The Test Automation Platform as a Service

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The testing problem

Always-on world - even non mission-critical IT system become **business-critical**

Failures in the production stage have strongly adverse business consequences: **catastrophic outcomes**, **physical injuries**, **regulation infringements**, **reputational damages**, **liabilities**, **customer churn**, **profit losses**, **competitive disadvantages**, **time-to-market delays**, and **extra labor and equipment costs**

Nowadays, **systematic and effective test** in several points of the **DevOps process** becomes **mandatory**

Manual test is **hard**, **knowledge-intensive**, **time-consuming**, very **expensive in labor and equipment**, and often **ineffective**, **inefficient**, and **error-prone**

Test automation is the **solution**

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What is Test Automation?

Test Automation is a buzzword: tools currently available in the QA & Testing market **implement at most the bare mechanization of clerical test tasks**

Agile, TDD and BDD methodologies and **Continuous Integration and Delivery DevOps** processes **need higher levels of test automation**

Leading organizations develop **complex, custom-built, tailor-made, and ad hoc test systems**, carried out by **challenging and expensive software projects** borne by **highly skilled developers**

Resulting home-made test systems are not only very limited in automation (only the clerical test tasks are mechanized) but also so **burdensome, brittle, error-prone, and dear to maintain, configure, deploy, and operate** – often more than the system to be tested - that many customers revert to **manual, outsourced, and offshore testing**

Anyway, **high code test automation is out of range of small and medium organizations**

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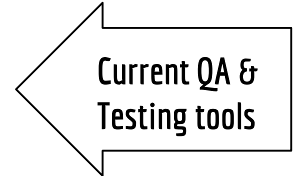
Test automation 2.0

Customer challenges generate needs that are not satisfied by the currently available technology and can be met only by full Test Automation

Automation levels

	Test generation	***Test run***	***Test management***
2	Autonomous, intelligence-led, robotics, and low code automated design and generation of synthetic, context aware, and focused test scenarios and samples (inputs and oracles) from models and policies	Autonomous, intelligence-led, robotics, and low code automation of the test runs, with automated configuration and binding, dynamic intelligent scheduling, on the fly focused generation, and evidence-based reactive planning	Fault-tolerant API/scripting invocation of autonomous test automation software robots running on a highly elastic, dependable, secure and performant platform
1	Mechanized generation of test input and oracle templates. User manual drafting of test inputs and oracles	High code configuration and binding of custom-built test systems. Mechanization of batches of sequential test execution. Eye-ball arbitration of SUT responses by inspection of bulky journals. Manual reporting	DevOps process invoking custom-built and unstable test systems without any guarantee of elasticity, dependability and performance
0	Manual drafting of test inputs and oracles	Manual configuration and binding of a client software. Manual sending of the test inputs and gathering the SUT responses. Eye-ball arbitration and manual reporting	Human workflow for an activity that uses disputed equipment and is carried out by scarce human resources, upon software of uncertain quality



