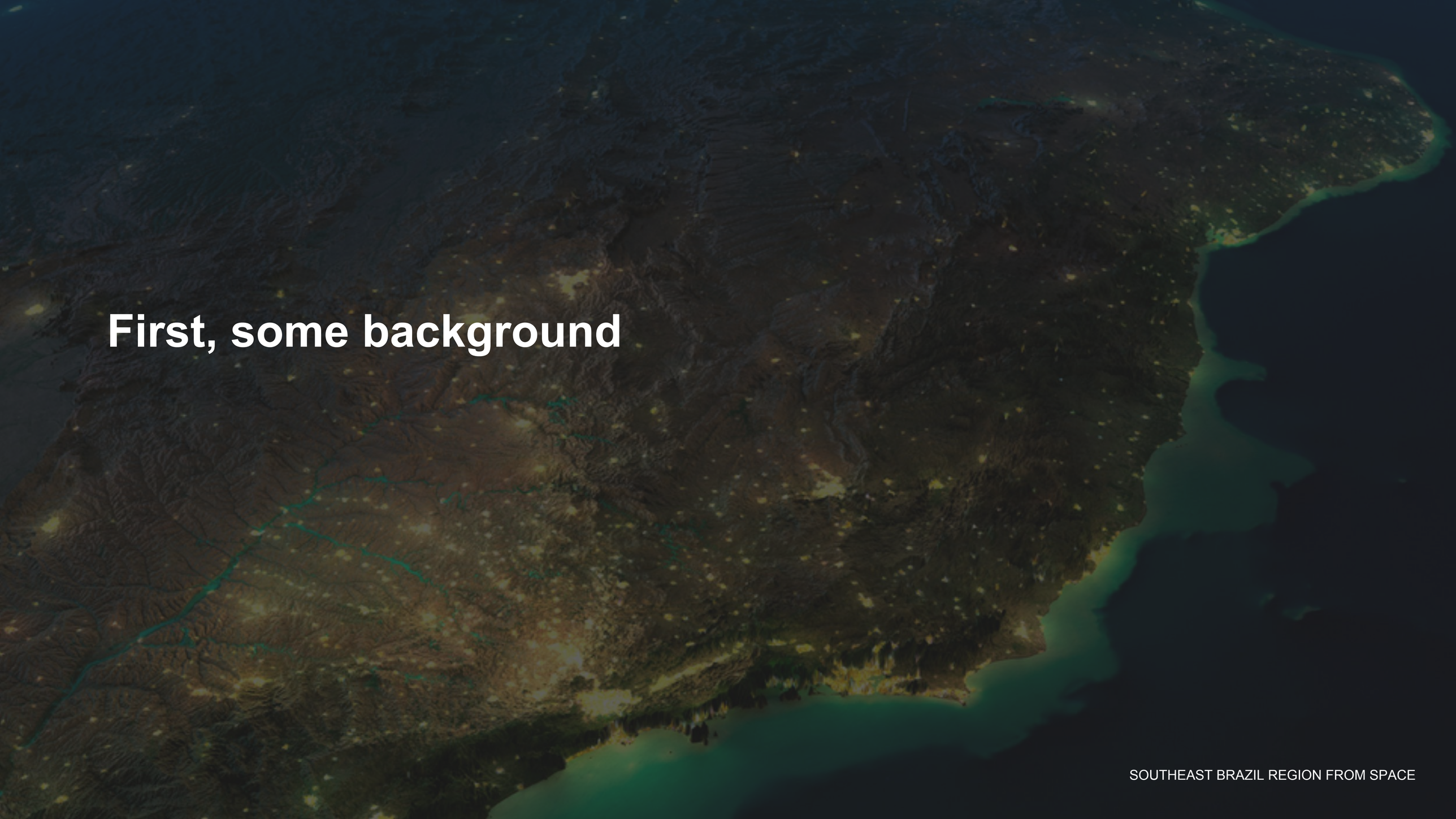
How we test at

Phillip Mates

First, some background



SOUTHEAST BRAZIL REGION FROM SPACE

What is Nubank?

- mobile-driven bank account and credit card services for ~4 million Brazilians
- Started in 2014 & we've been using clojure from the start
- 200 clojure microservices with 100+ engineers
- includes a small eng office in Berlin focused on data infrastructure

Why tests are important to us

Tests help with

- preventing mistakes in production
- cross-team mobility

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But tests aren’t a perfect solution:

- just like code, you can write unreadable tests
- there are maintenance costs
- buggy tests and buggy test frameworks

Why talk about testing?

