



**accompio**

# **Time to test your web-application efficiently**

**Which testing tool is best suited for the job?**

# Why another comparison?



Imagesource: created by AI

"Cypress generally executes tests faster than Selenium due to its architecture."

Source: <https://saucelabs.com/resources/blog/cypress-vs-selenium-a-question-of-scale>

# Who am I?



**Daniel Horn**

M.Sc. Business Informatics,  
Quantitative Methods of Business Informatics  
Test Automation Engineer & DevOps Advocate

# What do we do today?



Tools



Methods and Setup



Results



Recommendations

# Which tools did we look at?

## Selenium (2004)

**Selenium automates browsers. That's it!**

What you do with that power is entirely up to you.

Primarily it is for automating web applications for testing purposes, but is certainly not limited to just that.

## Cypress (2017)

**Test. Automate. Accelerate.**

With Cypress, you can easily create tests for your modern web applications, debug them visually, and automatically run them in your continuous integration builds.

## Playwright (2020)

**Playwright enables reliable end-to-end testing for modern web apps.**

Any browser • Any platform • One API

Resilient • No flaky tests

No trade-offs • No limits

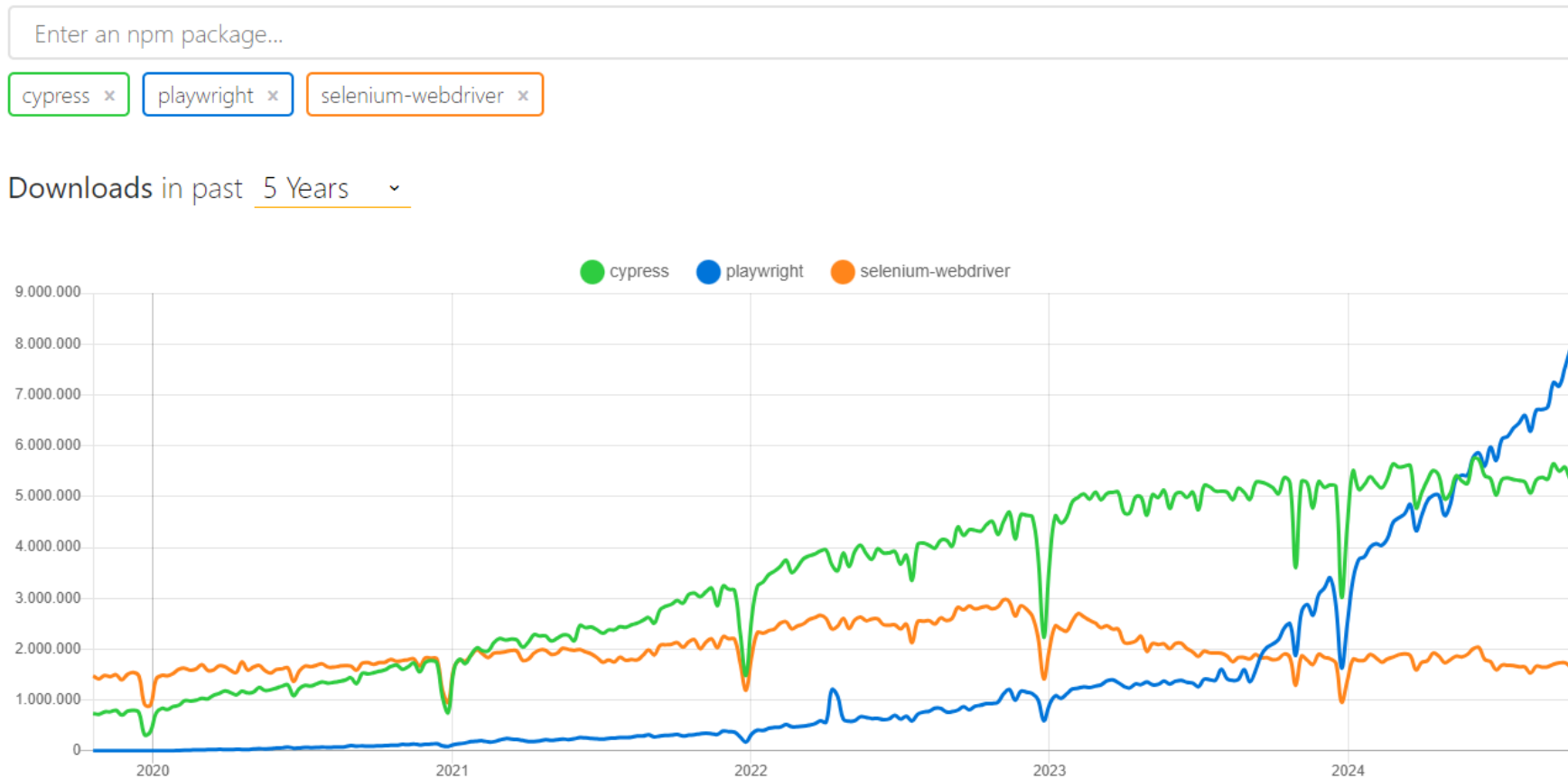
