CHAOSS

THE LINUX FOUNDATION PROJECTS

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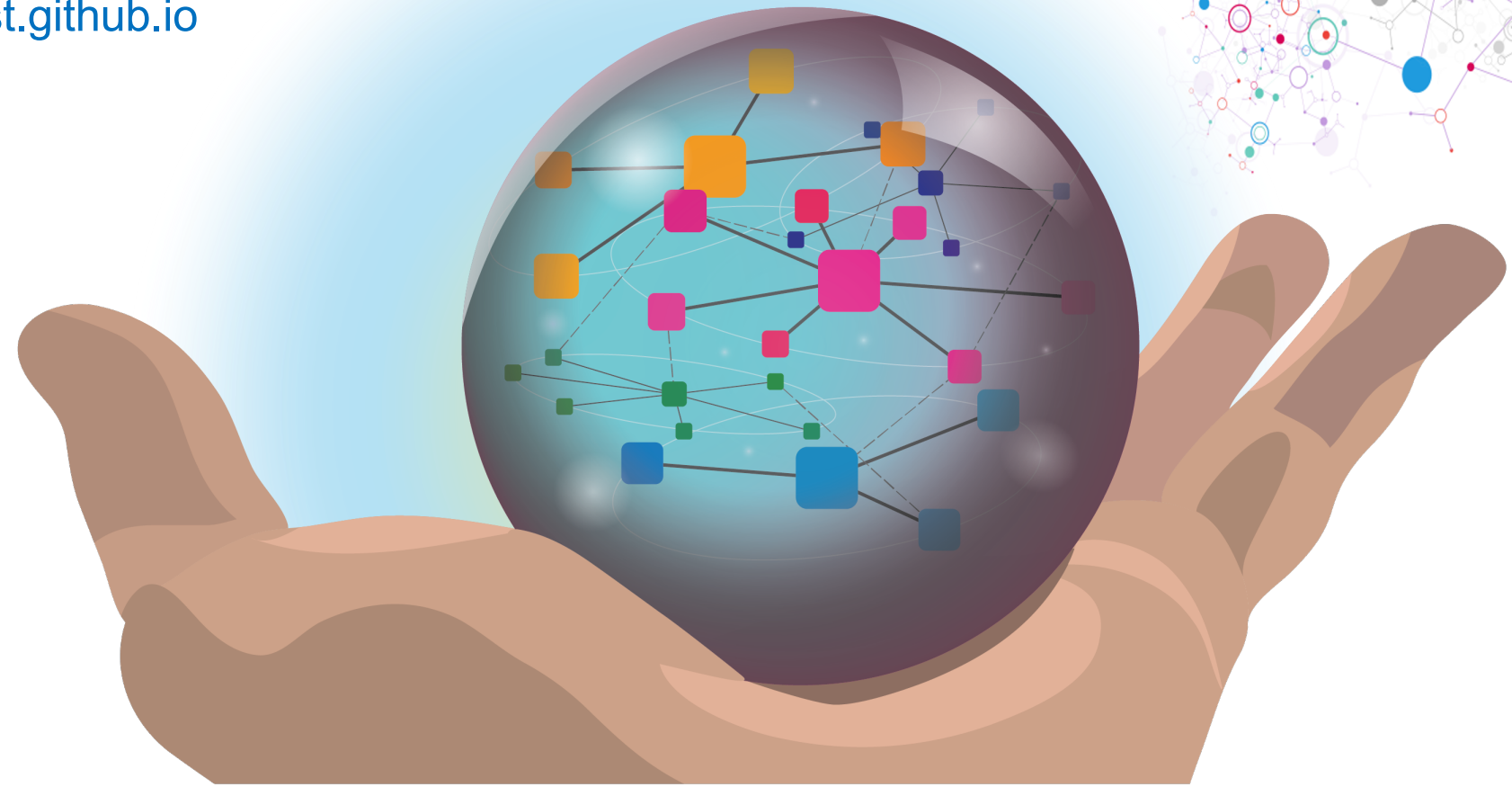

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LA LIBERTÉ DE CHERCHER

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"Excellence of Science" Research Project

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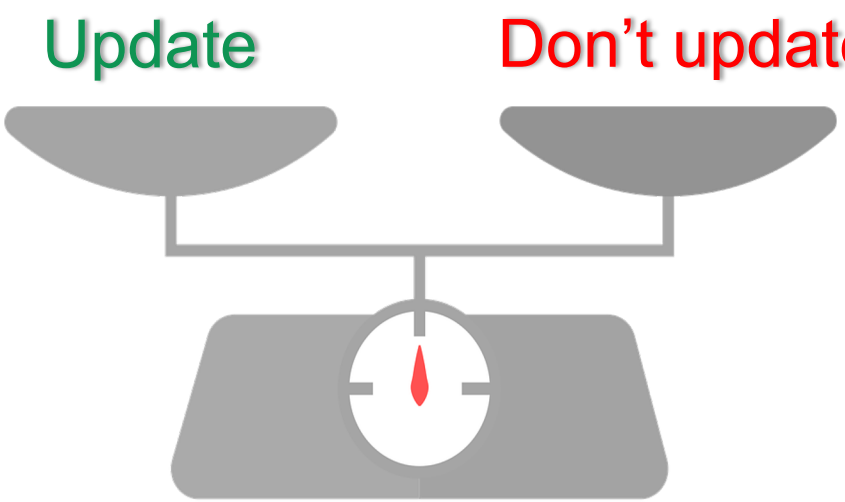
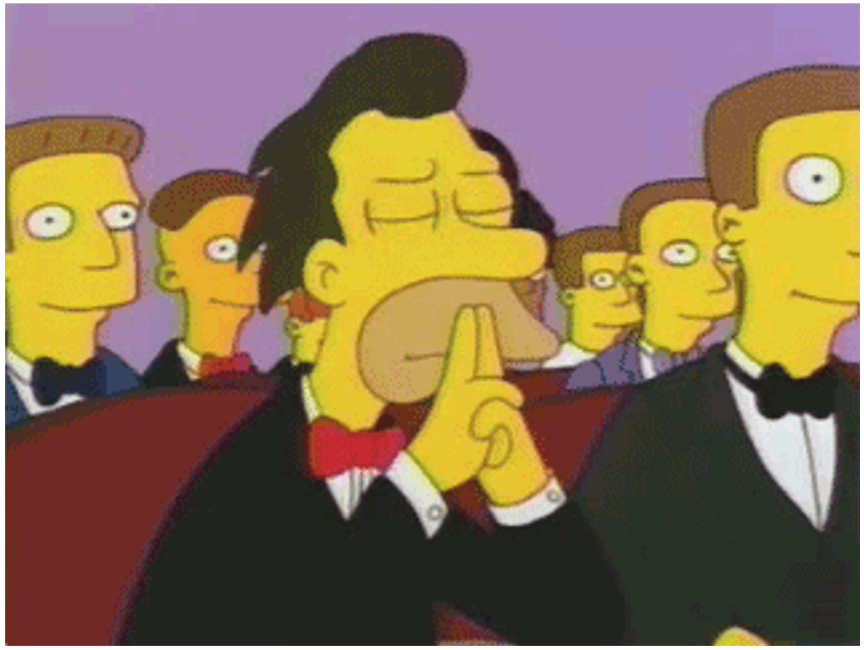
Focus