1. The REPL means we treat testing differently

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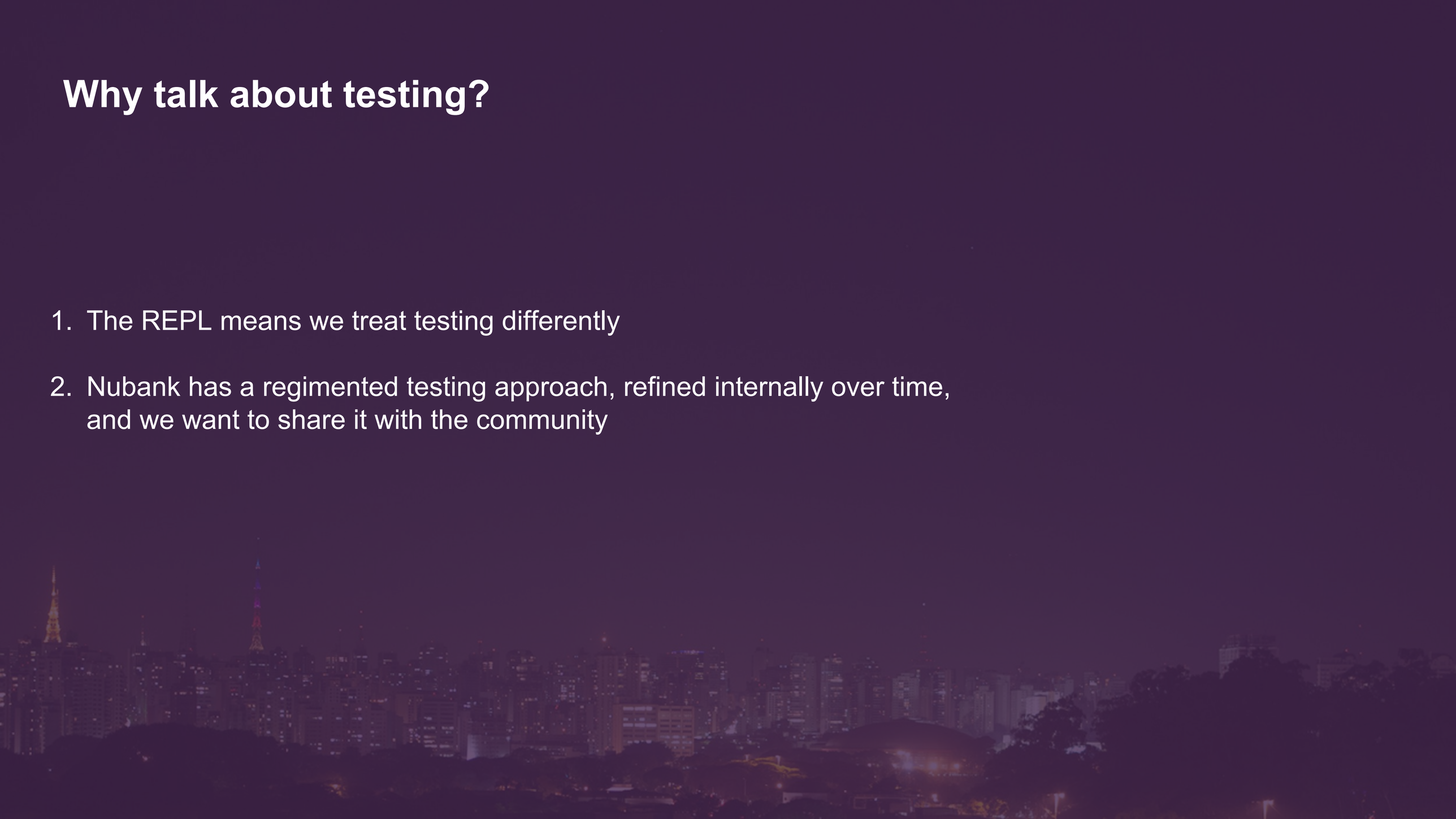
1. The REPL means we treat testing differently

2. Nubank has a regimented testing approach, refined internally over time, and we want to share it with the community



What we are testing

Microservices with a ports & adapters structure

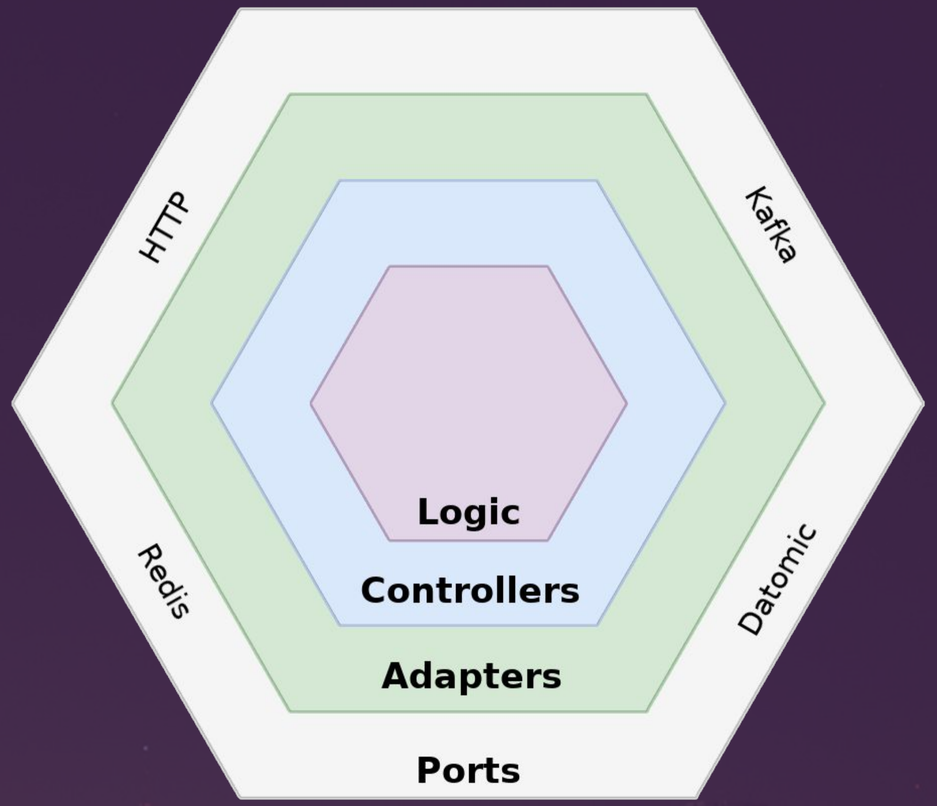
Logic: pure business logic

Controllers: glue that coordinates calls between ports and pure logic

Adapters: convert between external and internal data representations

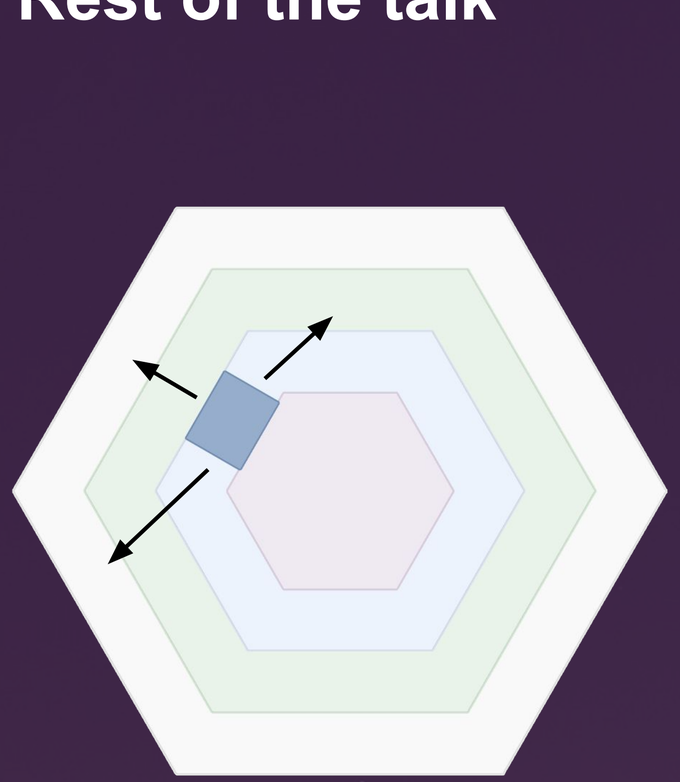
Ports: http, pubsub, database, other I/O