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The SIMPLYTESTIFY solution

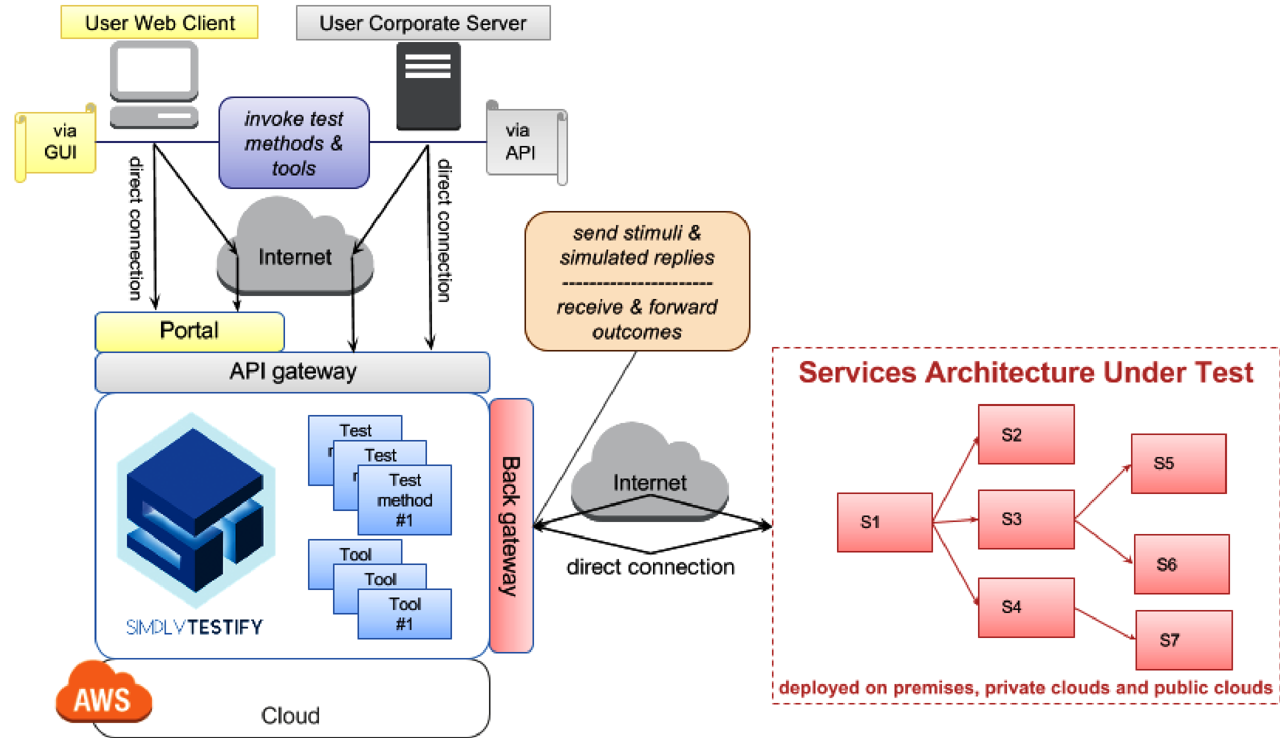
The use of SIMPLYTESTIFY is straightforward, declarative and low-code

The user

1. deploys the SUT in the distributed testbed (on-premises, on private, public, and hybrid cloud);
2. drafts a few declarative artifacts (models and policies);
3. implements the SUT Initialization API

The SIMPLYTESTIFY robots

- autonomously design and generate synthetic test scenarios and data sets,
- run dynamically scheduled test sessions,
- produce and summarize test verdicts, and
- plan and implement multi-session test campaigns.



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Automation of cognitive test tasks

The tools currently available in the QA & Testing market do not provide any support for the automation of **cognitive test tasks**

SIMPLYTESTIFY robots automate:

- the **derivation of test scenarios** from the **models** and **policies**
- the **design of test inputs** with elevated **fault exposing potential** from the **models** and **policies**
- the **derivation of the test oracles** from the **SUT models**
- the **generation** of **executable test samples** (scenarios' instances)
- the **configuration** of the **test harness** with **simulated components** (**clients**, **stubs**) and **intercepting proxies**
- the **binding** of the **test harness** to the **SUT** on the **distributed testbed**
- the **arbitration** of the **SUT responses**
- the **dynamic prioritization** of the **test samples**, based on probabilistic reasoning and driven by failure search policies and past test verdicts
- the **evidence-based planning** of **test campaigns**, based on probabilistic reasoning and driven by coverage policies, with on-the-fly generation of new test scenarios/samples
- the **reporting** of the **test sessions**

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Model/policy based test automation

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The user shall supply **the native interface and protocol descriptions** (e.g. WSDL for SOAP, WADL or WSDL for REST/XML, OpenAPI/Swagger for REST/JSON …)

SIMPLYTESTIFY test automation is based on a few additional **declarative artifacts** (XML format):

Models

- **SUT topology** - graph of SUT components linked by service dependency wires
- **Test harness configuration plan** - structural and behavioral model of the simulated upstream and downstream components (respectively, ***clients*** and ***stubs***) and of the intercepting ***proxies*** on the service dependency wires
- **Protocol state machines** - for each actual (SUT) and virtual (Test harness) component, a state/transition (event/condition/effect with transfer functions) representation of the allowed conversations with its upstream ad downstream services

Policies – **generation**, **scheduling**, and **planning** policies

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Low code test automation

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Low code automation: the only coding effort requested from the user concerns the (re)initialization procedure for each SUT component