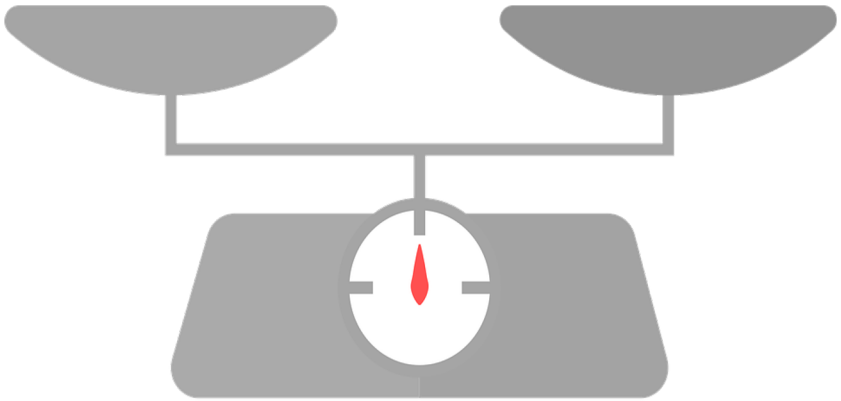
*Which **measures** can help software developers and deployers to decide **when** and **why** they should update?*

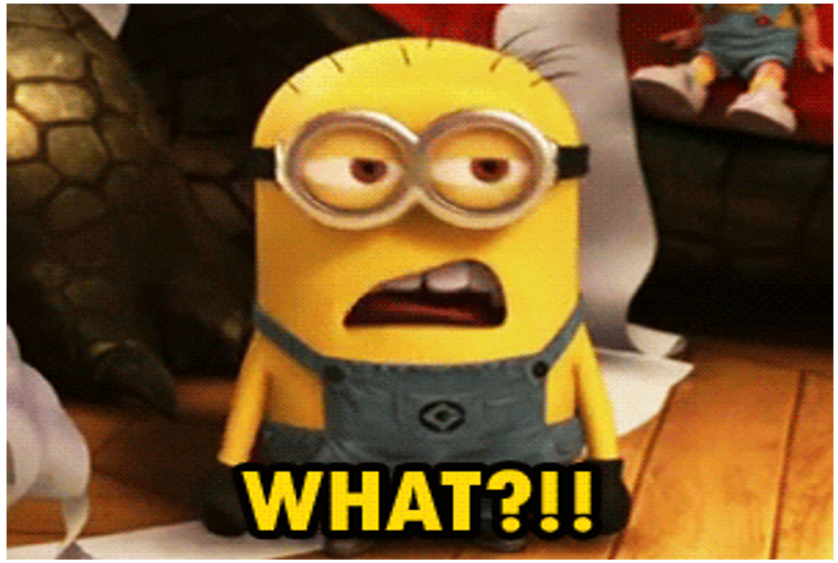




Focus

Up-to-date Outdated





Online survey

What would be the most appropriate (i.e., ideal) version of a software library to depend on?

- *17 respondents*

  Highly educated with an average of 3 years of development experience

- *Responses:*
  - ★ Most stable (14)
  - ★ Latest available (9)
  - ★ Most documented (7)
  - ★ Most secure (5)

Idea: Technical Lag

"The increasing **difference** between deployed software packages and the **ideal** available upstream packages."

Ideal

- stability, security, functionality, recency, etc.

Difference

- time, version updates, bugs, vulnerabilities, features, …

J. Gonzalez-Barahona, P. Sherwood, G. Robles, D. Izquierdo (2017) "Technical lag in software compilations: Measuring how outdated a software deployment is." *IFIP International Conference on Open Source Systems*. Springer

Importance of Technical Lag

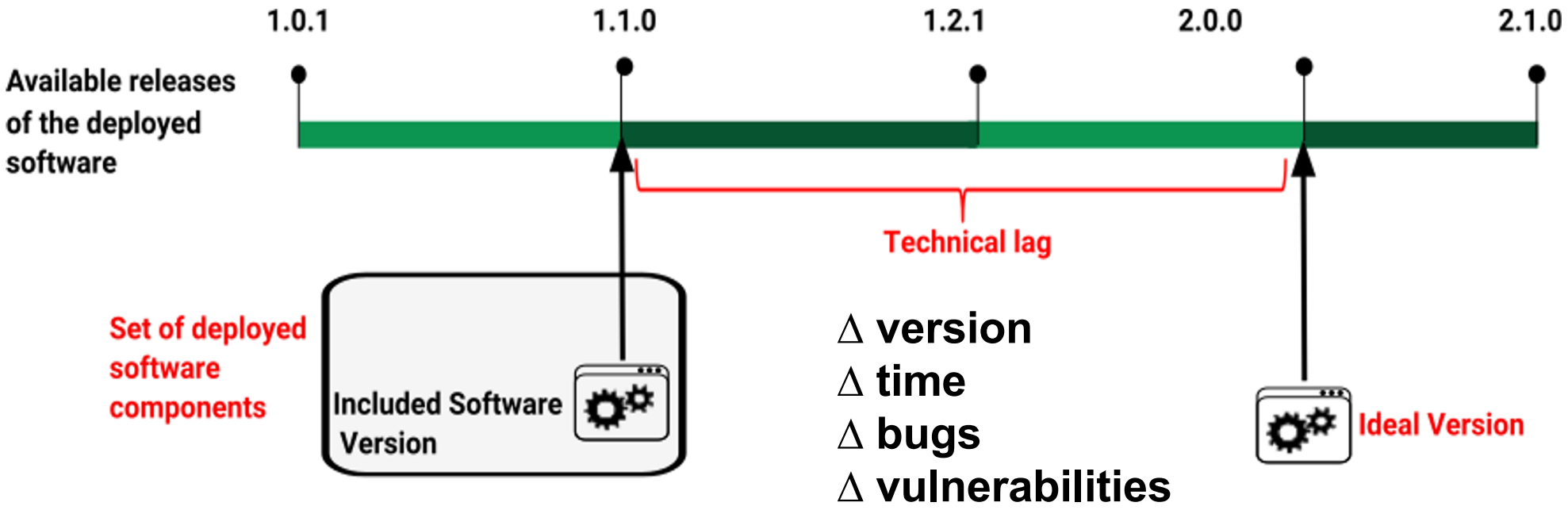
Semi-structured interviews:

FOSDEM 2019

5 highly educated software practitioners with an average of 10 years of experience

Technical Lag is important, especially if we mix between the benefits of updating and the effort required to do that.

Measuring Technical Lag



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Measuring Technical Lag

A **technical lag framework** *F* is a tuple *(C, L, ideal, delta, agg)* with

- *C* a set of component releases
- *L* a set of possible lag values
- *ideal: C → C* computes the "ideal" (upstream) component release for a given (deployed) release
- *delta: C x C → L* computes the difference between two component releases
- *agg:* $2^L \rightarrow L$ aggregates the results of a set of lags

A formal framework for measuring technical lag in component repositories – and its application to npm. A. Zerouali, T. Mens, J. Gonzalez-Barahona, A. Decan, E. Constantinou, G. Robles. Wiley Journal on Software Evolution and Process, 2019