“Components” abstraction is used to organize ports

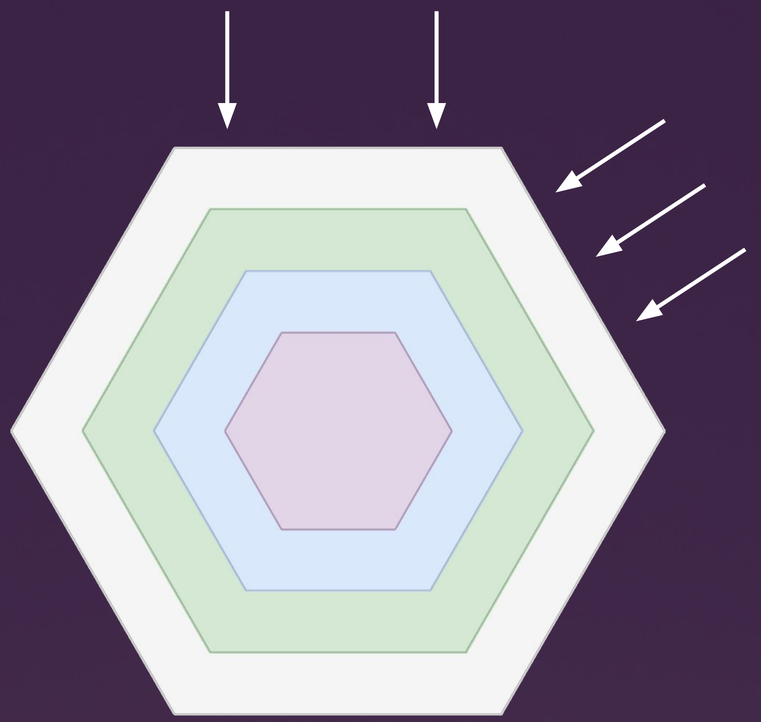


service

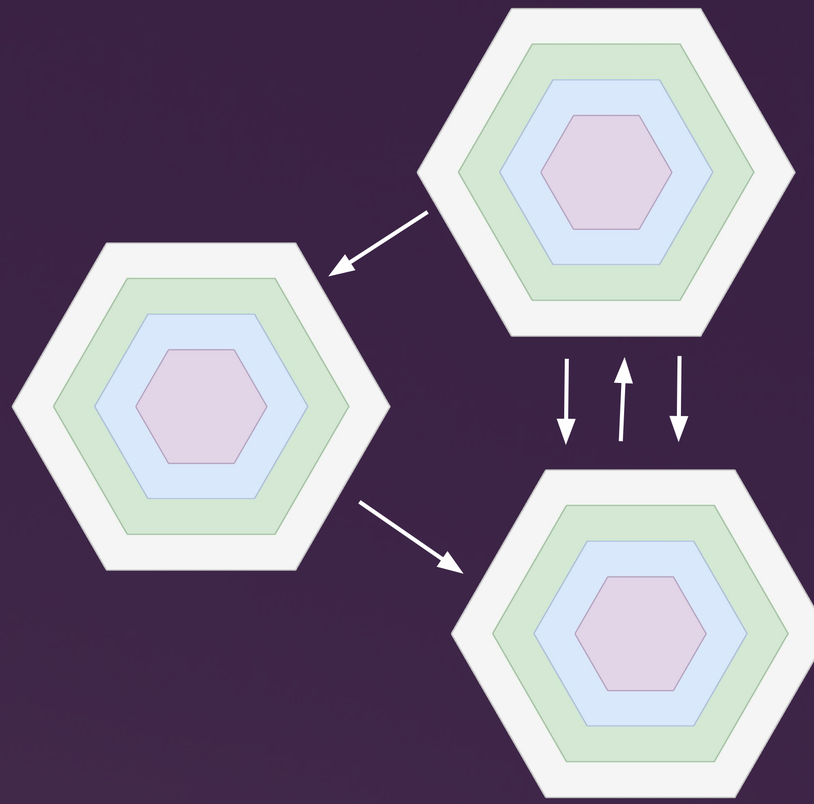
Rest of the talk



unit

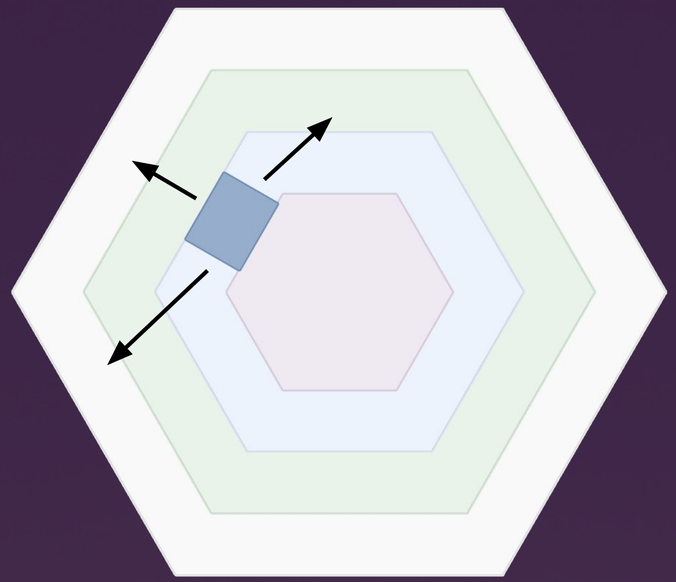


integration



end-to-end

unit tests



Anatomy of a unit test in Midje

```
1 (ns basic-microservice-example.logic)
2
3 (defn new-account [customer-id customer-name]
4   {:id          (java.util.UUID/randomUUID)
5    :name        customer-name
6    :tags        ["savings-beta" "verified"]
7    :customer-id customer-id})
```

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```

```clojure
(ns basic-microservice-example.logic-test ...)

(def customer-id (java.util.UUID/randomUUID))

(fact "New account generation"
  (new-account customer-id "Tim Maia") => (just {:id          uuid?
                                                 :name        "Tim Maia"
                                                 :tags        sequential?
                                                 :customer-id customer-id}))