- Each (re)initialization procedure implements the **SUT initialization APIs**
- The **executor/arbiter robot automatically invokes the initialization APIs** on each SUT component: (i) at the start of the test session, and (ii) at the end of each test run
- **SIMPLYTESTIFY** ensures the **repeatability of the test runs** by implementing the ETSI* recommendation that each test run must leave the SUT in its initial state
- The **setup of the test system** does not require **any specific coding effort**

* European Telecommunication Standard Institute - http://www.etsi.org/

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Contract-based test automation

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The user can model **pre/post-conditions** on **stateful SUT components**

She shall

- define a **state resource** (XML infoset) that represents the **externally visible state** of the component
- implement a the **Contract-Based Test API** on the component for **setting/getting the state resource**

The executor/arbiter robot **automatically invokes these APIs** on the SUT components at particular moments of the test run

- to **set** the **initial component state** for the test run
- to **get** the **actual component state** for checking whether it meets the **pre/post-conditions**

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Automated testing capability

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The **SIMPLYTESTIFY executor/arbiter** can handle:

- **protocol testing** – of the compliance of the actual message with the oracle message type,
- **content testing** – of the compliance of the actual message content with the oracle message content,
- **contract testing** – of the compliance of the actual SUT state with the oracle SUT state,
- **fault-tolerance testing** – of the component behavior in the presence of the failure of downstream services (stubs that do not respond),
- **non-determinist test scenarios** - where asynchronous SUT feedbacks are allowed arriving in an unspecified order.

N.B.: the features mentioned above are applied to **gray-box testing of complex and large-scale distributed architectures**.

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Automatic test arbitration

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SIMPLYTESTIFY automates the **arbitration task**

For each test run, the executor/arbiter initializes a **compound test verdict**, i.e. an **array of local verdicts** (one for each **expected SUT feedback** in the **test scenario – actual message** or **retrieved state**) - all the local verdicts are initialized to ***none***

The **test components** (**clients**, **stubs**, **proxies**) set the **local verdicts** for the **SUT feedbacks** they arbitrate to

- ***pass*** - the **SUT feedback matches** the **oracle**
- ***fail*** - the **SUT feedback mismatches** the **oracle**

The occurrence of a ***fail*** local verdict or a ***timeout*** ends the test run. The verdicts of the non received SUT feedbacks remain unchanged (***none***)

At the end of the test run, the executor/arbiter re-initializes the SUT and returns the compound test verdict

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Test automation as a service

SIMPLYTESTIFY implements

- the **reliable invocation** of **test automation methods** via APIs
- the **reliable execution** of **test automation methods** by **autonomous robots** on a highly elastic, dependable, and secure cloud infrastructure

SIMPLYTESTIFY enables the **swift wrapping** of **test automation services** in **all types of DevOps automated processes**:

- **automated black-box test of components** starting at the early stages of design and development (**shift left testing**);
- **automated black-box test of partners' and third-parties' components** (**client-driven testing**)
- **automated gray-box test** throughout all the process of **incremental integration** of distributed systems (**incremental testing**)
- **automated regression test** of new and updated **component builds** (**acceptance testing**)
- **on-the-fly automated test** of **suspicious components** triggered by the ops monitoring system (**shift right testing**)