Measuring Technical Lag

Given a **technical lag framework** *F*, *we define*

$techlag_F(c) = delta(c, ideal(c))$

for any deployed component *c*

$aggLag_F(D) = agg(\ \{techlag_F(c) \mid c \text{ in } D\}\ )$

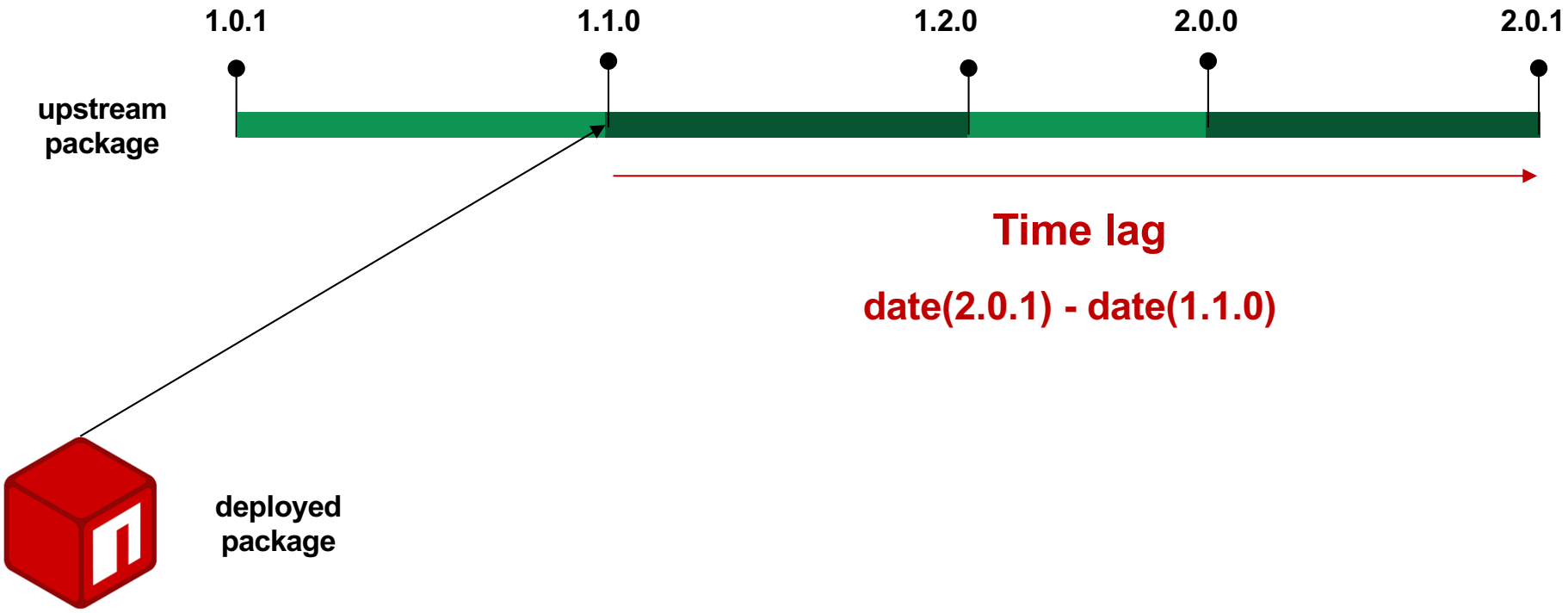
for any set of deployed components *D*

A formal framework for measuring technical lag in component repositories – and its application to npm. A. Zerouali, T. Mens, J. Gonzalez-Barahona, A. Decan, E. Constantinou, G. Robles. Wiley Journal on Software Evolution and Process, 2019

Technical Lag - Example

***Time*-based measurement of technical lag**

(ideal = most recent release; delta = time difference)



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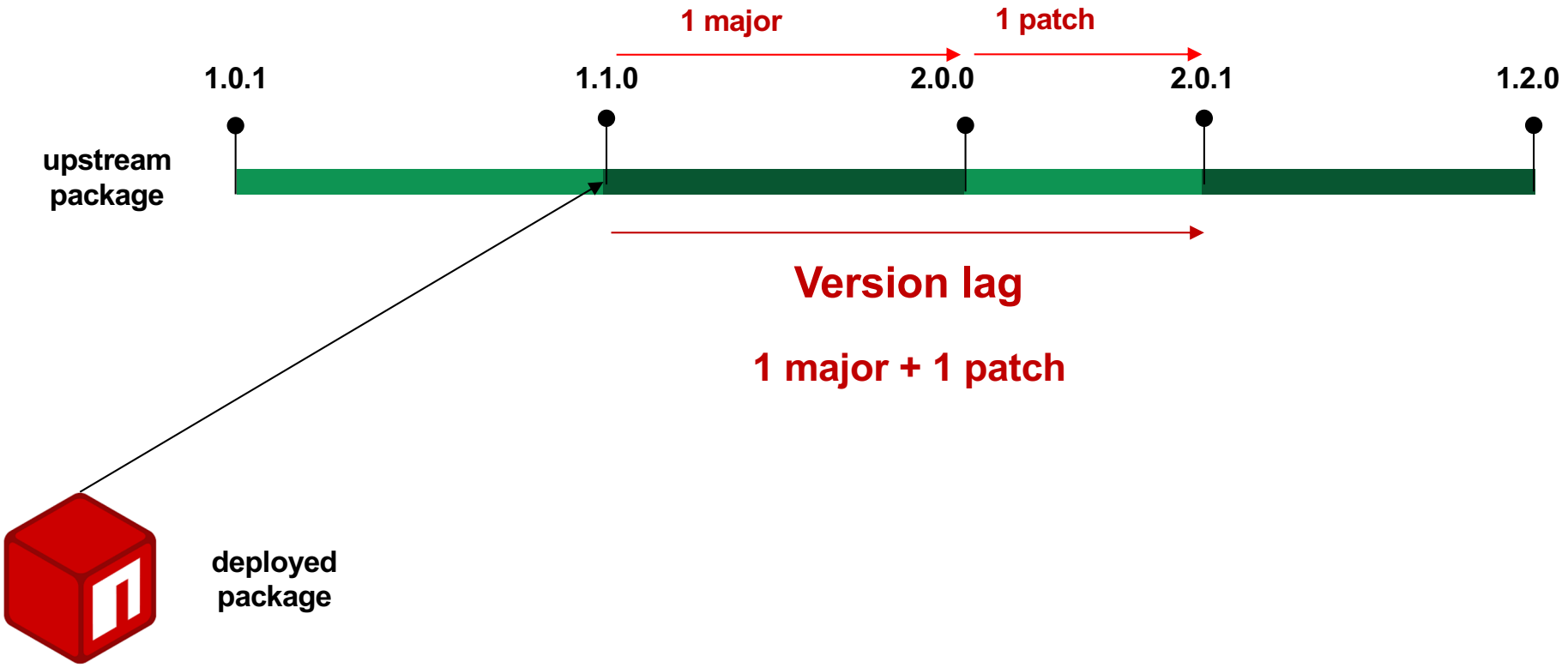
Technical Lag - Example