```

Anatomy of a unit test in Midje

```
1  (ns basic-microservice-example.controller)
2
3
4
5
6
7
8  (defn create-account! [customer-id storage http]
9    (let [customer (get-customer customer-id http)
10         account  (logic/new-account customer-id (:customer-name customer))]
11     (db.saving-account/add-account! account storage)
12     account))
```

Anatomy of a unit test in Midje

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4    (let [customer-url  (str "http://customer-service.com/customer/" customer-id)]
5      (:body (http-client/req! http {:url    customer-url
6                                     :method :get}))))
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    account))
```

```
(ns basic-microservice-example.controller-test)

(def customer-id (UUID/randomUUID))

(fact "Sketching account creation"
  (create-account! customer-id ..storage.. ..http..) => (just {:id          uuid?
                                                               :name        "Tom Zé"
                                                               :tags        (just ["verified" "savings-beta"]
                                                                                  :in-any-order)
                                                               :customer-id customer-id})
```

Anatomy of a unit test in Midje

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```

```
1  (ns basic-microservice-example.controller-test)
2
3  (def customer-id (UUID/randomUUID))
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5  (fact "Sketching account creation"
6    (create-account! customer-id ..storage.. ..http..) => (just {:id          uuid?
7                                                                 :name        "Tom Zé"
8                                                                 :tags        (just ["verified" "savings-beta"]
9                                                                                    :in-any-order)
10                                                                :customer-id customer-id})
11   (provided
12     (get-customer customer-id ..http..) => {:customer-name "Tom Zé"}