Continuous Integration

Continuous Delivery

Continuous Development

Continuous Testing

Continuous Deployment

Change Management

Ops Monitoring

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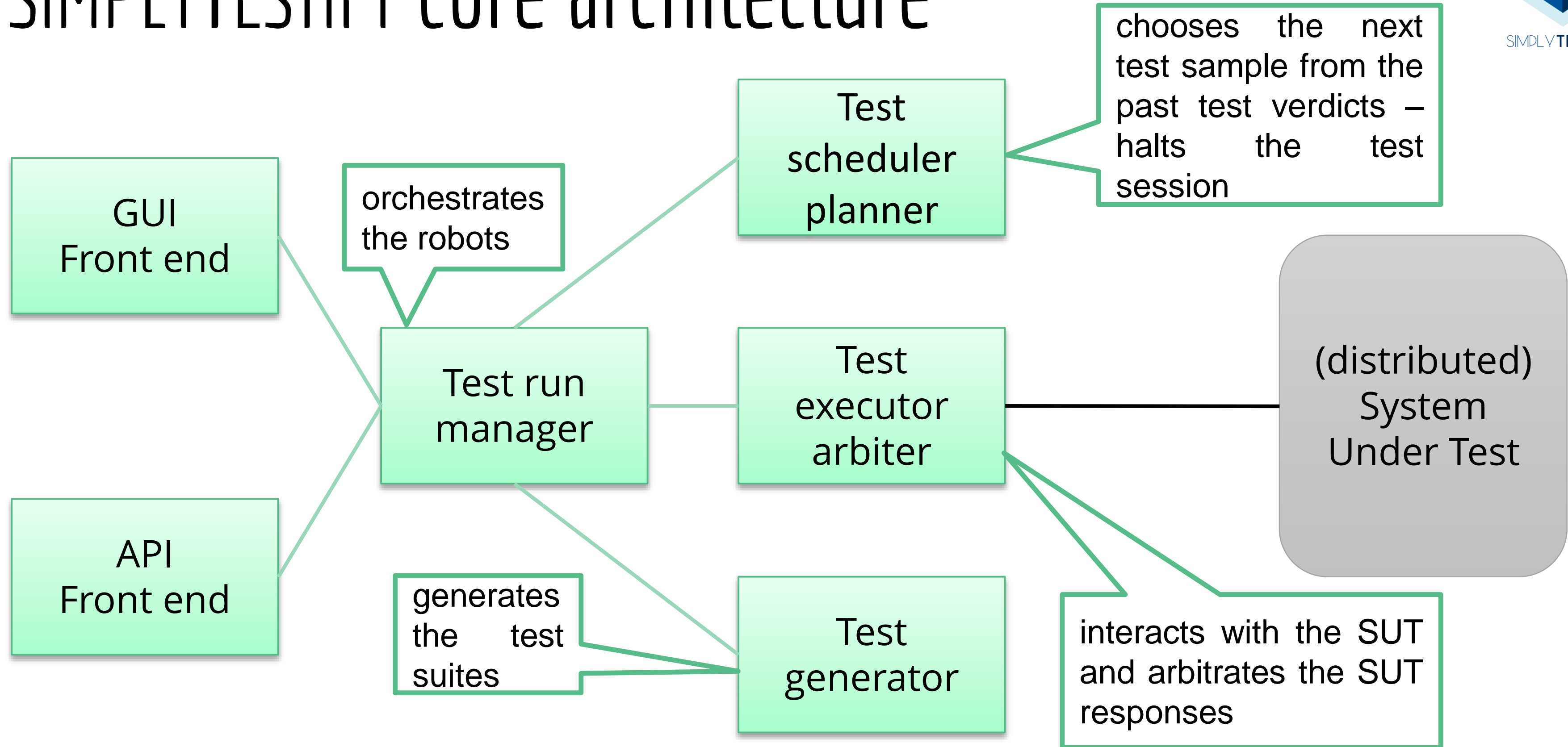
SIMPLYTESTIFY core architecture



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Conclusion

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Test Automation: full, autonomous, intelligence-led, robotics, low-code, as a Service

Black-box, contract-based, client-driven Test Automation

Gray-box Test Automation of complex and large-scale distributed system

Availability

- Platform as a Service on public cloud – self-provisioning, pay-as-you-go, low-cost – today AWS
- Can be licensed on private cloud