Version-based measurement of technical lag

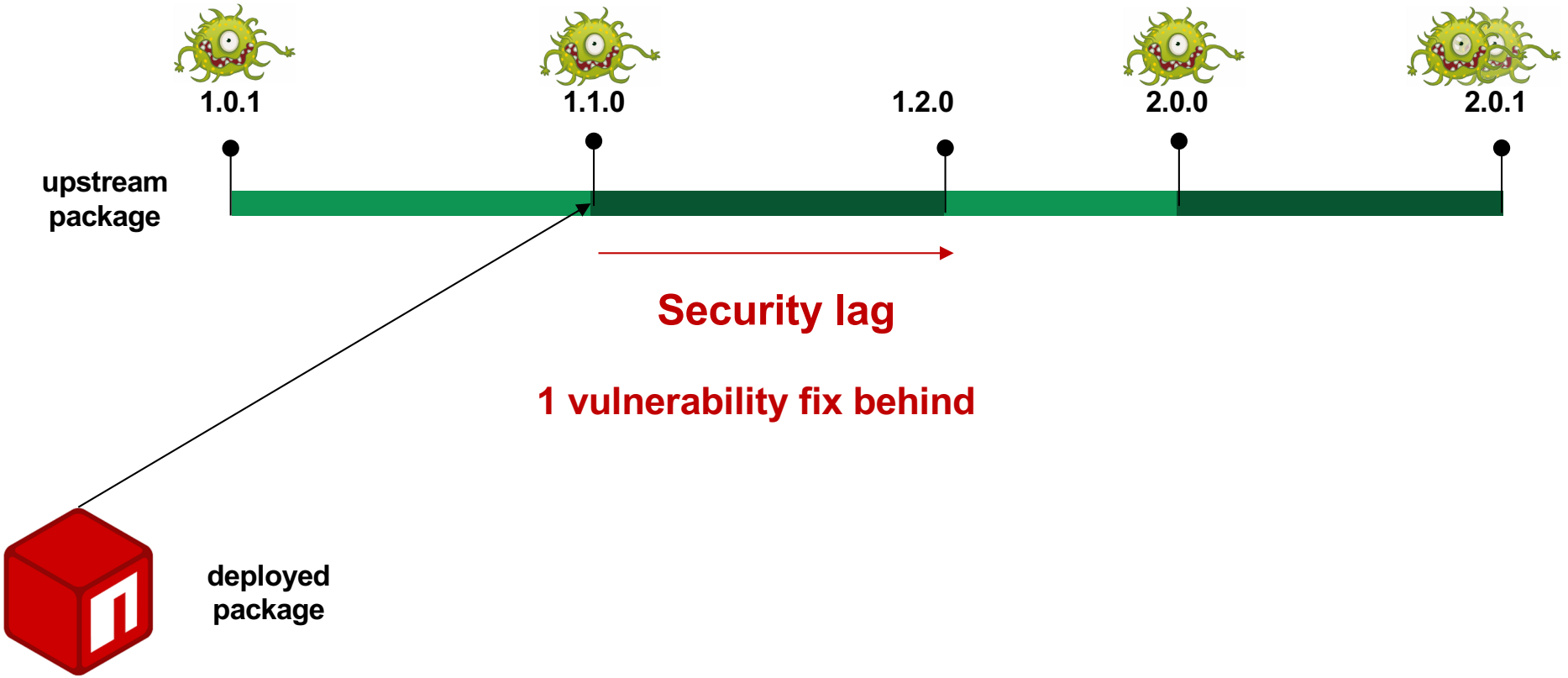
(ideal = highest release; delta = version difference)



Technical Lag - Example

Vulnerability-based measurement of technical lag

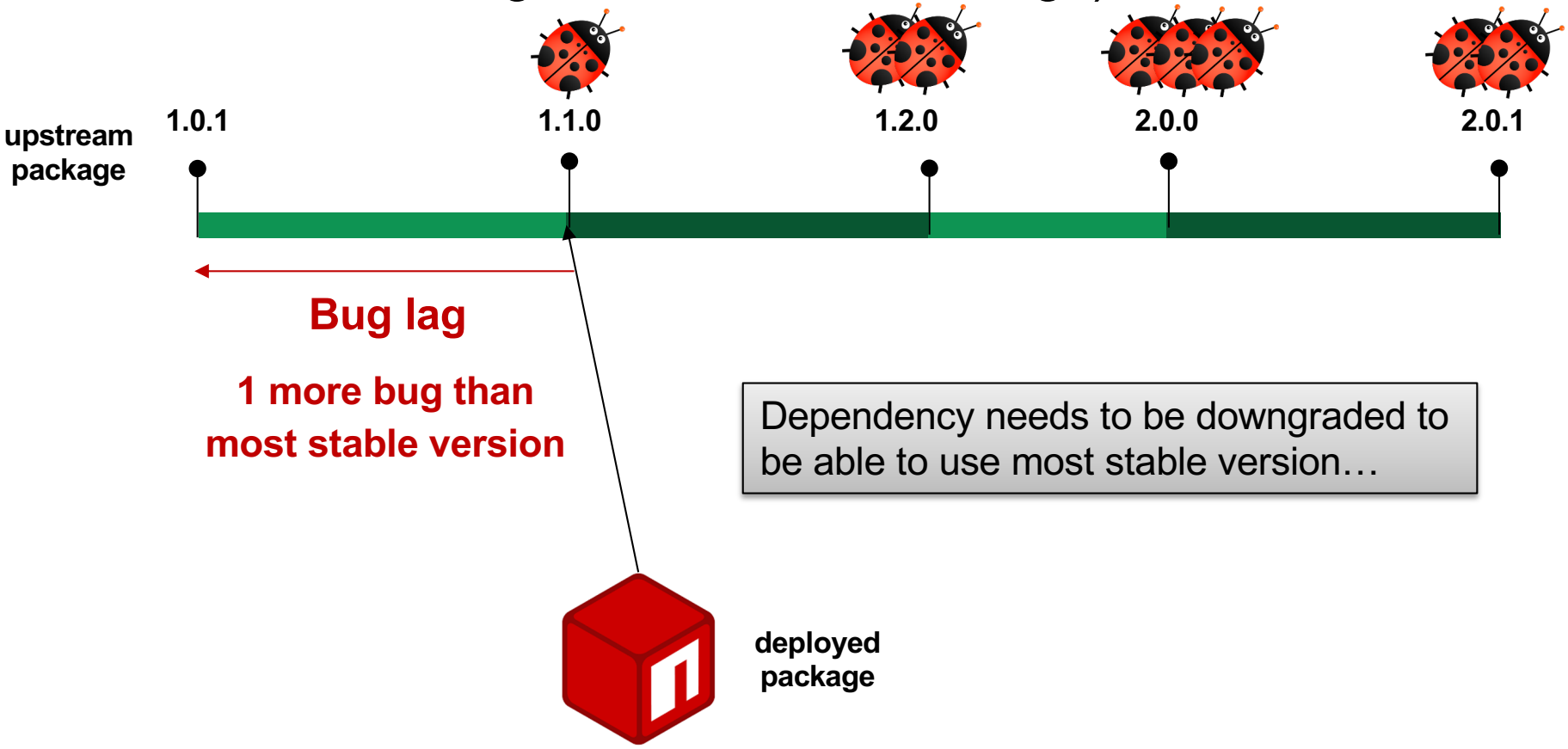
(ideal = least vulnerable release; delta = #vulnerabilities)



