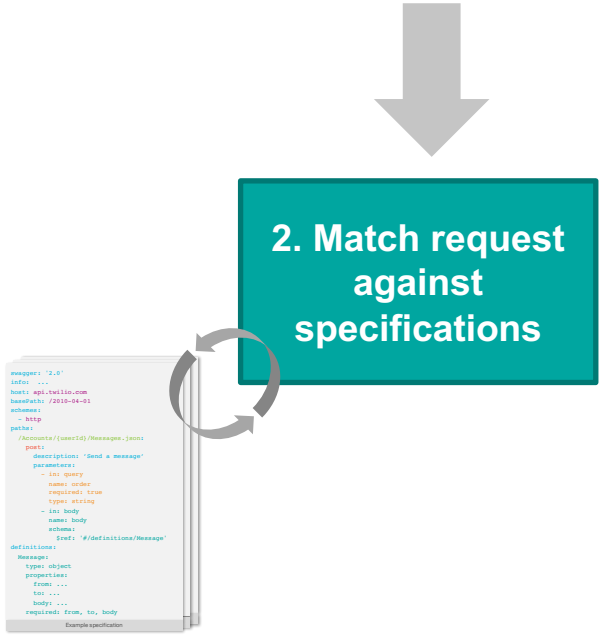
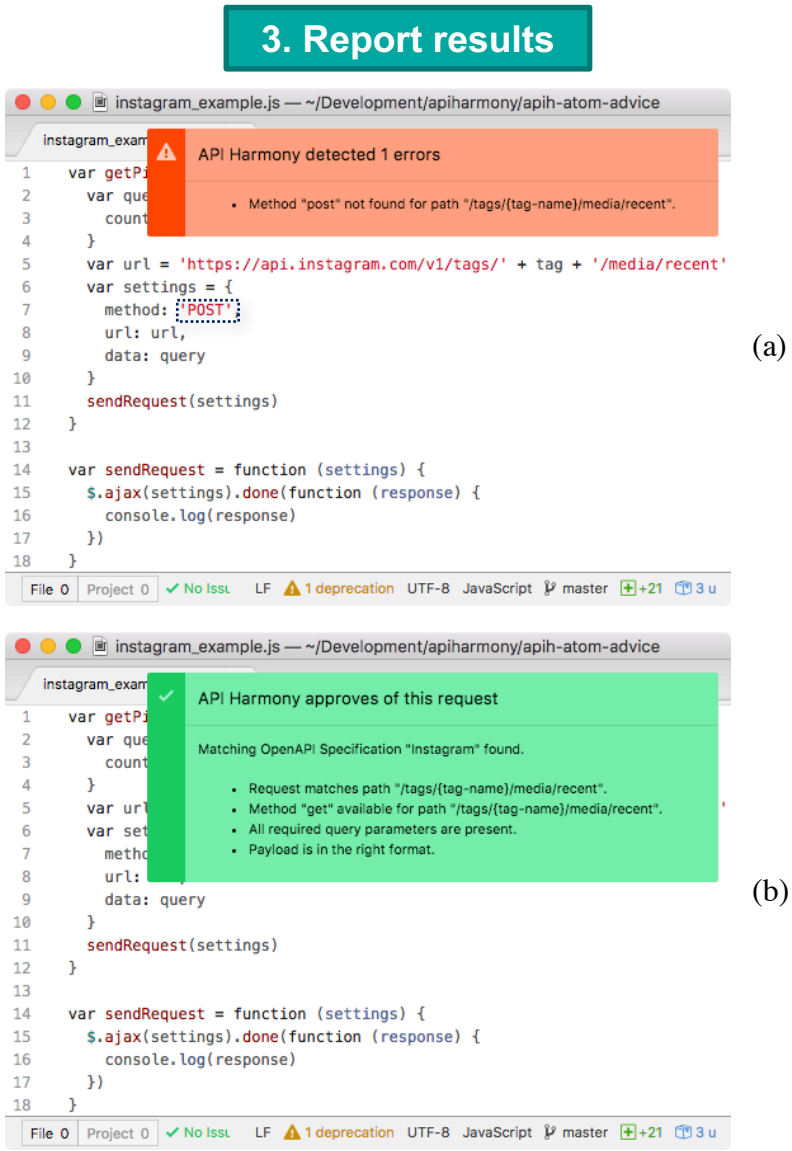
Overview of the approach







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Example: Request to Medical Lab Inferencing Service

Video: https://youtu.be/8IJKs7rMjJI

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Many research opportunities

- **Generation / maintenance of specifications**
  - From dynamic traces [7] or via proxies [21]
  - From documentation
  - Through code annotations [b]
- **Static checking of code** [8] [*this work*]
  - During development
  - On existing code bases
- **Automatic testing of APIs**
- **Mining API usage**
  - How are APIs used in the wild?
  - Lessons learned
- **QoS measurement & mitigation** [12]
- **Emerging API paradigms**
  - GraphQL / Apollo (Facebook, GitHub…)
  - Falcor (Netflix…)
- …

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Discussion points

- Why has web API consumption barely been subject of SE research?
- And how can we change this situation?
- Which existing SE tools & methods from library APIs can be used in the context of web APIs?