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Thanks

Libero MAESANO
libero.maesano@simple-eng.com

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Annexes

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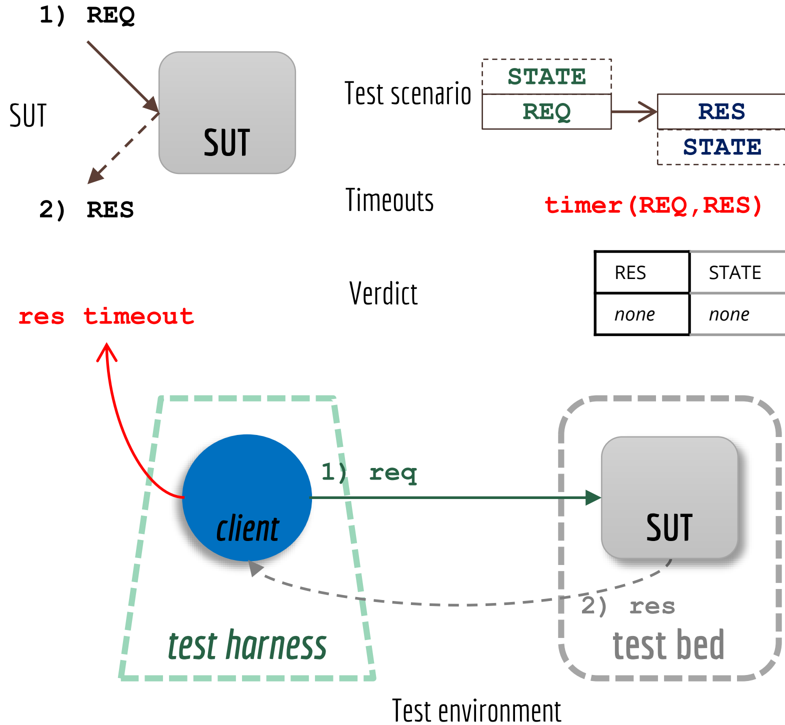
Unit test of a terminal component



(*The SUT is initialized*)

1. Optionally, the *client* sets the **actual SUT state** with the **canned SUT state** (contract-based testing)
2. The *client* sends to the SUT the **req stimulus request**
3. The *client* starts the **res timer** for the **res actual response** and waits - if **res timeout**, go to 6
4. The *client* receives the **res actual response** before the **res timeout**, stops the **res timer**, compares the **res actual response** with the **res oracle response**, and sets the **res response local verdict**
5. Optionally, the *client* retrieves the **actual SUT state**, compares it with the **oracle SUT state**, and sets the **SUT state local verdict** (contract-based testing)
6. The executor/arbiter re-initializes the SUT and returns the **compound test verdict**

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Unit test of a non-terminal component

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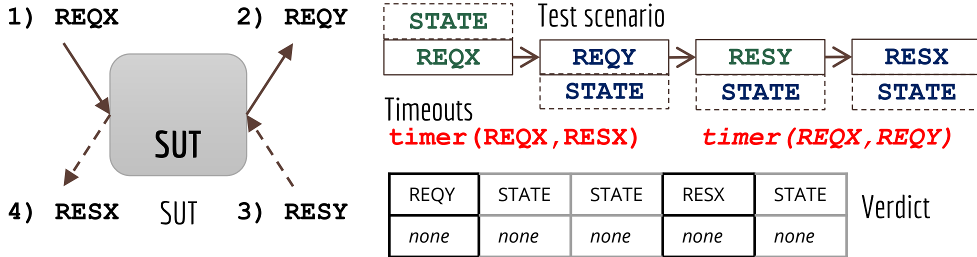
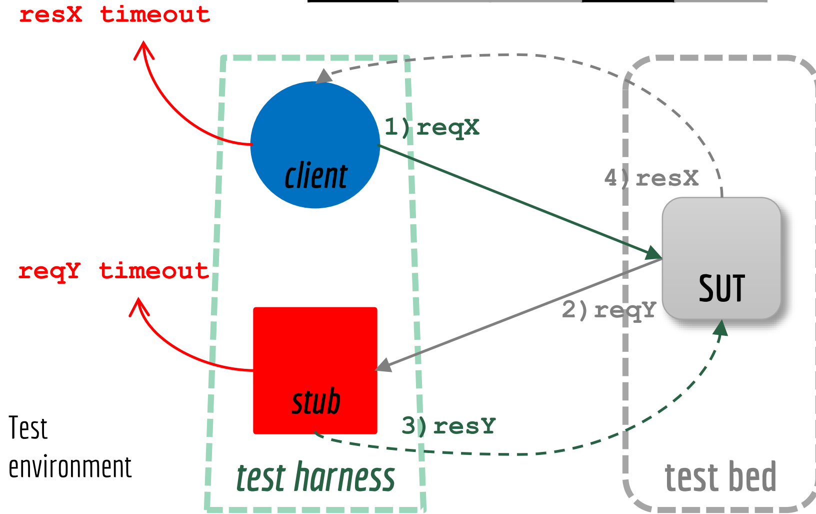


REQY	STATE	STATE	RESX	STATE
none	*none*	*none*	*none*	*none*



(*The SUT is initialized*)