Technical Lag - Example

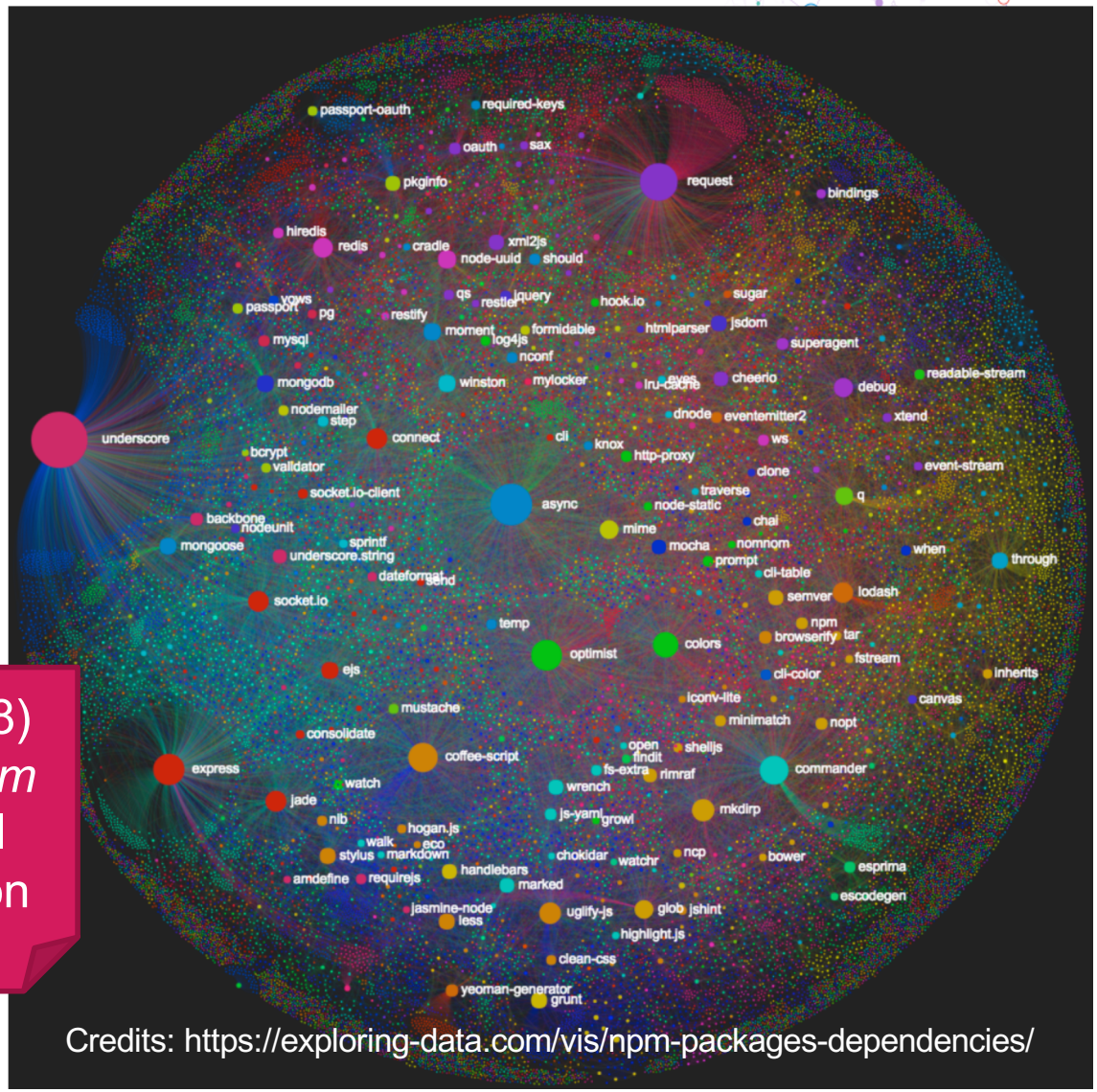
Bug-based measurement of technical lag

(ideal = least known bugs; delta = #known bugs)



Case study 1: Technical lag in npm distribution of JavaScript packages

+20M dependencies



Credits: https://exploring-data.com/vis/npm-packages-dependencies/

A. Decan, T. Mens, E. Constantinou (2018) *On the evolution of technical lag in the npm package dependency network.* IEEE Int'l Conf. Software Maintenance and Evolution

Technical Lag – Example

youtube-player

5.5.2 • Public • Published 4 months ago

Readme | 3 Dependencies

Dependencies (3)

debug load-script sister

Dev Dependencies (15)

ava babel-cli babel-plugin-add-module-exports

babel-plugin-transform-flow-strip-types babel-plugin-transform-obj

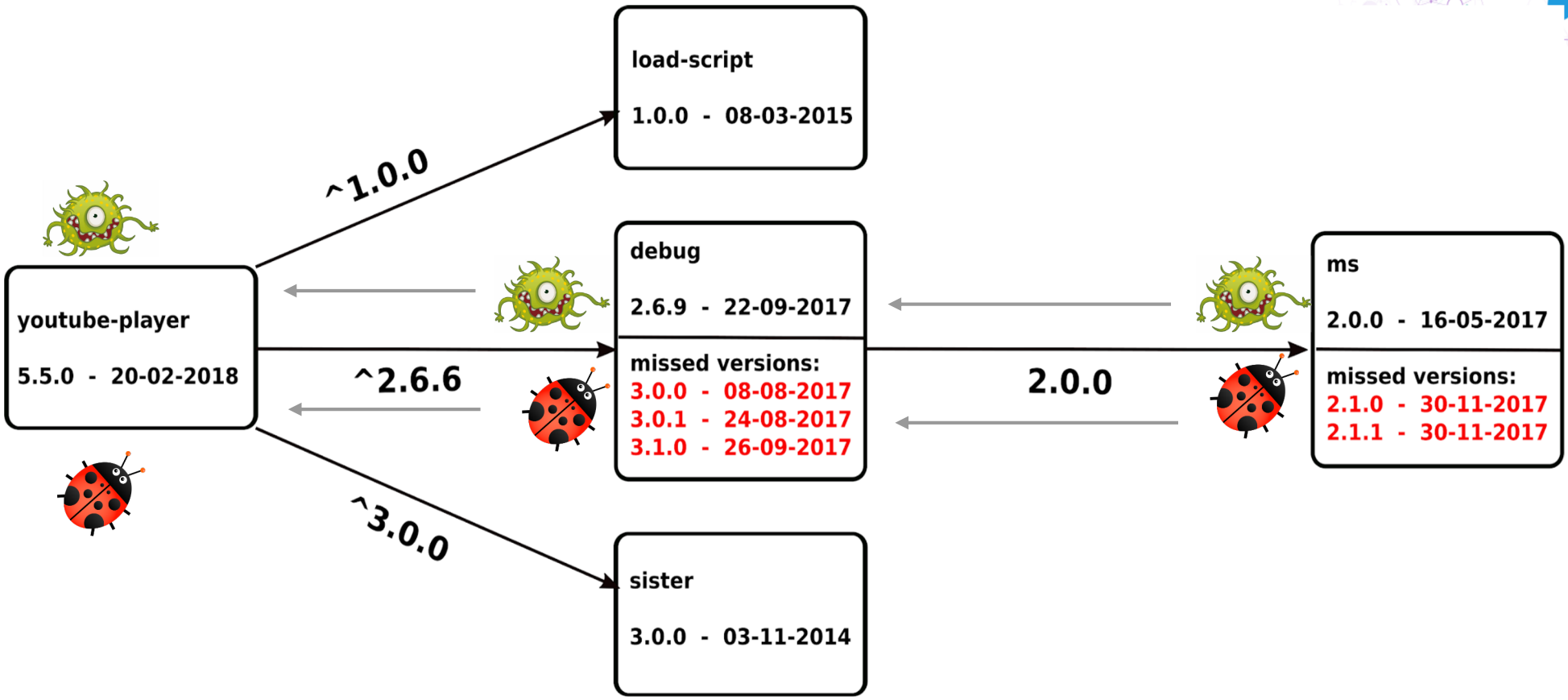
babel-preset-env babel-register chai eslint eslint-config-canonic