Full isolation • Fast execution

Powerful Tooling

Sources: official product websites

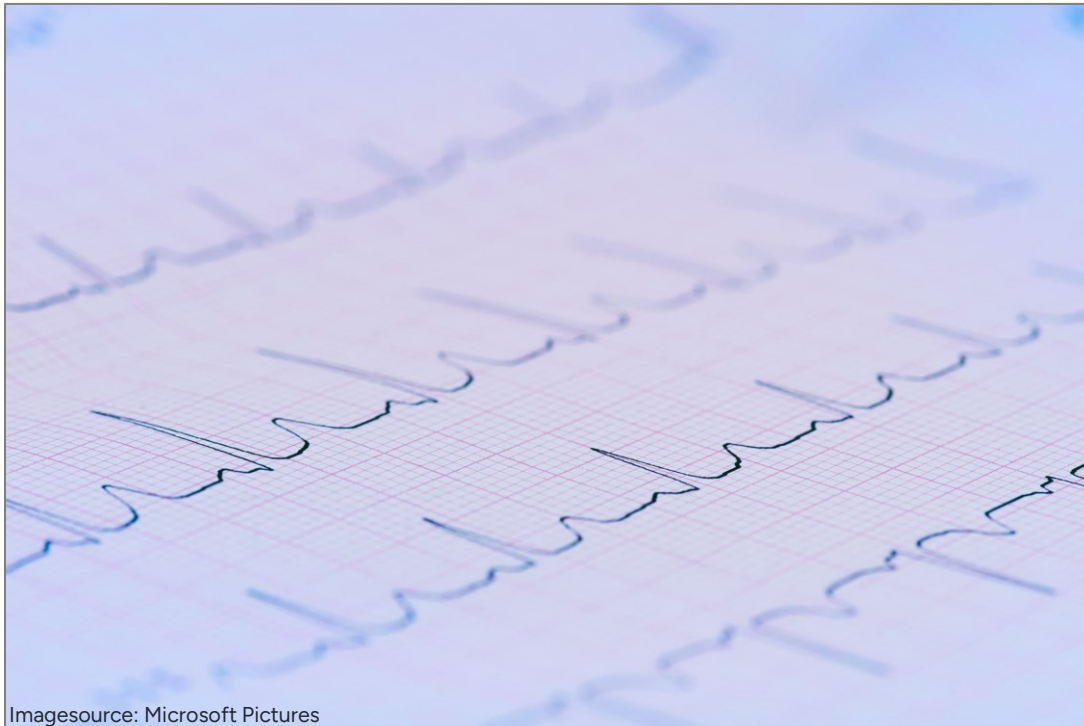
# Popularity Poll

cypress vs playwright vs selenium-webdriver





# Where did we measure?



- Defined and repeatable set-up to measure run times

	Java	Node.js
Selenium	4.22.0	4.22.0
Cypress		13.13.1
Playwright	1.45.0	1.45.0

- Inside containers
  - Maven: [docker.io/maven:3.9.8](https://hub.docker.com/r/maven/maven)
  - Node.js: [docker.io/node:20.15.1-bookworm](https://hub.docker.com/r/bookworm/node)
  - Cypress: [docker.io/cypress/base:20.15.1](https://hub.docker.com/r/cypress/cypress-base)

# How did we measure?

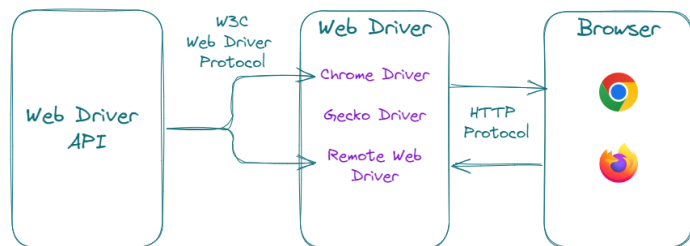
- Run test on every combination 100 times
- Two time points
  - Before browser start
  - Before test start



# How do the tools work?

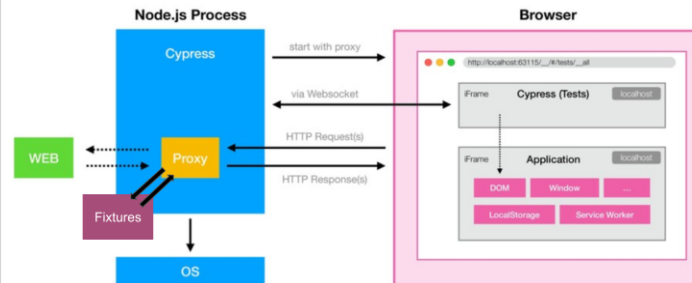
## Selenium (2004)

- Special WebDriver
- Communicating with local browsers by HTTP(S) protocol



## Cypress (2017)

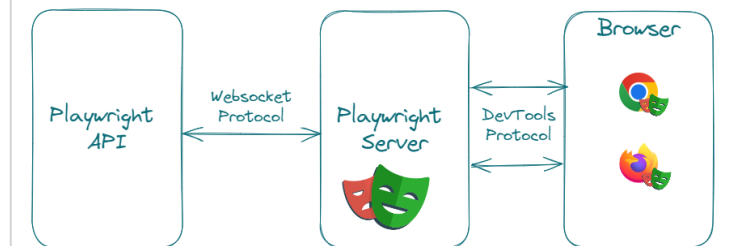
- Local Node.js process
- Running directly in local browser



Imagesource: <https://media.graphassets.com>

## Playwright (2020)

- ad Hoc Playwright server during runtime
- Communicating with Playwright distributed browsers by DevTools protocol