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Detect inconsistencies between analysis results and specifications

```
{
  "request": {
    "data": {},
    "success": "JSFunction",
    "error": "JSFunction",
    "type": "GET",
    "url": "https://api.instagram.com/v1
           /tags/<$global#tag$>
           /media/recent?count=10"
  }
}
```

Example data produced by analysis

Procedure

1. Find all specifications that match base URL
2. Check usage of schema
3. Select specifications that also match path
4. Select specifications that also match method
5. Determine whether URL contains required query parameters*
6. Determine whether payload matches the required schema*

```
swagger: '2.0'
info:  ...
host: api.instagram.com
basePath: /v1
schemes:
  - https
paths:
  /tags/{tag_id}/media/recent:
    get:
      description: 'Get recent media for tag'
      parameters:
        - in: query
          name: count
          required: true
          type: number
      responses:
        '200':
          schema:
            $ref: '#/definitions/Message'
definitions:
  Message:
    type: object
    properties:
      from: ...
      to: ...
      body: ...
    required: from, to, body
```

Example specification

* If multiple spec-path-method triples match, consider least demanding requirement

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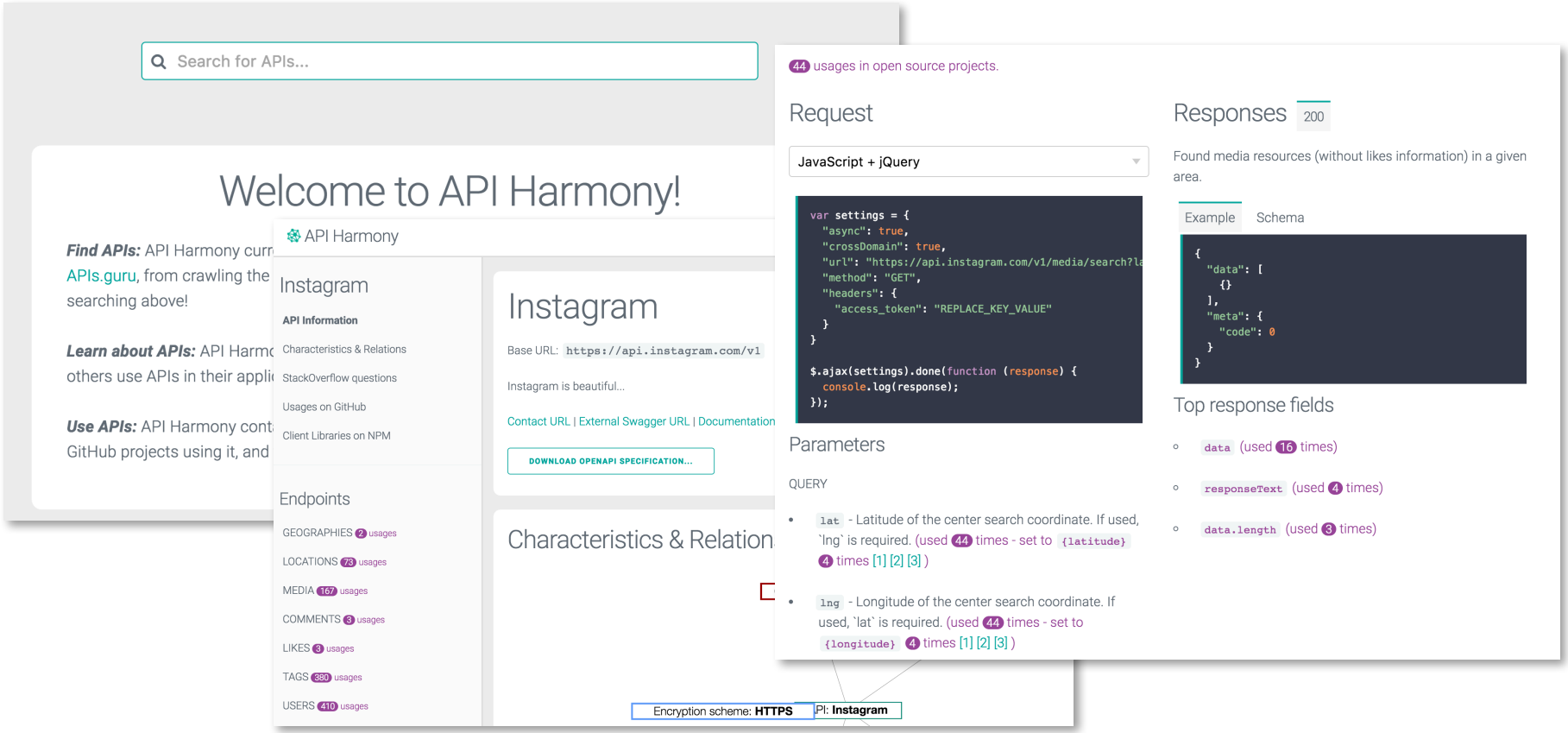
System context: API Harmony - *find, learn about, and use web APIs*