flow-copy-source husky npm-watch semantic-release

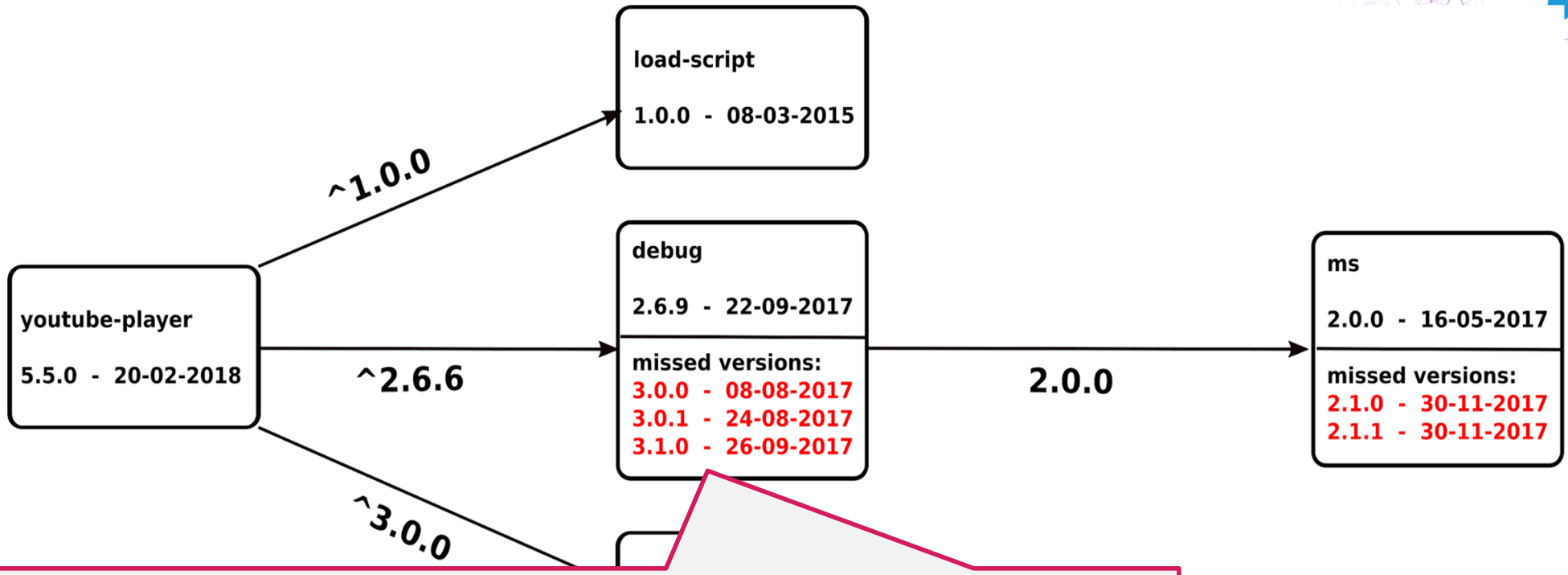
package.json

```
13  "dependencies": {
14    "debug": "^2.6.6",
15    "load-script": "^1.0.0",
16    "sister": "^3.0.0"
17  },
18  "description": "YouTube IFrame Player API abstraction.",
19  "devDependencies": {
20    "ava": "^0.19.1",
21    "babel-cli": "^6.24.1",
22    "babel-plugin-add-module-exports": "^0.2.1",
23    "babel-plugin-transform-flow-strip-types": "^6.22.0",
24    "babel-plugin-transform-object-rest-spread": "^6.23.0",
25    "babel-preset-env": "1.4.0",
26    "babel-register": "^6.24.1",
27    "chai": "^3.5.0",
28    "eslint": "^3.19.0",
29    "eslint-config-canonical": "^8.2.0",
30    "flow-bin": "^0.45.0",
31    "flow-copy-source": "^1.1.0",
32    "husky": "^0.13.3",
33    "npm-watch": "^0.1.9",
34    "semantic-release": "^6.3.2"
35  },
36  "keywords": [
```

Technical Lag – Example



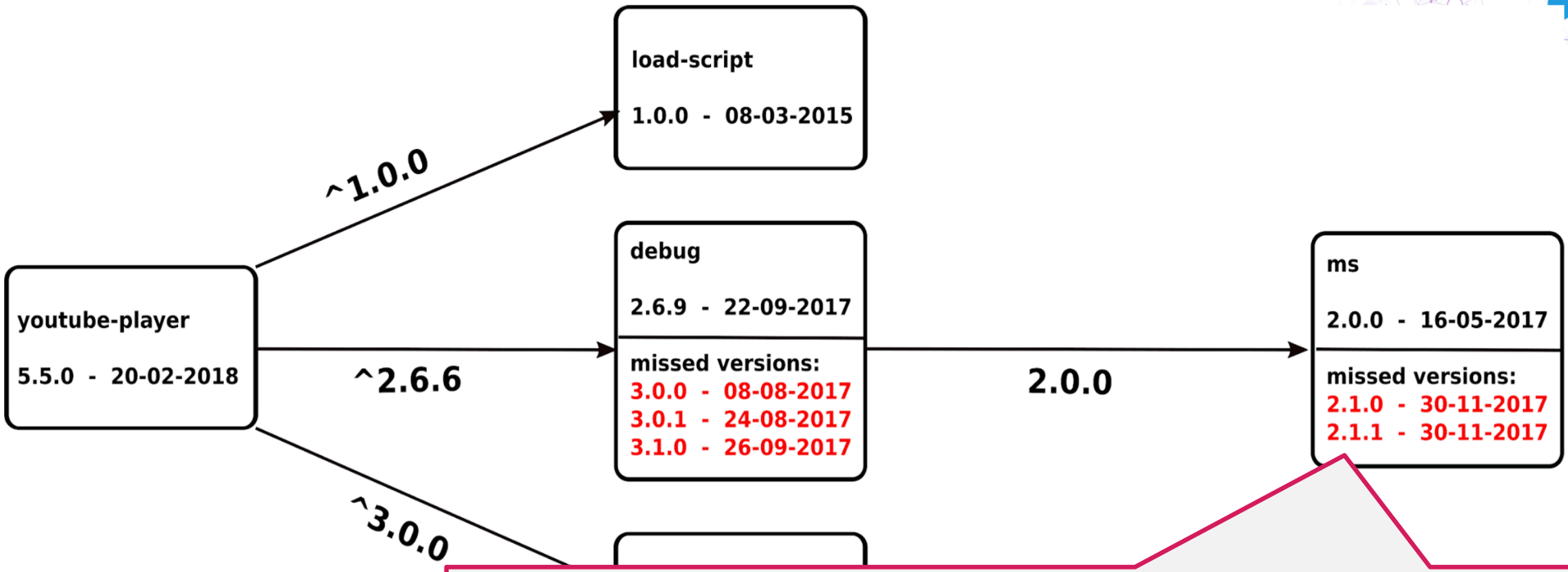
Technical Lag – Example



Time-based technical lag for deployed release **debug 2.6.9**

ideal (debug 2.6.9) = debug 3.1.0
timeLag(debug 2.6.9) = 26-09-2017 - 22-09-2017 = 4 days
versionLag(debug 2.6.9) = 1 major + 1 minor + 1 patch