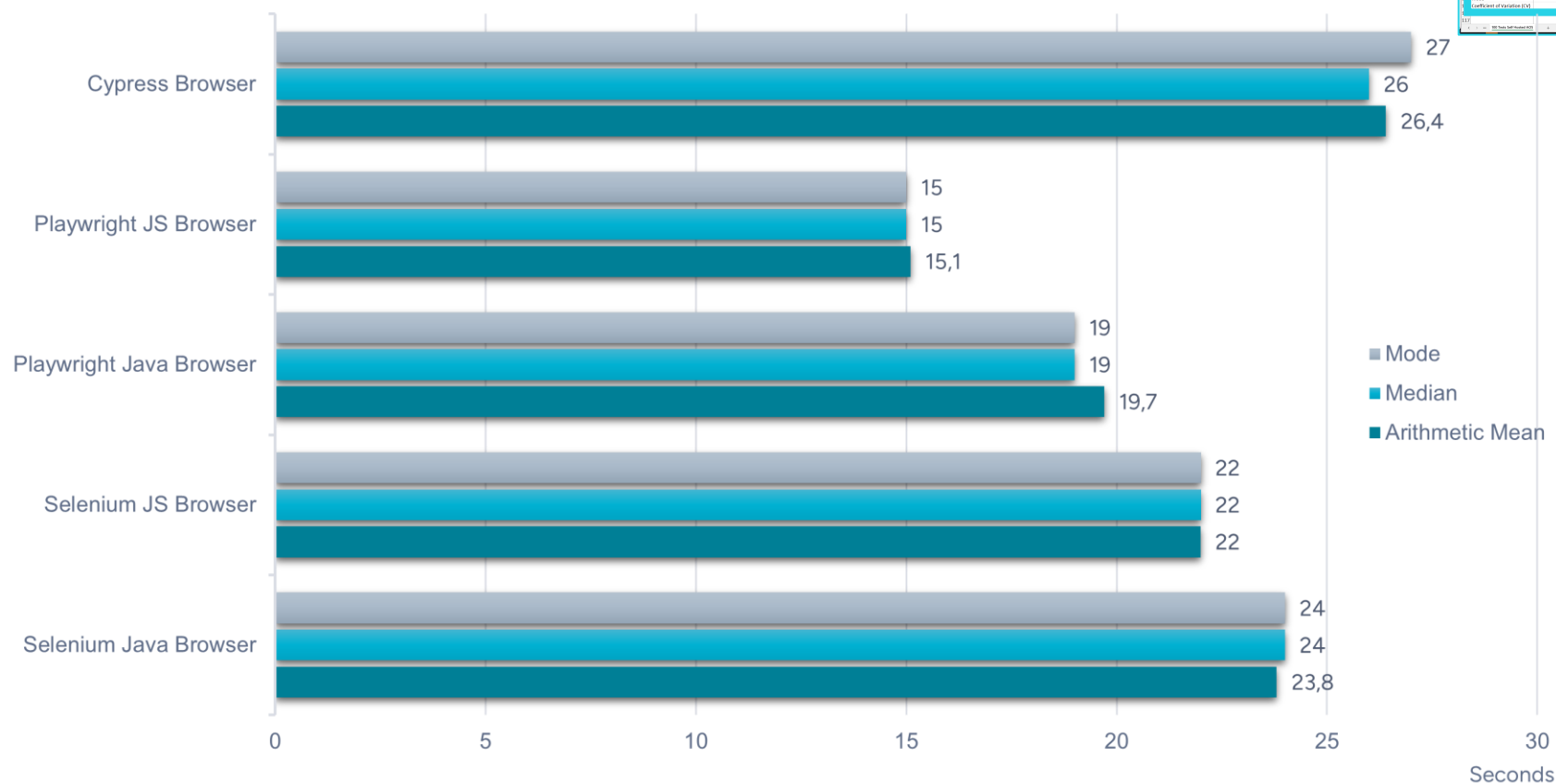


# Finally some data

1	2	3	6	7	10	11	14	15	18	19	26	27
	Selenium Java PoP Br	Selenium Java PoP Te	Selenium Java Browser	Selenium Java Test	Selenium JS Browser	Selenium JS Test	Playwright Java Browser	Playwright Java Test	Playwright JS Browser	Playwright JS Test	Cypress Browser	Cypress Test
75	23830	21545	24313	20371	22313	19400	19505	16264	14503	14364	25859	25856
76	25002	21931	24636	21176	22022	18572	19056	16866	14987	14902	26660	26657
77	23962	21643	24234	20551	22379	18872	18754	16570	15556	15418	27543	27535
78	23060	20957	25226	21264	22589	20122	20663	17718	14277	14208	27589	27586
79	24844	21868	24100	20677	21525	18910	19807	16761	16640	16491	25349	25346
80	24771	21680	22098	20082	22724	19628	19055	16012	15332	15189	28067	28064
81	25265	22014	23524	20079	23084	20212	19701	17651	15274	15116	24790	24787
82	24193	21158	23552	20495	21777	18091	18876	16300	14725	14593	24385	24382
83	24180	20668	23864	20736	21410	19168	18397	16185	15033	14863	26266	26263
84	25266	22325	24153	20976	21974	19360	19240	17215	15469	15410	26581	26578
85	24680	22155	23735	20554	20631	19190	17099	14789	15120	14985	24909	24906
86	25225	22076	23250	20174	21976	19446	20160	16714	15499	15353	27628	27625
87	25423	22031	23565	20713	21605	19093	19152	16744	14929	14785	26559	26556
88	23162	21182	23257	20733	22761	19830	20716	17498	14232	14163	28467	28464
89	24217	20875	22212	20112	20609	19236	20309	17117	14905	14770	25958	25955
90	24775	21757	23236	20844	20346	18879	19226	16553	14295	14141	26870	26863
91	23028	21146	22529	20428	20540	18841	19828	16755	14266	14100	27390	27386
92	24884	21948	22726	20225	20564	19264	19767	17074	15281	15106	26598	26595
93	24663	21595	22863	19692	21685	19002	18625	16342	15542	15391	27092	27089
94	24374	21986	25195	20716	22224	19405	19017	16825	15569	15509	25962	25959
95	24920	21802	22607	20516	21249	19621	19553	16797	15345	15201	27016	27013
96	24815	21783	21766	19575	20476	19112	18951	16893	14849	14703	24994	24991
97	25409	21685	22898	19381	21656	19815	19495	16863	14414	14247	27070	27067
98	23575	21641	23796	21210	22622	19910	20176	17073	15149	15006	25369	25366
99	25417	22233	24510	20889	19617	18462	20116	17123	15455	15255	25726	25723
100	23921	21782	24427	21204	21878	19689	18918	16861	15448	15294	27384	27381
101	24791	21822	24694	20938	22335	19295	20011	16882	15796	15651	27150	27147
102												
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108	Selenium Java PoP Br	Selenium Java PoP Te	Selenium Java Browser	Selenium Java Test	Selenium JS Browser	Selenium JS Test	Playwright Java Browser	Playwright Java Test	Playwright JS Browser	Playwright JS Test	Cypress Browser	Cypress Test
109												
110	Arithmetic Mean	24,5	21,6	23,8	20,6	22	19,5	19,7	16,6	15,1	15	26,4
111	Mean Deviation	0,7	0,5	0,9	0,6	0,6	0,5	1,2	0,5	0,5	0,4	0,9
112	Standard Deviation	0,8	0,6	1,4	1	0,8	0,6	4,6	0,6	0,7	0,6	1,1
113	Median	25	22	24	21	22	19	19	17	15	15	26
114	Mode	25	22	24	21	22	20	19	17	15	15	27
115	Coefficient of Variation (CV)	0,03	0,03	0,06	0,05	0,04	0,03	0,23	0,04	0,05	0,04	0,04
116												
117												