http://ibm.biz/apiharmony

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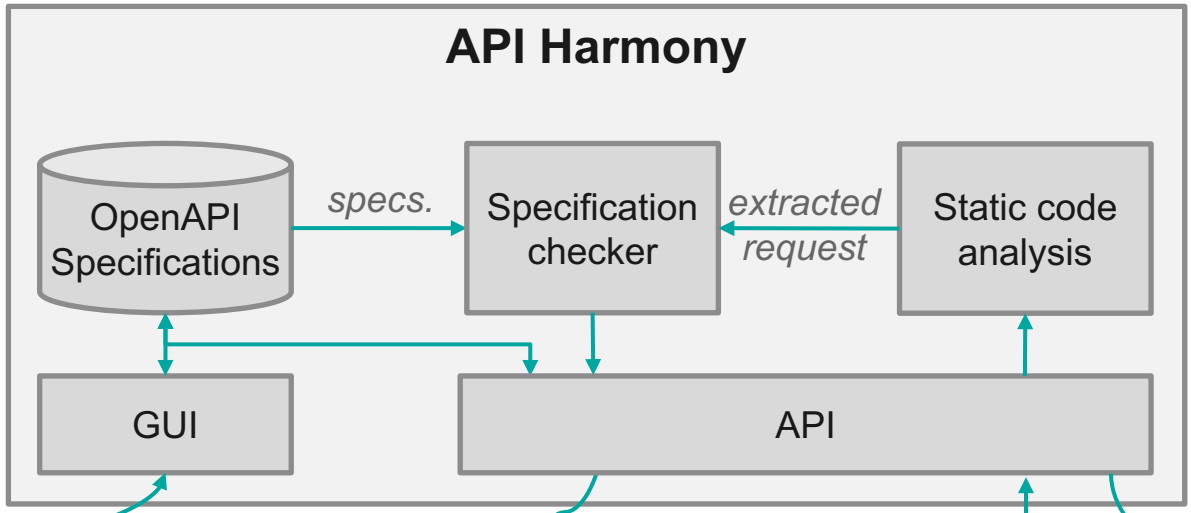
System integration & developer work-flow

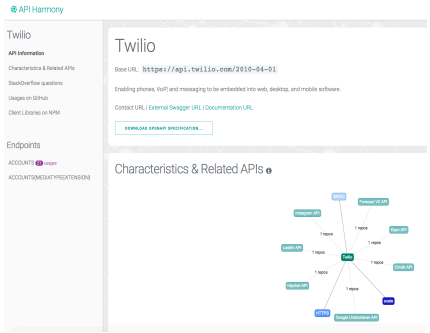


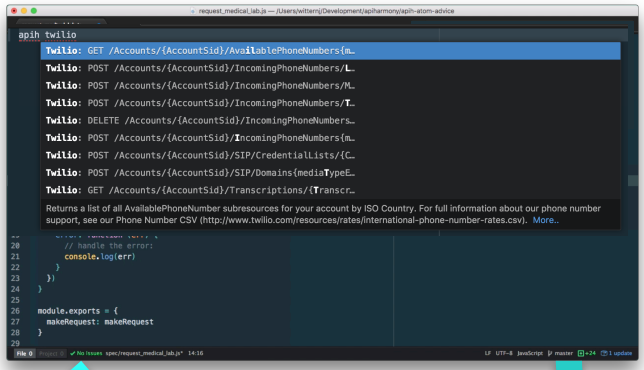
API search & recommendation

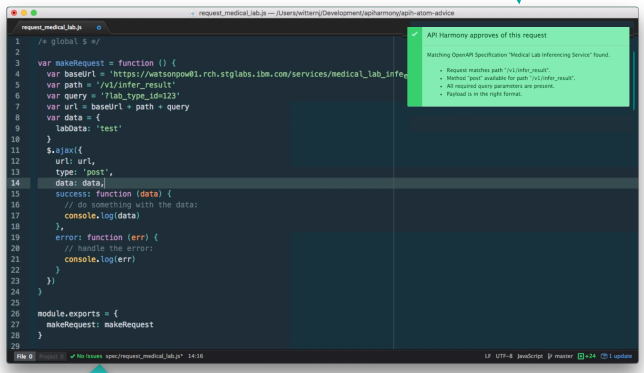
Endpoint search & Snippets

source code

report







ATOM

Start dev

Edit code

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