1. Optionally, the *client* sets the **actual SUT state** with the **canned SUT state** (contract-based testing);
2. The *client* sends the **reqX stimulus request** to the SUT and notifies the *stub*
3. The *client* starts the **resX timer** and waits; if specified, the *stub* starts the **reqY timer** and waits; if one of the **timeouts** raises, go to 7
4. The *stub* receives the **reqY actual request** before the **reqY timeout**, stops the **reqY timer**, compares the **reqY actual request** with the **reqY oracle request**, and sets the **reqY message local verdict**; optionally, the *stub* retrieves the **actual SUT state**, compares it with the **oracle SUT state**, and sets the **SUT state local verdict** (contract-based testing); if one of the local verdicts is set to *fail*, go to 7
5. The *stub* sends the **resY stimulus response** to the SUT
6. The *client* receives the **resX actual response** before the **resX timeout**, stops the **resX timer**, compares the **resX actual response** with the **resX oracle response**, and sets the **resX message local verdict**;
7. Optionally, the *client* retrieves the **actual SUT state**, compares it with the **oracle SUT state**, and sets the **SUT state local verdict** (contract-based testing)
8. The executor/arbiter re-initializes the SUT and returns the **compound test verdict**

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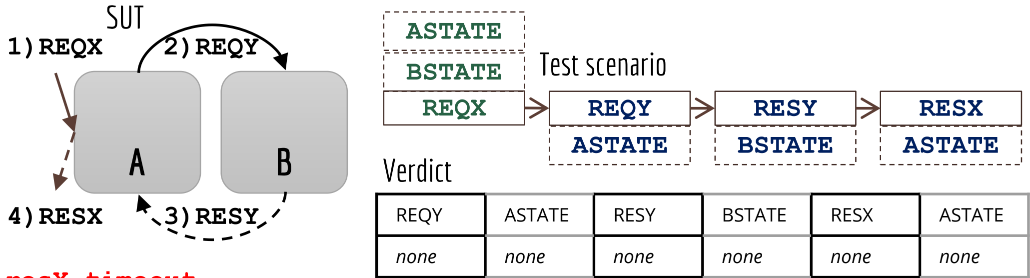
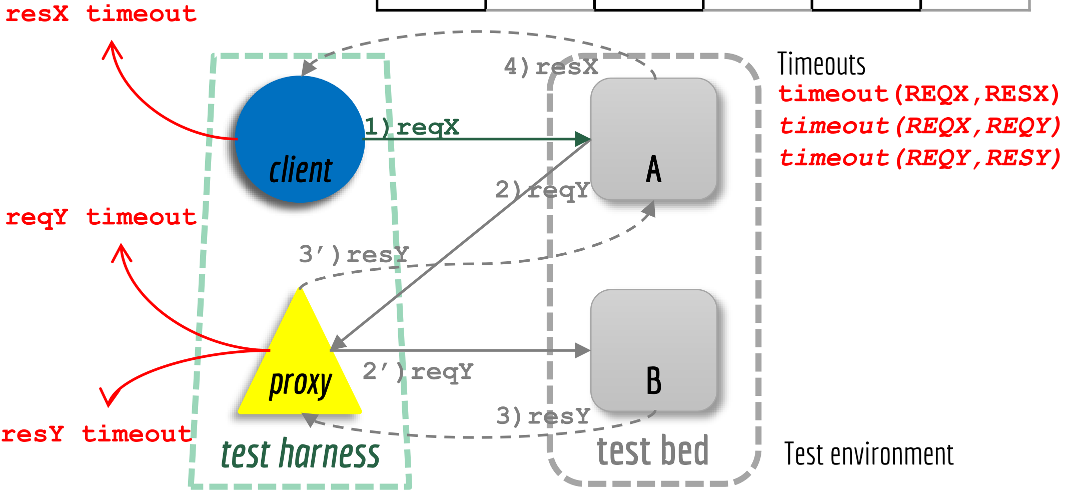
Integration test of a distributed Sut





(*The SUT - A and B - is initialized*)