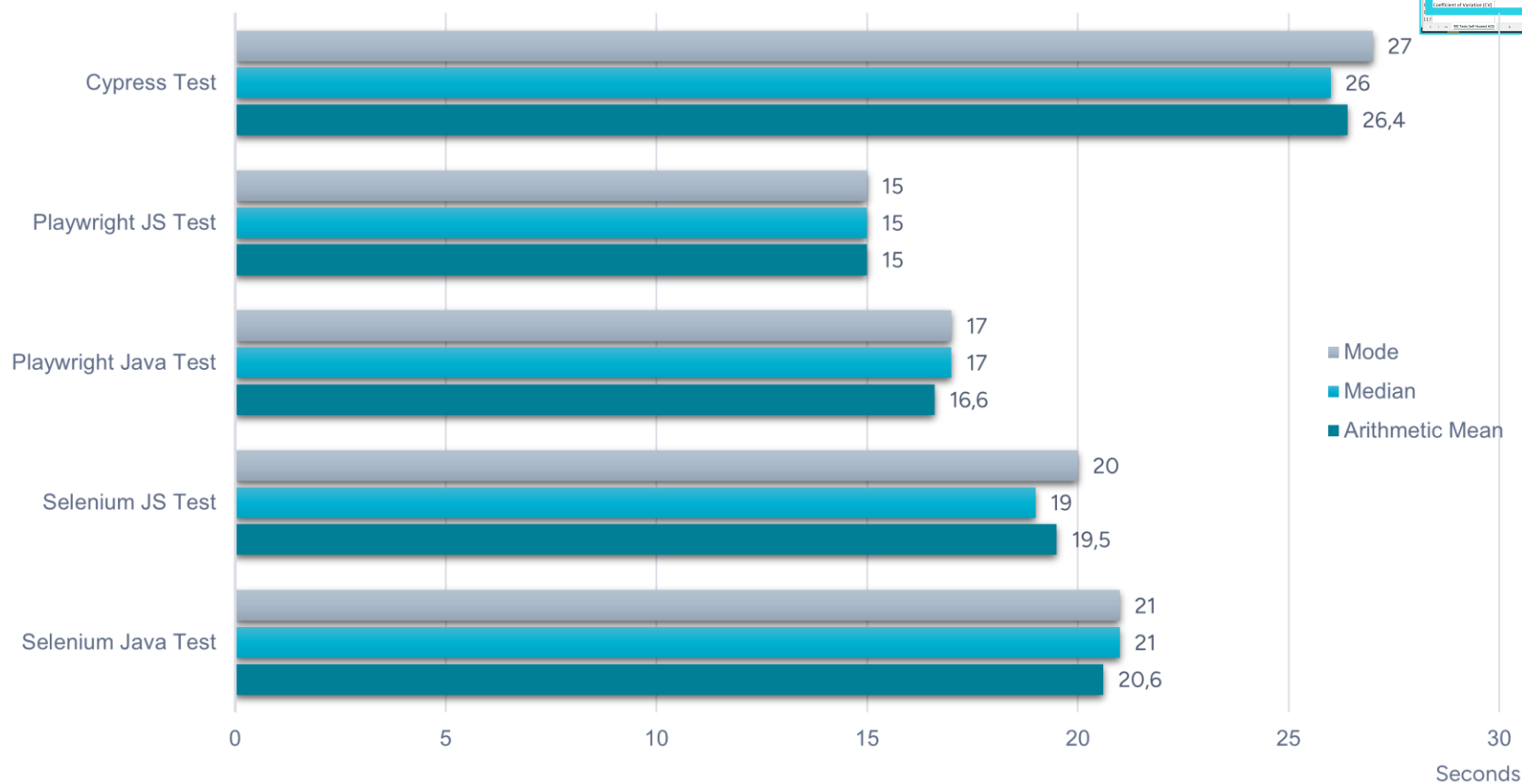
# Finally some data

## Run times including browser start



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43	20000	21500	20000	21500	20000	21500	20000	21500																			

## Run times without browser start

[illegible]