13     (db/add-account! (contains {:name "Tom Zé"}) ..storage..) => irrelevant))
14
```

unit tests: take-aways

Pros

- Allows quick iteration with stubbing functionality
- Light-weight and ideal for testing pure logic

Cons

- High-touch: due to stubs and lots of entry points
- Can get cluttered

Take-away:

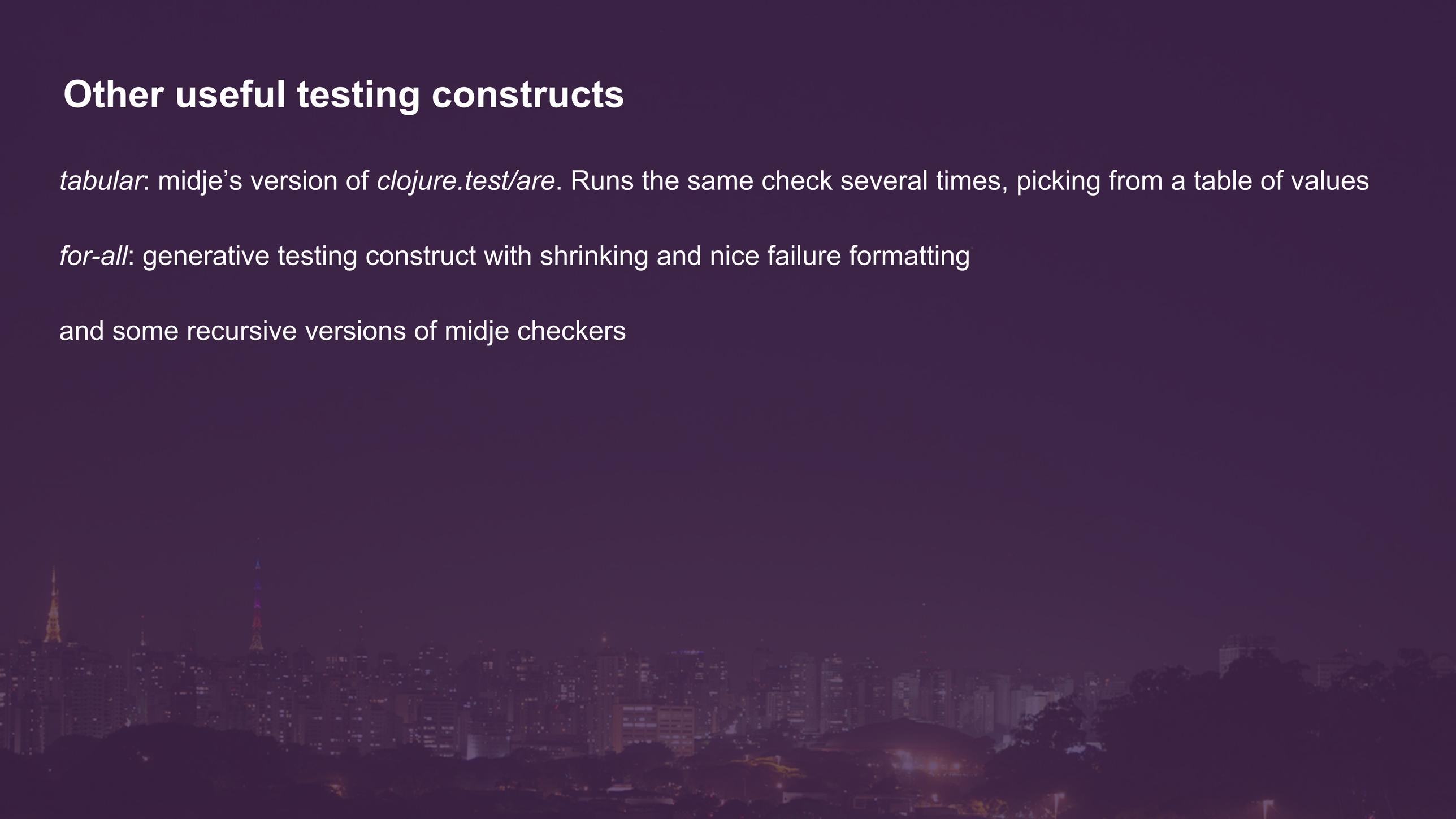
should be used to test core logic and guide one through incremental code dev

Other useful testing constructs

tabular: midje's version of *clojure.test/are*. Runs the same check several times, picking from a table of values

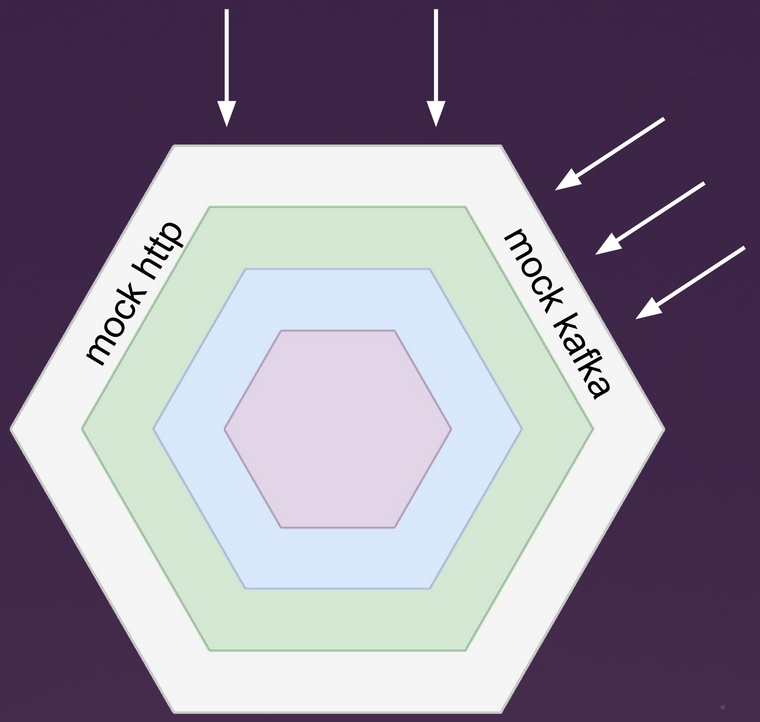
for-all: generative testing construct with shrinking and nice failure formatting

and some recursive versions of midje checkers



Demo: checking nested data with matcher-combinators

Integration



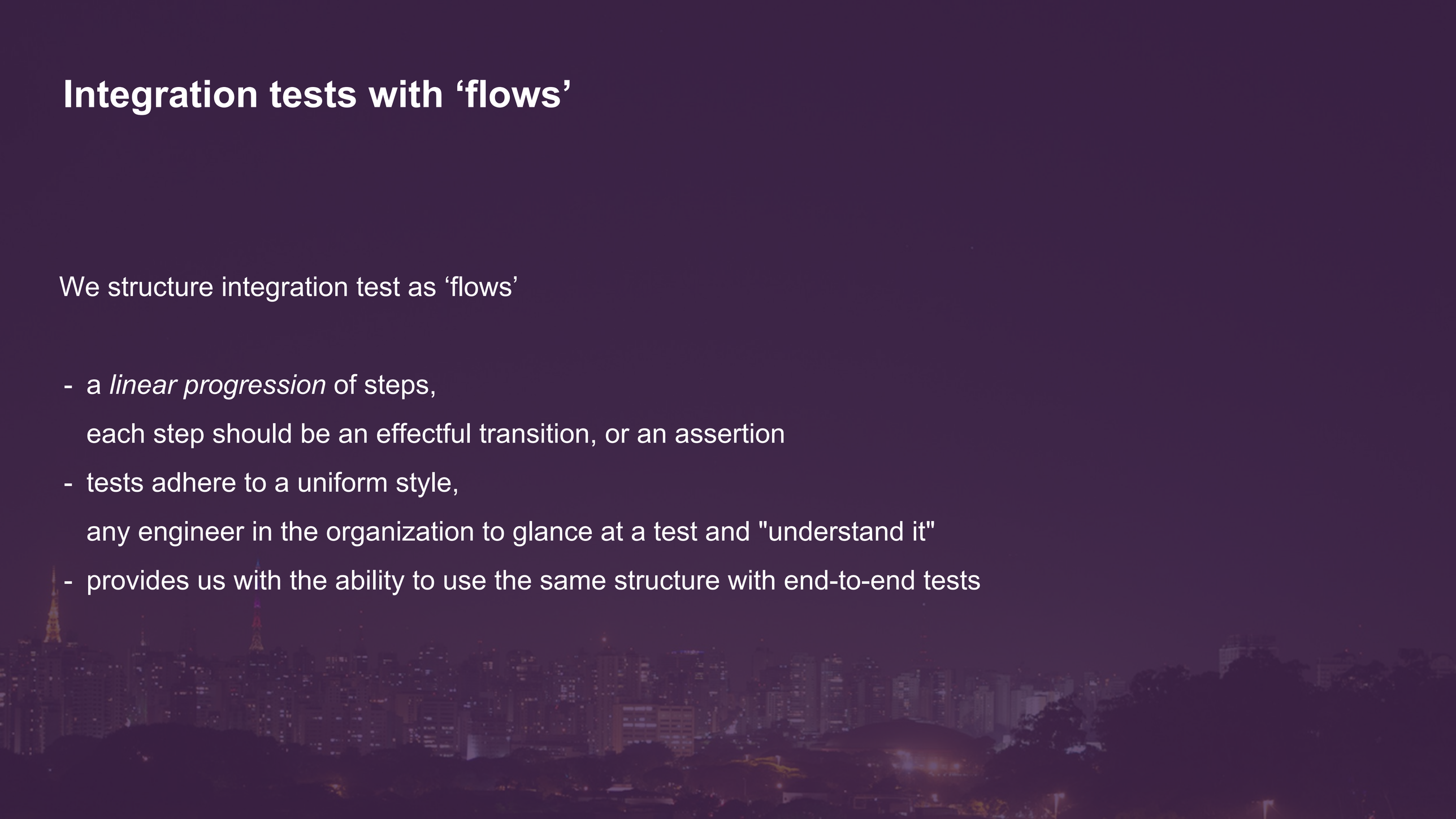
Integration tests

- Cover an entire flow of business logic
- Granularity of a single service. The service code remains unmocked, but mocks for http, pubsub, and other ports are needed
- Trigger code paths via the service’s boundaries, making assertions on outgoing messages