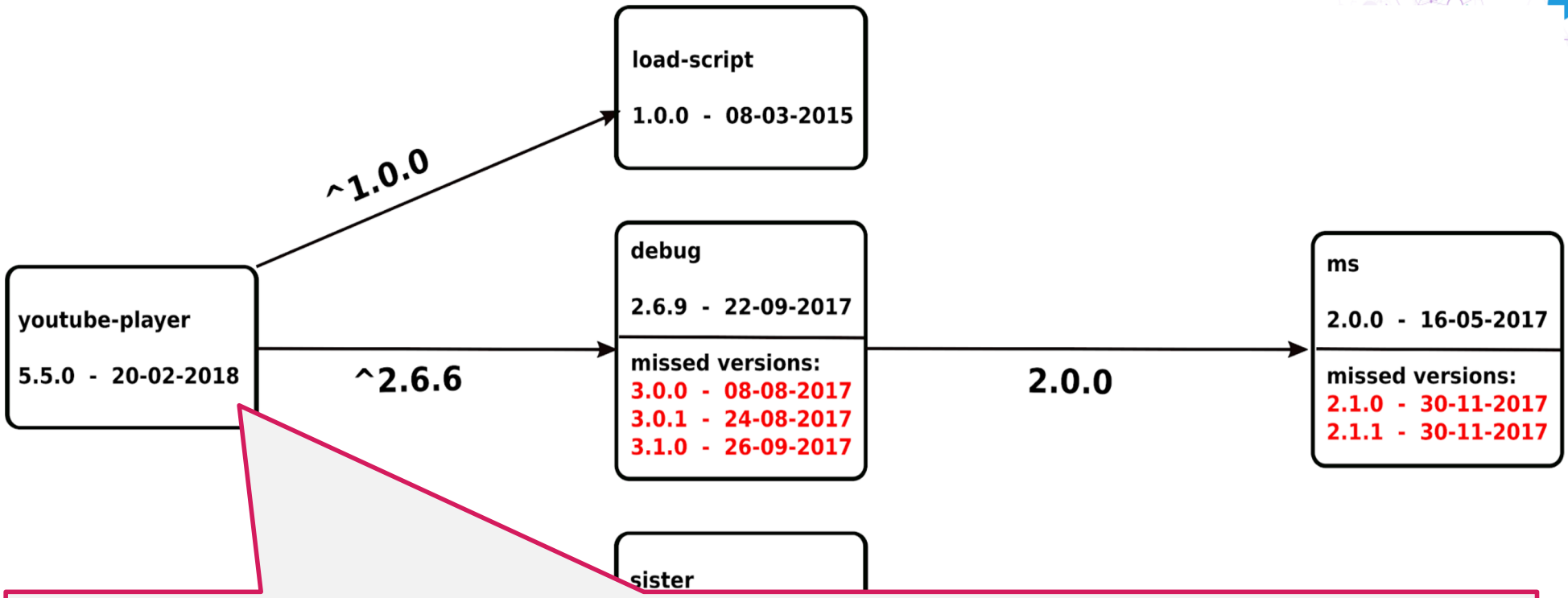
Technical Lag – Example



Time-based technical lag for deployed release **ms 2.0.0**

ideal (ms 2.0.0) = ms 2.1.1
timeLag(ms 2.0.0) = 30-11-2017 - 16-05-2017 = 198 days
versionLag(ms 2.0.0) = 1 minor + 1 patch

Technical Lag – Example



Aggregated transitive time lag for deployed release **youtube-player 5.5.0**

agglag({**debug 2.6.9, ms 2.0.0**}) = ***max***(**4 days, 198 days**) **= 198 days**

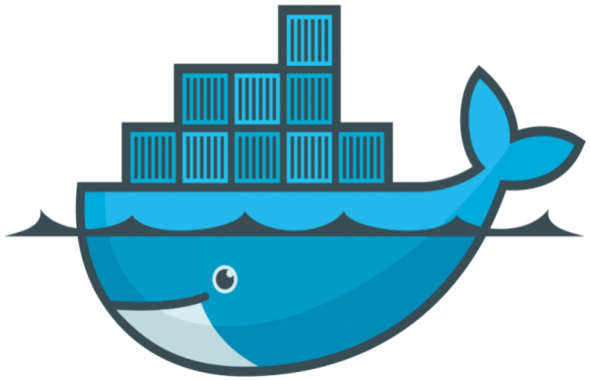
Tool support
Example: david-dm.org

DEPENDENCIES | DEVDEPENDENCIES | dependencies out of date | LIST | TREE

17 Dependencies total | 9 Up to date | 0 Pinned, out of date | 8 Out of date

DEPENDENCY	REQUIRED	STABLE	LATEST	STATUS
async-foreach	^0.1.3	0.1.3	0.1.3	
chalk	^1.1.1	3.0.0	3.0.0	
cross-spawn	^3.0.0	7.0.1	7.0.1	
gaze	^1.0.0	1.1.3	1.1.3	
get-stdin	^4.0.1	7.0.0	7.0.0	
glob	^7.0.3	7.1.6	7.1.6	
in-publish	^2.0.0	2.0.0	2.0.0	
lodash	^4.17.15	4.17.15	4.17.15	
meow	^3.7.0	6.0.0	6.0.0	

Case study 2: Technical lag in Debian-based Docker containers



docker

debian

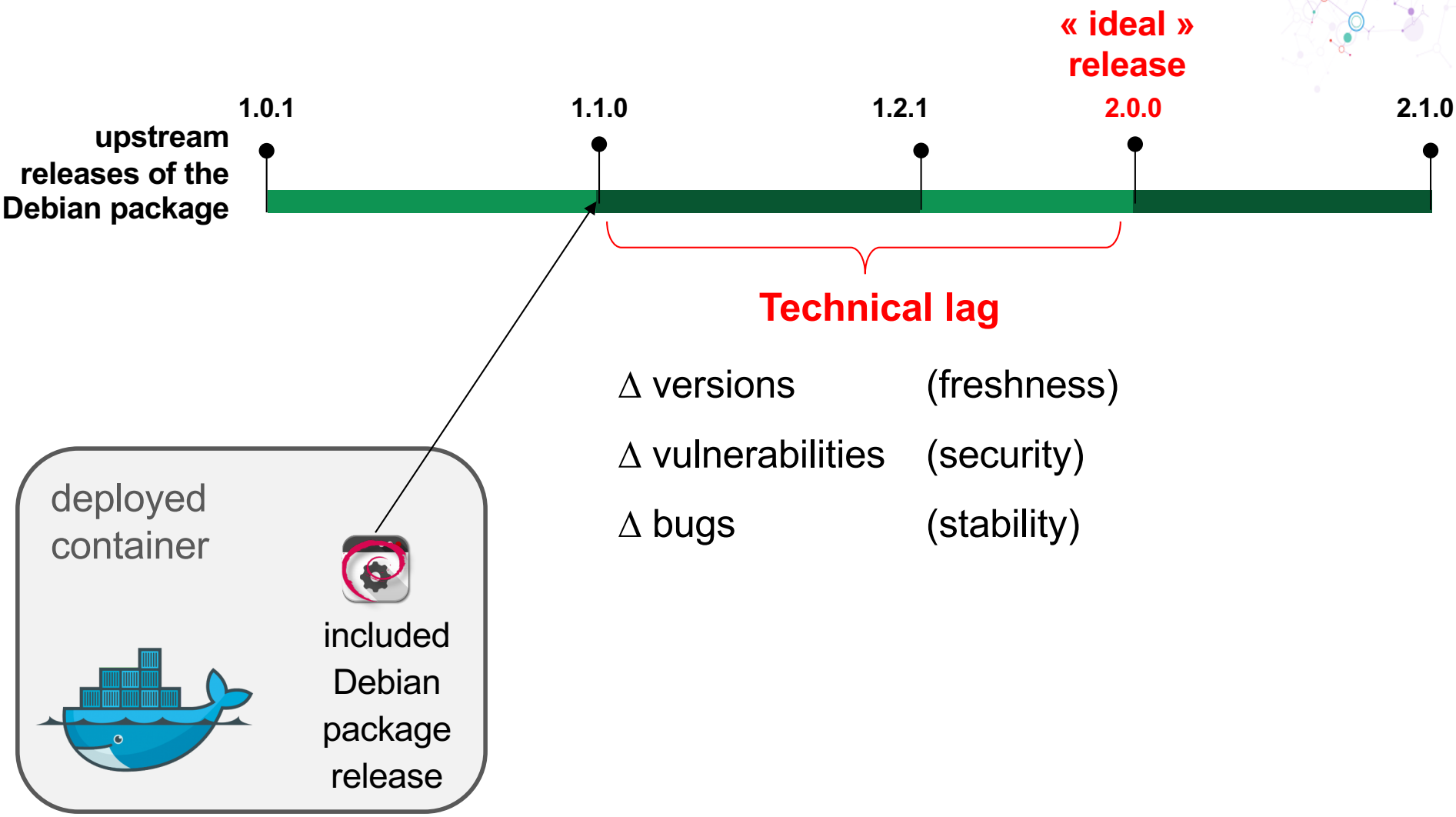
A. Zerouali, T. Mens, G. Robles, J. Gonzalez-Barahona (2019). On the relation between outdated Docker containers, security vulnerabilities, and bugs. IEEE In'tl Conf. SANER