# First findings

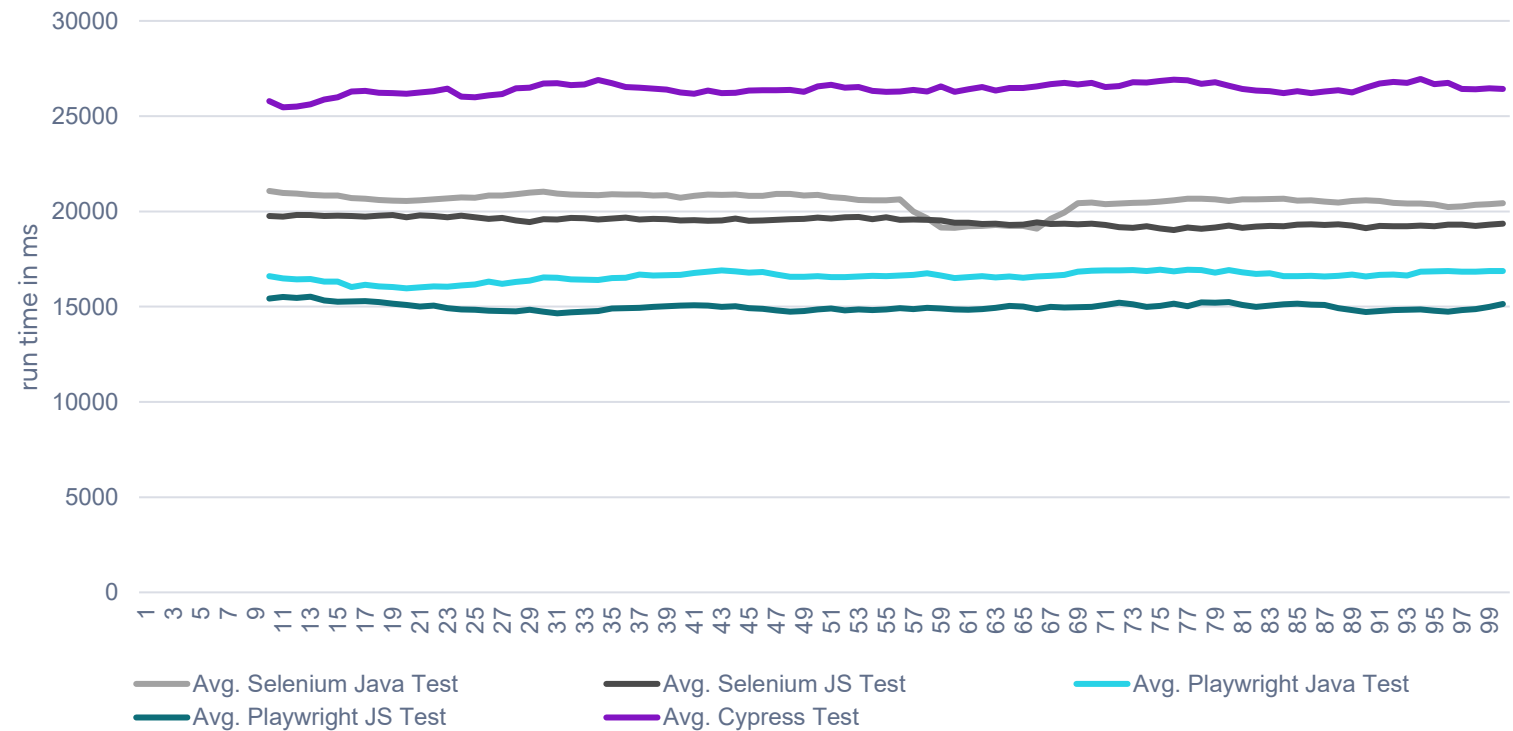
- Mean mode and median are quite similar
  - Our tests did run in predictable times each times
- Starting and connecting to a browser takes about 3 seconds
  - Restarting Browsers can increase the total run time quite significantly



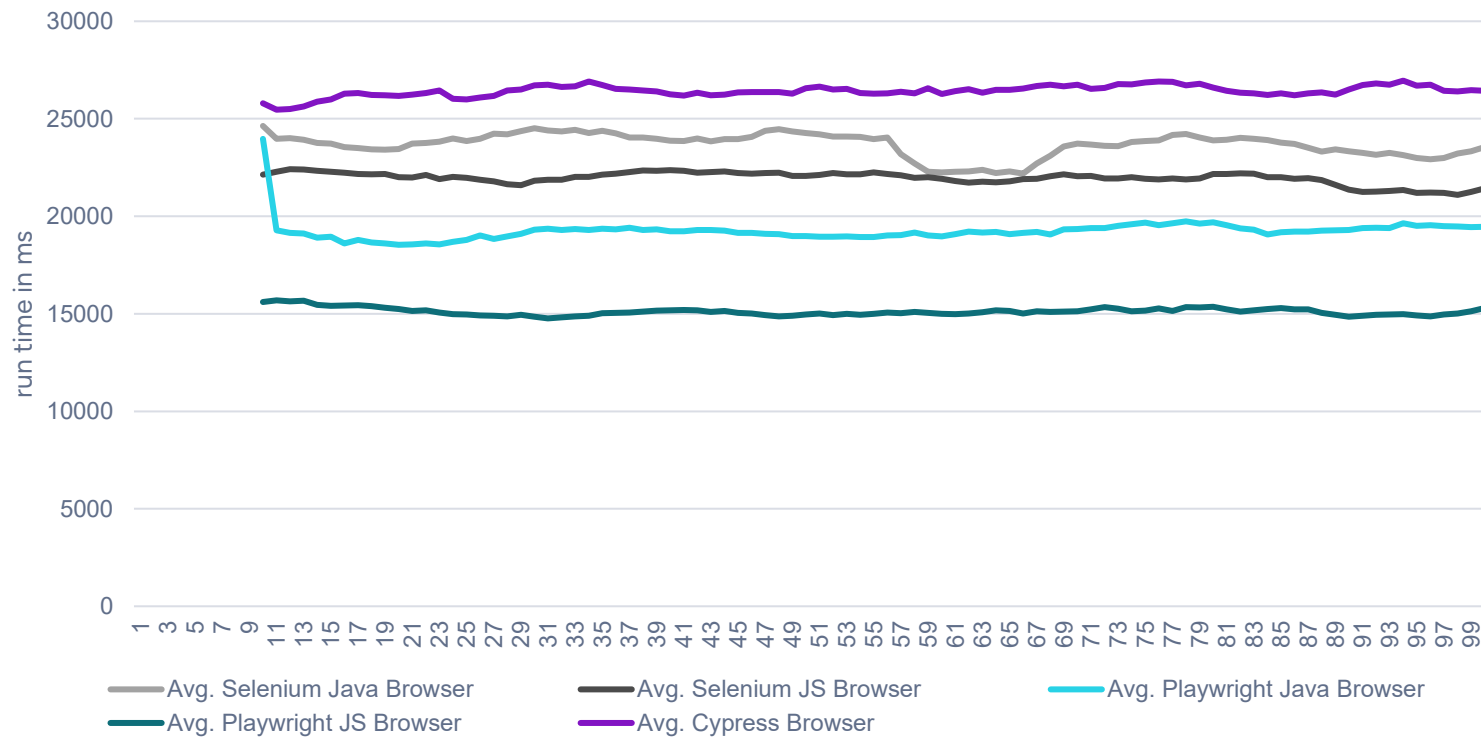
Try to facilitate the tools solutions to use and create clean browser sessions.