Integration tests with ‘flows’

We structure integration test as ‘flows’

- a *linear progression* of steps,
  each step should be an effectful transition, or an assertion
- tests adhere to a uniform style,
  any engineer in the organization to glance at a test and "understand it"
- provides us with the ability to use the same structure with end-to-end tests

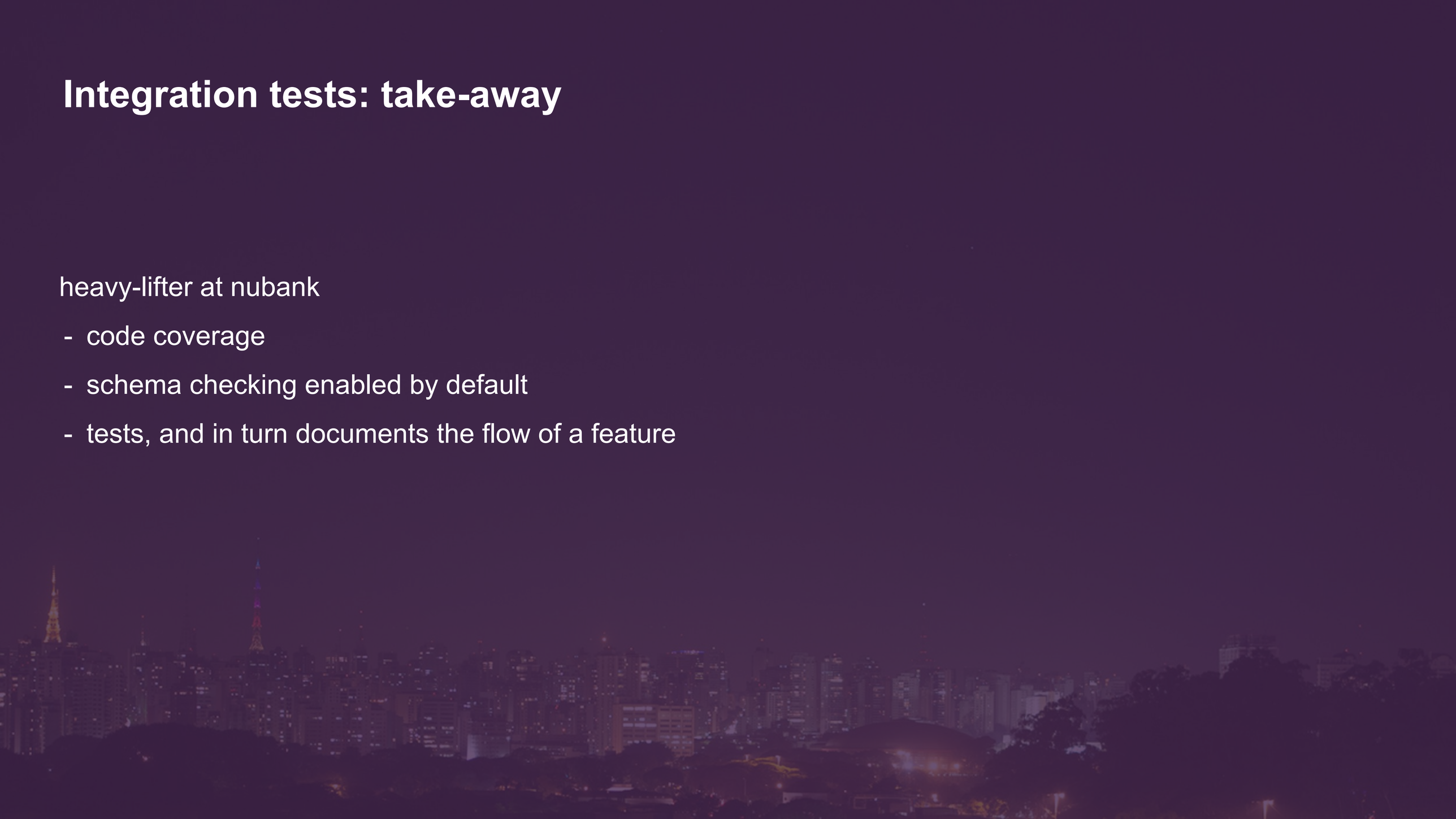


Demo: flow

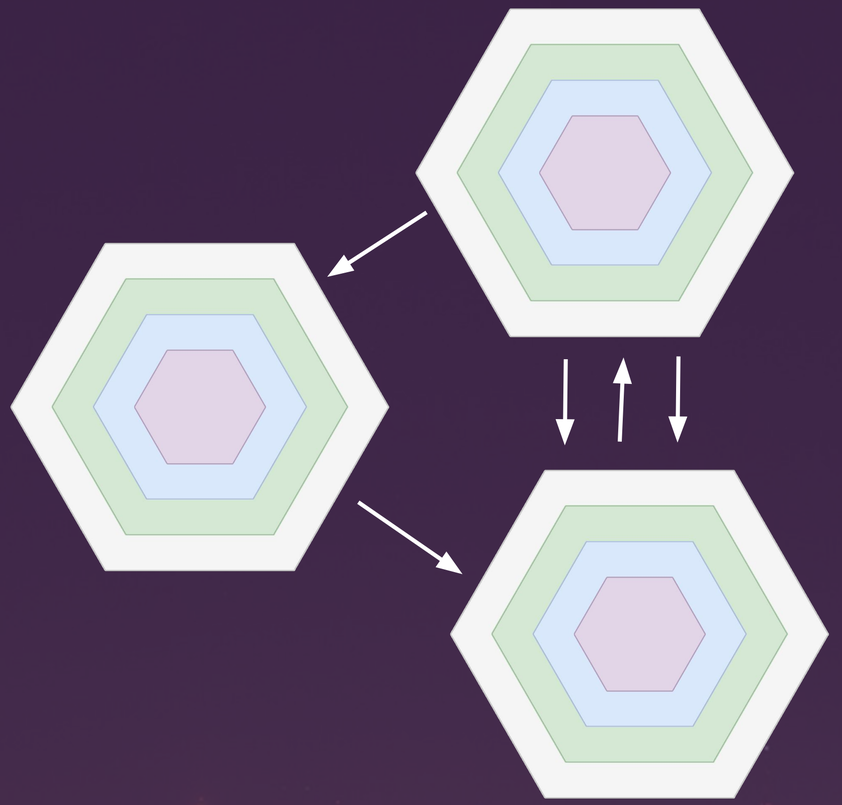
Integration tests: take-away

heavy-lifter at nubank

- code coverage
- schema checking enabled by default
- tests, and in turn documents the flow of a feature



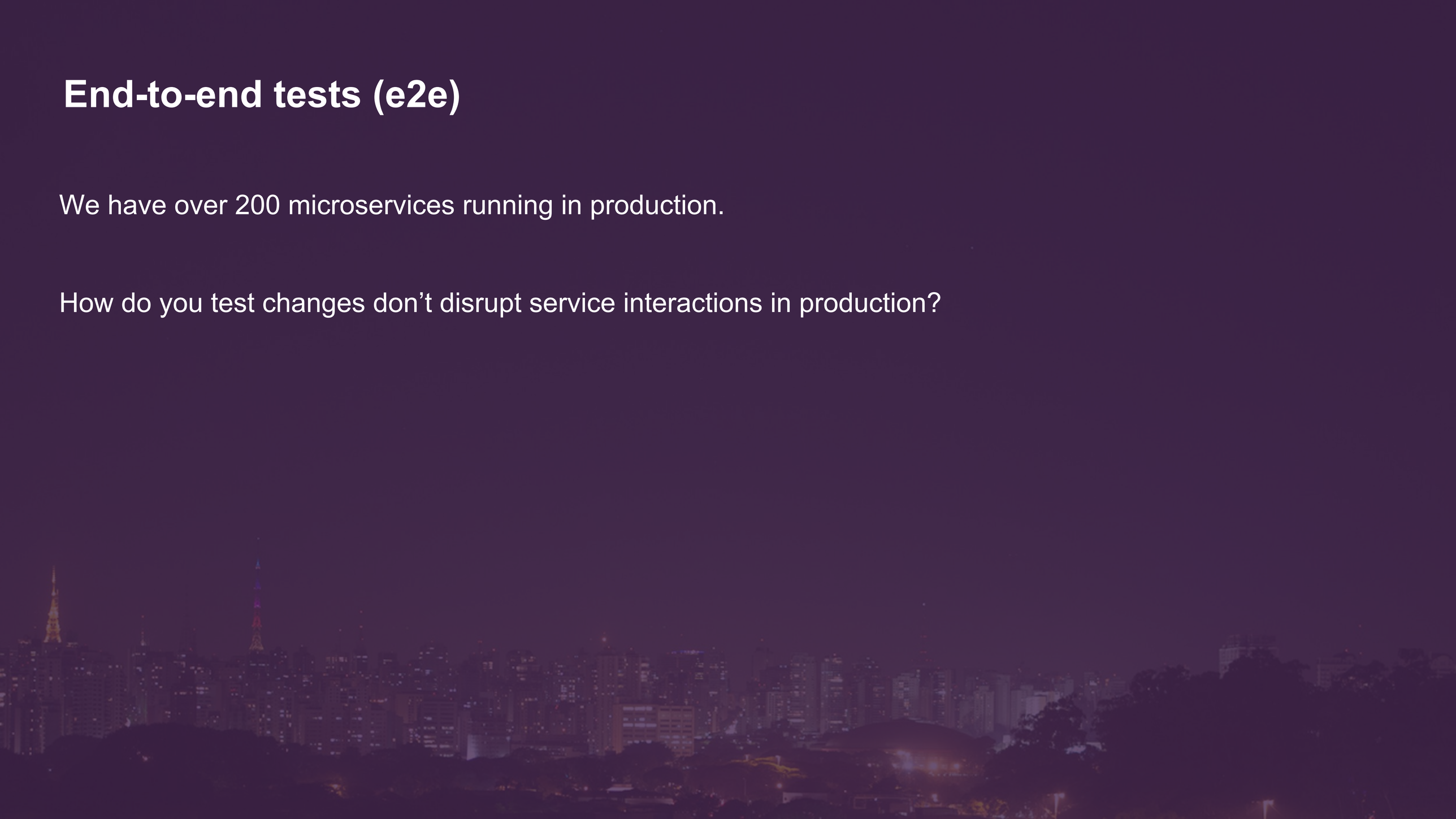
End-to-end tests (e2e)



End-to-end tests (e2e)

We have over 200 microservices running in production.

How do you test changes don’t disrupt service interactions in production?



End-to-end tests (e2e)

We have over 200 microservices running in production.

How do you test changes don’t disrupt service interactions in production?

Make a copy of our production stack and simulate actions via the flow abstraction.