Case study 2: Technical lag in Debian-based Docker containers

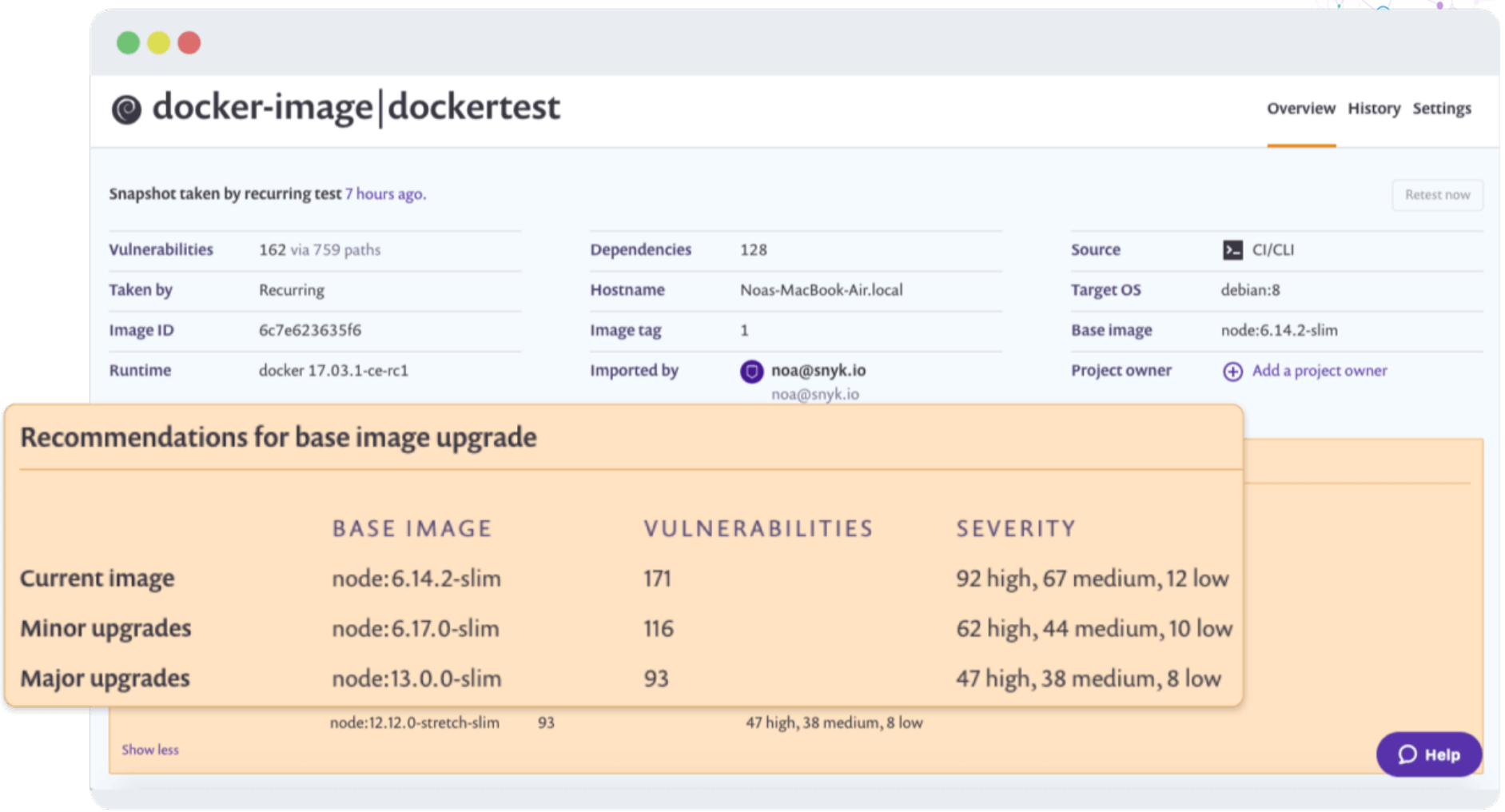
Important issues faced when deploying Docker containers:

- Security vulnerabilities
- Dependence on external software packages
- Presence of bugs in third-party software
- Outdated third-party software

Technical Lag in Debian-based Docker containers



Tool support
Example: snyk container



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Summary

> If you can't **measure** it
> you can't **manage** it
>
> Peter Drucker

Technical Lag is a very useful generic measure for assessing to which extent deployed software is outdated w.r.t. upstream releases.

- Different ways to measure (time, version, bugs, vulnerabilities, …) and aggregate (max, sum, …) technical lag
- It can be operationalized in different contexts (package dependency management, container deployment, …)

Suggestion:

- Include this measure as part of the CHAOSS Metrics and Tooling

Open Challenges:

- How to measure effort required to update?
- How to combine multiple dimensions of technical lag?
- How to assess whether updates do not cause breaking changes?

New proposed CHAOSS project metrics

- **Dependencies**
  - Number of / List of; Direct or transitive
- **Dependency depth**
- **Outdated dependencies**
  - List of / Number of / Ratio of
- **Vulnerable dependencies**
  - List of / Number of / Ratio of
- **Dependents** (i.e. reverse dependencies)
  - Number of / List of; Direct or transitive
- **Dependency lag**
  - aggregated dependency-based technical lag of a project
- Deployment lag
  - Aggregated lag of set of deployed components w.r.t. upstream

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SoHeal, May 2020 http://soheal.github.io

3rd Int'l ICSE Workshop on Software Health

Seoul, South Korea – May 2020

What?

- Focus on the *health* of software projects, communities and ecosystems
- Discuss about technical, social, legal and business aspects related to project effectiveness, success, longevity, growth, resilience, survival, diversity, sustainability, popularity, inclusiveness, ...

Who?

- Open Source Community Members, Industry and Academia

Why?

- Raise awareness on software health
- Present tools, methods, practical experiences
- Advance body of knowledge on software health

SoHeal

@iw_soheal

chaoss.community

SoHeal 2020 http://soheal.github.io/cft.html

Extended call for submissions

Are you a involved in software projects or ecosystems, and have something to say about software health?

Submit a **short paper** or **talk proposal** on

- Open source and industrial experiences from individual, team or community level
- Relation between software health and social, technical, legal, process and business aspects
- Tools, dashboards and models to enable, assess, predict and recommend software health
- Guidelines and lessons learned

SoHeal

Submission deadline: Friday, February 7, 2019

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