# Some more data

- Floating average (over 10 tests) also show a stable data set
- Cypress in running continuously around 10 sec slower than Playwright



# Some more data

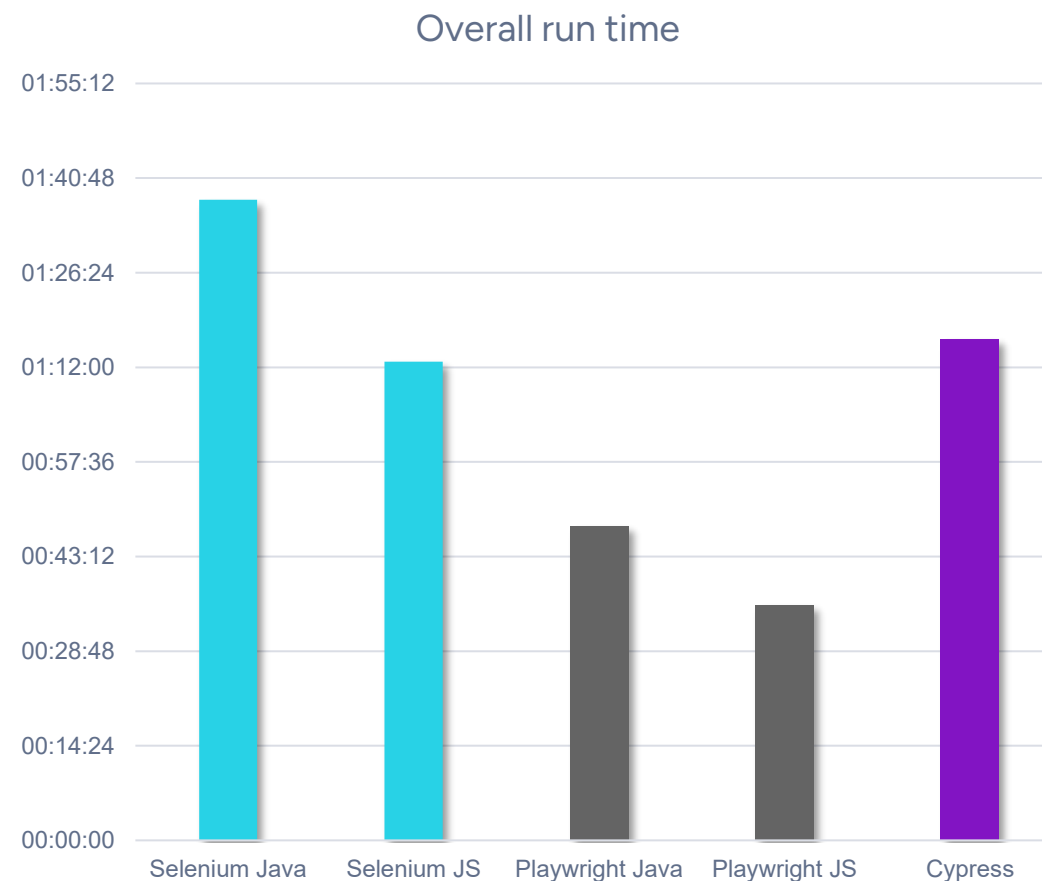


- Playwright needs some time to start a browser the first time when running in Java
  - even when they are different builds



# Findings based on the data alone

- For tools with several APIs the Node.js API is always significantly faster in the long run
- Cypress performs for tests against 3rd party websites the slowest
- Build systems can have significant impact on overall runtime



# Functional Overview

## Browsers and Browser-Tabs

### Selenium (2004)

- Uses the locally installed browser
  - possibility to use remote browser for CI Environments
- Automating the browser via browser API
- Connection to browser via synchronous HTTP(S)

### Cypress (2017)

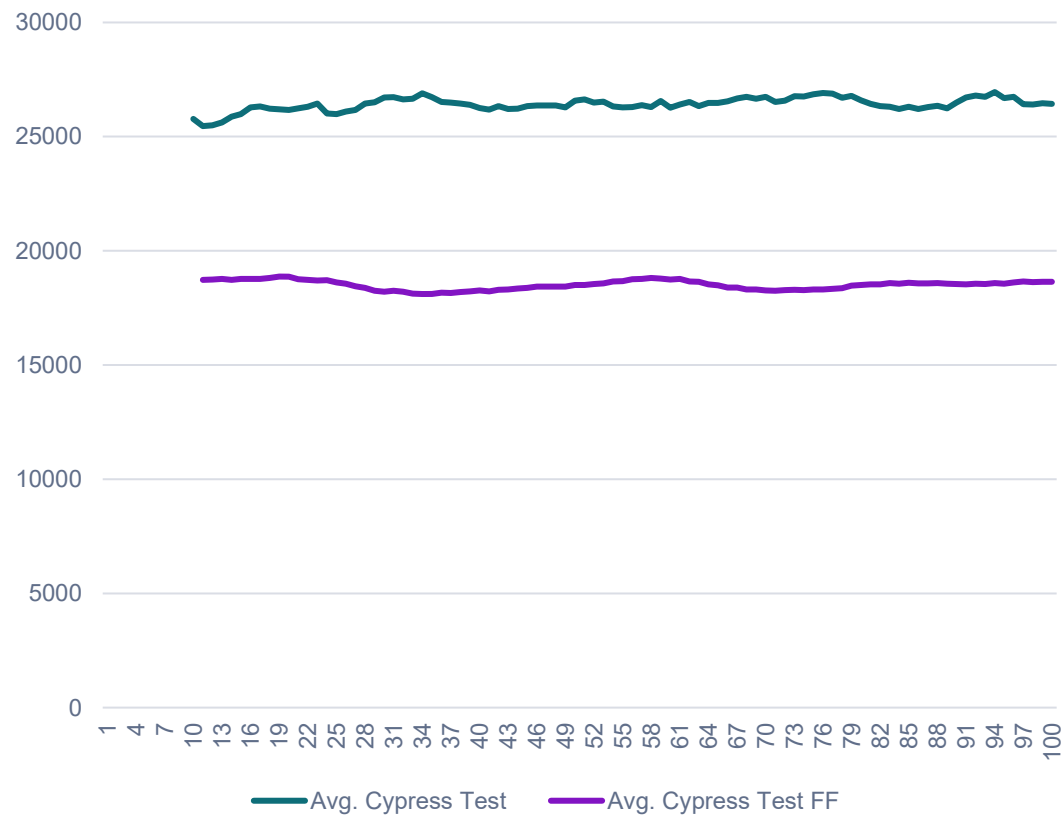
- Runs inside locally installed browser
  - If no browser is available a packaged Electron browser can be used – useful during CI
  - Can handle browser-events and components natively
- Only one browser and tab at a time per process