1. Optionally, the *client* sets the **actual A state** with the **canned A state**, the *proxy* sets the **actual B state** with the **canned B state** (contract-based testing)
2. The *client* sends the **reqX stimulus request** to A and notifies the *stub*
3. The *client* waits for the **resX actual response**, and the *proxy* waits for the **reqY actual request** - if one of the **timeouts** raises, go to 12
4. A sends **reqY actual request** to the *proxy*;
5. The *proxy* receives **reqY actual request**, compares it with the **reqY oracle request**, and sets the **reqY local test verdict** - optionally, it retrieves the **A actual state**, compares it with the **A oracle state**, and sets the **A state local verdict** (contract-based testing); if one of the local verdicts is set to fail, go to 12
6. The *proxy* sends **reqY actual request** to B and waits for the **resY actual response** - if **resY timeout** raises, go to 12
7. B sends **resY actual response** to the *proxy*
8. The *proxy* receives **resY actual response**, compares it with the **resY oracle response**, and sets the **resY local test verdict** - optionally, it retrieves the **B actual state**, compares it with the **B oracle state**, and sets the **B state local verdict** (contract-based testing); if one of the local verdicts is set to fail, go to 12
9. The proxy sends the **resY actual response** to A
10. A sends the **resX actual response** to the *client*
11. The *client* receives the **resX actual response**, compares it with the **resX oracle response** and sets the **resX local test verdict** - optionally, it retrieves the **A actual state**, compares it with the **A oracle state**, and sets the **A state local verdict** (contract-based testing)
12. The executor/arbiter re-initializes the SUT and returns the **compound test verdict**

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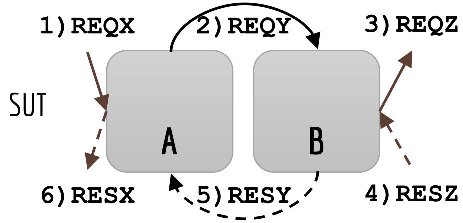
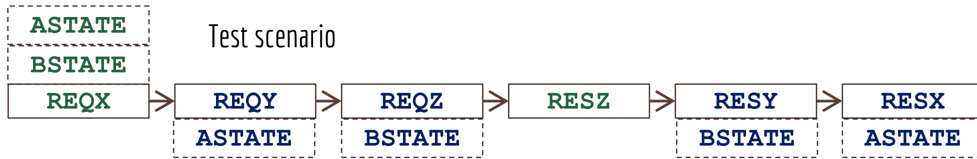
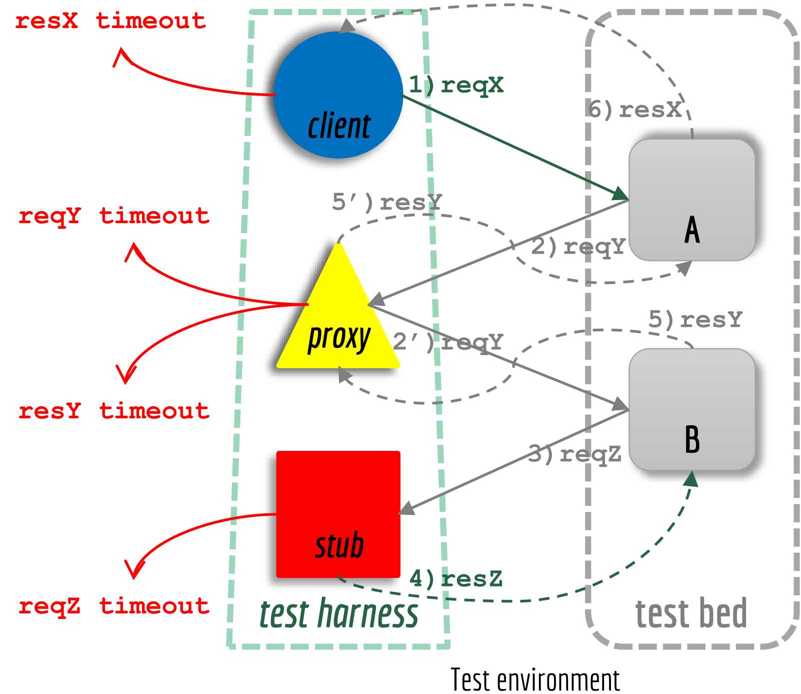
Integration test of a distributed Sut (II)







timeout(REQX,RESX)
timeout(REQX,REQY)
timeout(REQY,RESY)
timeout(REQY,REQZ)

Timeouts

REQY	ASTATE	REQZ	BSTATE	RESY	BSTATE	RESX	ASTATE
none	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Verdict

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