- Gave us confidence in the early years
- Last check before changes are deployed; takes 15 minutes
- Test only happy path
- Tests can be flaky
- Means it is a huge bottleneck

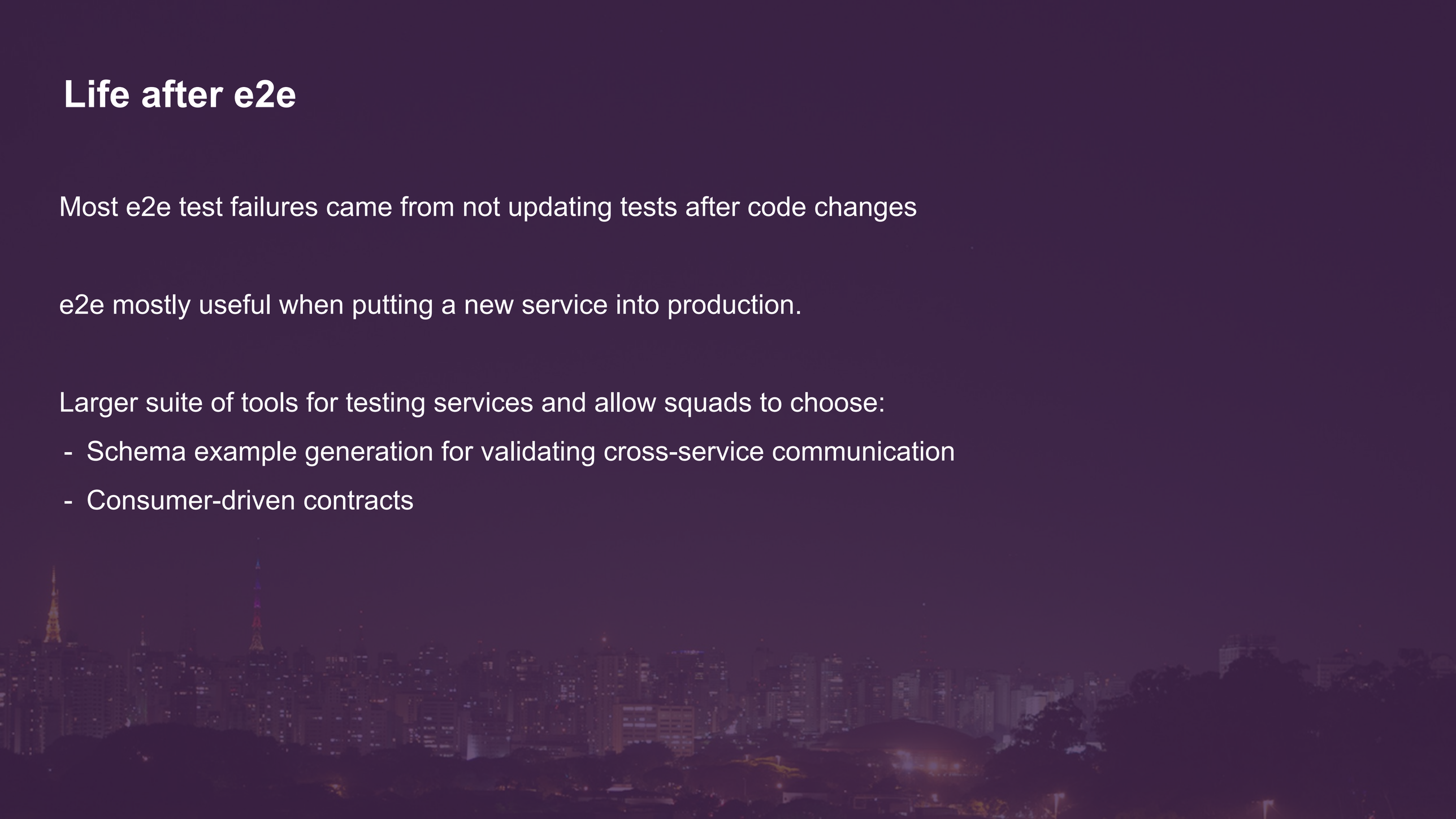
Life after e2e

Most e2e test failures came from not updating tests after code changes

e2e mostly useful when putting a new service into production.

Larger suite of tools for testing services and allow squads to choose:

- Schema example generation for validating cross-service communication
- Consumer-driven contracts

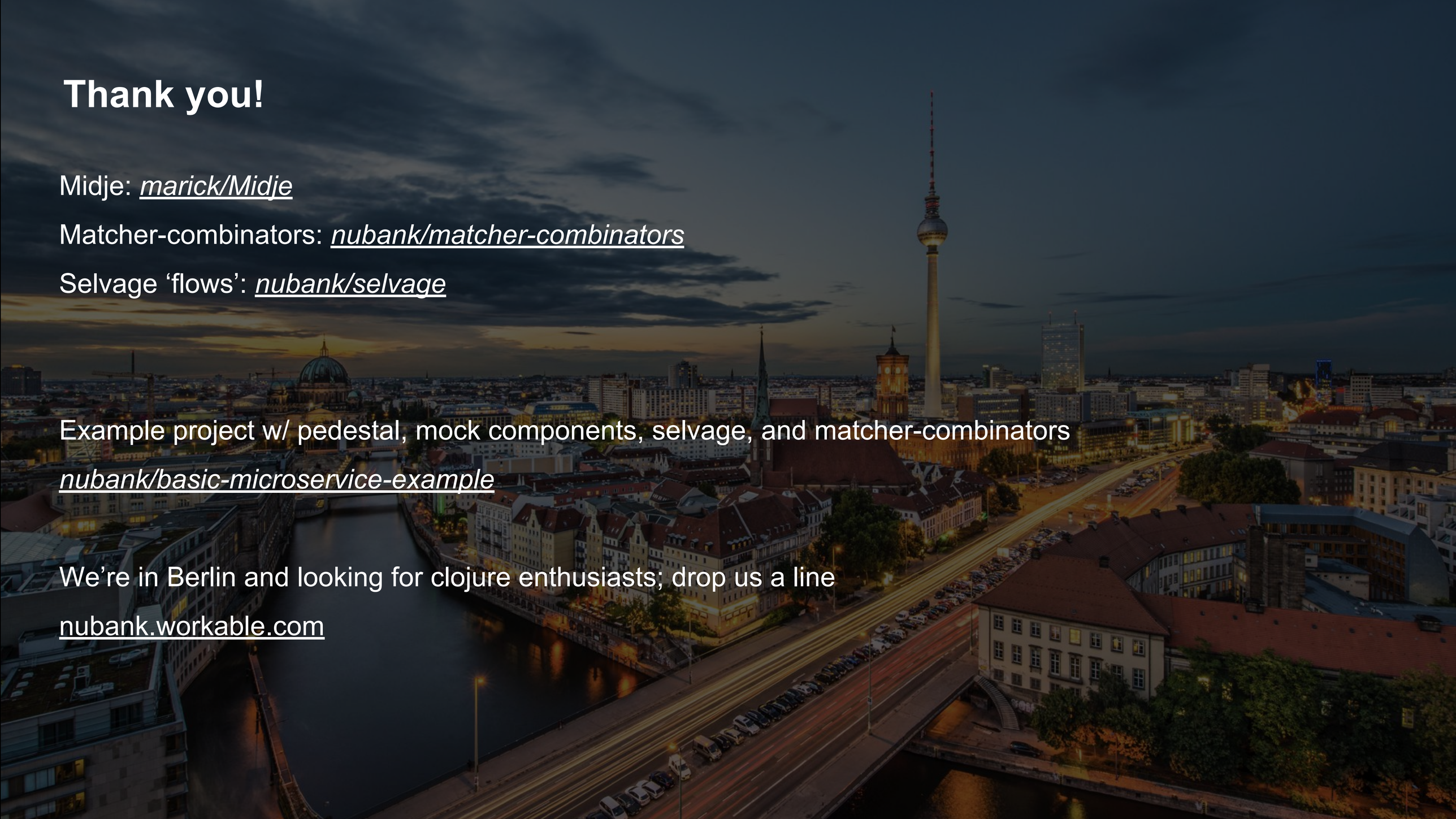


Wrap up

Unit tests are good for pure logic and iterating on code

Integration tests are the work-horse at Nubank

Cross-service testing is hard: moving from e2e to a suite of lightweight validation tools



Thank you!

Midje: *marick/Midje*

Matcher-combinators: *nubank/matcher-combinators*

Selvage ‘flows’: *nubank/selvage*

Example project w/ pedestal, mock components, selvage, and matcher-combinators

nubank/basic-microservice-example

We’re in Berlin and looking for clojure enthusiasts; drop us a line

nubank.workable.com