### Playwright (2020)

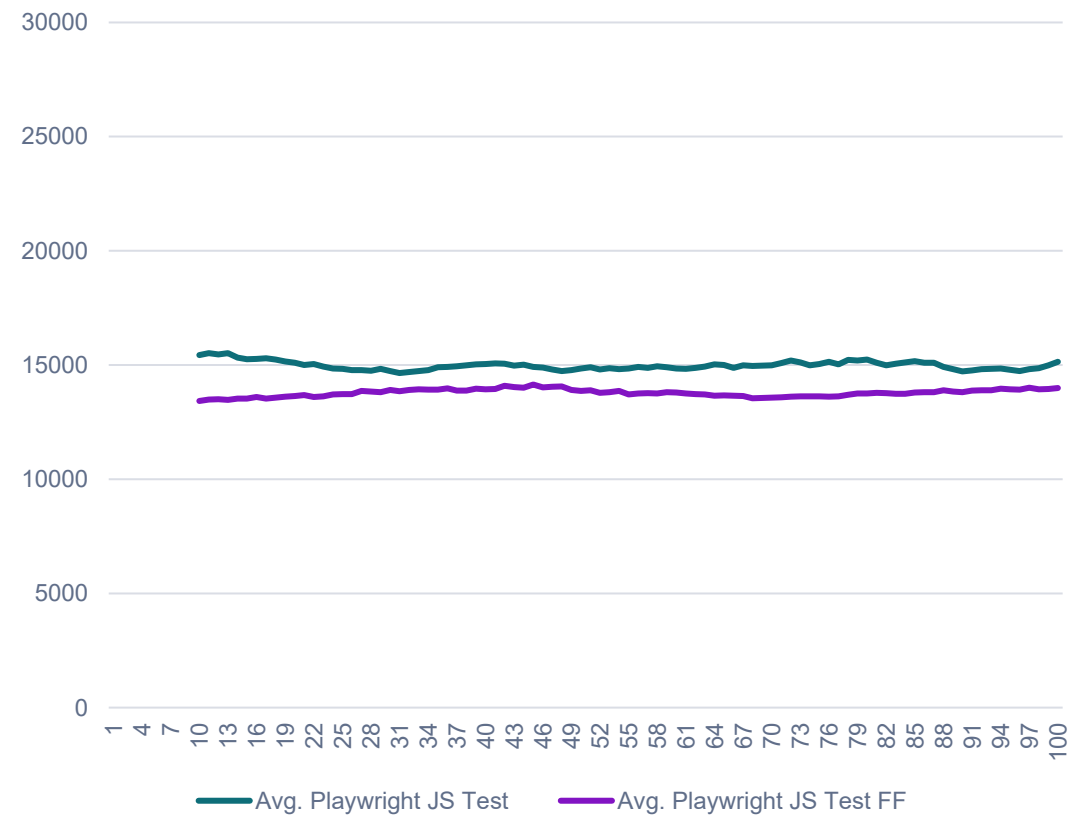
- Uses Playwright-packaged browser-variants
  - Can be installed by cli
- Handles browser-events by the DeveloperTools interface
- Connection to browser via WebSocket-connection

# Chromium vs. Mozilla

Cypress



Playwright



# Functional Overview

## Screenshots and Reporting

### Selenium (2004)

- Screenshots of the current viewport via browser API
- No native functionality to capture videos
- No native reporting framework

### Cypress (2017)

- Screenshots of the current viewport via Cypress API to file
  - Can be extended to screenshot the whole page
- Video capturing can be enabled by config-file
  - .mp4 Format
- Facilitates reporting of mocha-framework

### Playwright (2020)

- Screenshots of current viewport or element via API to buffer
- Video capturing is enabled during test start
  - .webm Format
- Own reporting framework to create several outputs (node.js)

# Functional Overview

## Some USPs

### Selenium (2004)

- Great community
- Does one thing and sticks to it
  - Selenium only handles browser-interactions
  - Everything else has to be done by other libraries and solutions














































### Cypress (2017)

- Development of test scripts directly in browser
- Simulation of webcam-inputs by providing a placeholder video
- Great pool of community developed plugins

### Playwright (2020)

- UI Mode: create and view tests in browser DevTools mode
- Test Generator: Capture&Replay solution to create new tests fast
- Capabilities to test and virtualize APIs directly

# Our experience in one table

	Selenium	Cypress	Playwright Java	Playwright Node.js
Execution speed				 
Ease of element-interaction				
Availability of different locator-strategies				
Ease of reporting				 
Integration and execution in CI environments				
Parallel testing				 
Cross browser functionality				
Remote execution	 			
Quality of official documentation				
Quality of community support	 			

# What can you take with you?



Imagesource: Microsoft Pictures



ALL SOLUTIONS HAVE  
THEIR ADVANTAGES  
AND DISADVANTAGES



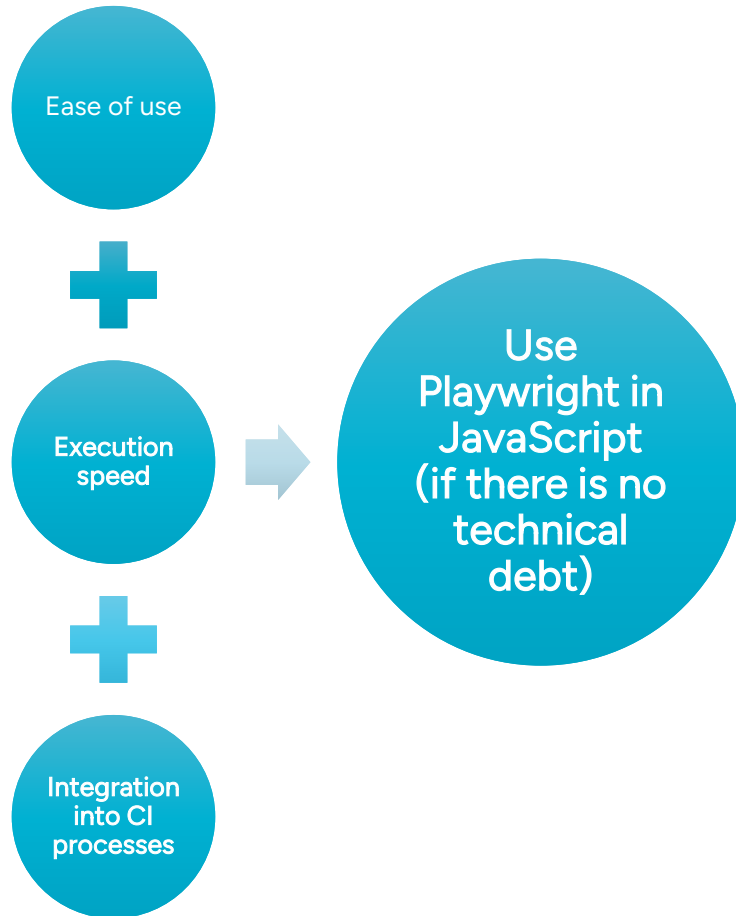
NEVER TOUCH A  
RUNNING SYSTEM ...



... BUT SOMETIMES  
MOVING HOUSES CAN  
HELP TO CLEAN UP  
YOUR STUFF



# If you want a final answer...



# Thank you for your attention

All the code and data is open  
source



<https://github.com/proficomde/ta-tool-vergleich>

# Thank you for your attention



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# Thank you for your attention

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# Appendix

# Reasons for decision matrix

-	<u>Selenium</u>	<u>Cypress</u>	<u>Playwright Java</u>	<u>Playwright Node.js</u>
Ease of element-interaction	Basic interactions are available Complex interactions often only feasible throw workarounds described by community	Almost all interactions can be defined descriptive	Almost all interactions can be defined descriptive	Almost all interactions can be defined descriptive
Availability of different locator-strategies	Possible element identification via: class-name css selector id name link text partial link text tag name xpath	Possible element identification via: DOM-query (css selector)	Possible element identification via: role label placeholder text alt text title test id css selector xpath	Possible element identification via: role label placeholder text alt text title test id css selector xpath
Ease of reporting	Possible by using other libraries inside the chosen unit testing framework	Reporting by unit testing framework. Other reports must be integrated by plugins	Possible by using other libraries inside the chosen unit testing framework	Integration von Reporting out-of-the-box

# Reasons for decision matrix

-	<u>Selenium</u>	<u>Cypress</u>	<u>Playwright</u> Java	<u>Playwright</u> Node.js
Integration and execution in CI environments	Depends on installed browsers on the execution system (ore remote browser). No possibility to install browsers during run time	Is packed with Electron browser as default. Other browsers need to be installed on system.	Browsers can be installed via cli. All browsers can run headless within any environment.	Browsers can be installed via cli. All browsers can run headless within any environment.
Parallel testing	Must be handled by unit testing framework	Not possible by design	Must be handled by unit testing framework	Handled by packaged runner and configured by config-file
Cross browser functionality	<p>Integration in installed browsers on the system</p> <p>Chrome Firefox Internet Explorer Edge (Chromium) Safari</p> <p>Remote browser can enhance this list by several version combinations</p>	<p>Integration in installed browsers on the system</p> <p>Chrome Firefox Safari Edge (Chromium)</p> <p>Needs an installed browser or falls back on Electron. Remote Execution only possible in SaaS-Cloud</p>	<p>Usage of packaged browsers by Playwright</p> <p>Chrome Firefox Safari Edge (Chromium)</p> <p>Browser version depends on Playwright version and installer</p>	<p>Usage of packaged browsers by Playwright</p> <p>Chrome Firefox Safari Edge (Chromium)</p> <p>Browser version depends on Playwright version and installer</p>



# Reasons for decision matrix

-	<u>Selenium</u>	<u>Cypress</u>	<u>Playwright</u> Java	<u>Playwright</u> Node.js
Enterprise browser functionalities (e.g enterprise-proxies)	Uses the system browser and it's configuration.  Remote execution in Selenium Grid can provide further variants of setups	Uses the system browser and it's configuration.  CI-Setup relies on the browser configuration on the build-node.	Configuration of packaged browsers must be done by test script.	Configuration of packaged browsers must be done by test script.
Remote execution	Integration in self-hosted Selenium Grid possible.  SaaS-offers by several companies.	Integration in SaaS-platform possible. (Cypress Cloud)	Integration in Selenium Grid possible (functionality is not guaranteed, because of dependence on 3rd party solution)	Integration in Selenium Grid possible (functionality is not guaranteed, because of dependence on 3rd party solution)
Quality of official documentation	Dated or incomplete API documentation in some cases.  Interface descriptions not complete.	Detailed API-description with examples and interface descriptions.	Detailed API-description with examples and interface descriptions.	Detailed API-description with examples and interface descriptions.
Quality of community support	Massive community support with solutions and help to nearly every problem.	Big community support. Many problems can be solved by consulting the official documentation	Community support is growing. Not as big as the competitors due to shorter time in the market.	Community support is growing. Not as big as the competitors due to shorter time in the market.