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Evaluating the performance of continuous test-based cloud service certification

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Overview

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  - Popular example: Location of cloud service components (e.g. migrating VMs between different AWS regions)

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- Put differently: How close are produced test results to their true values?

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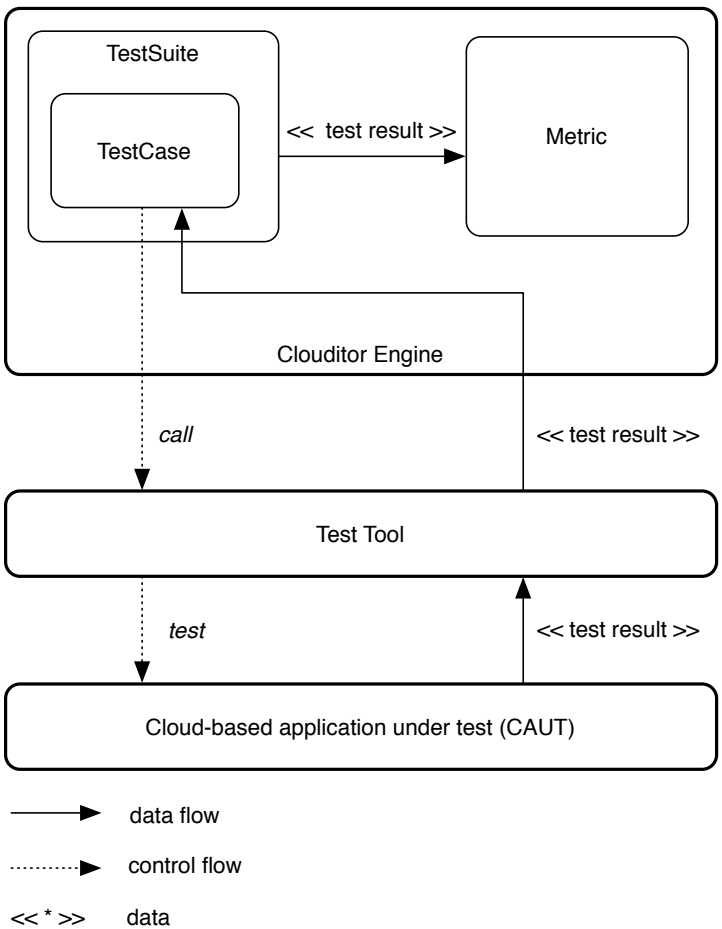
  3. provide a process to analyze performance of continuous test-based certification techniques

Framework

Building blocks to continuously produce test-based evidence



- Test cases: primitive
- Test suites: combine test cases, singular test
- Workflow: which test suite is run next?
- **Test metrics: produce evidence based on test (suite) results**

Universal continuous test metrics

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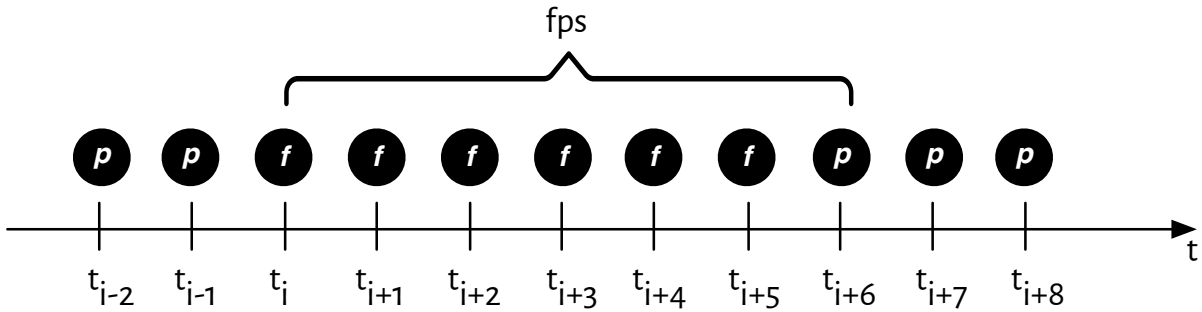

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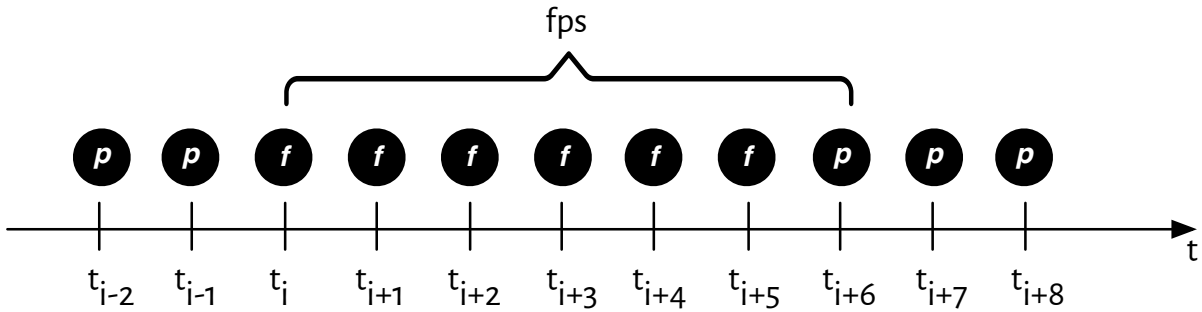

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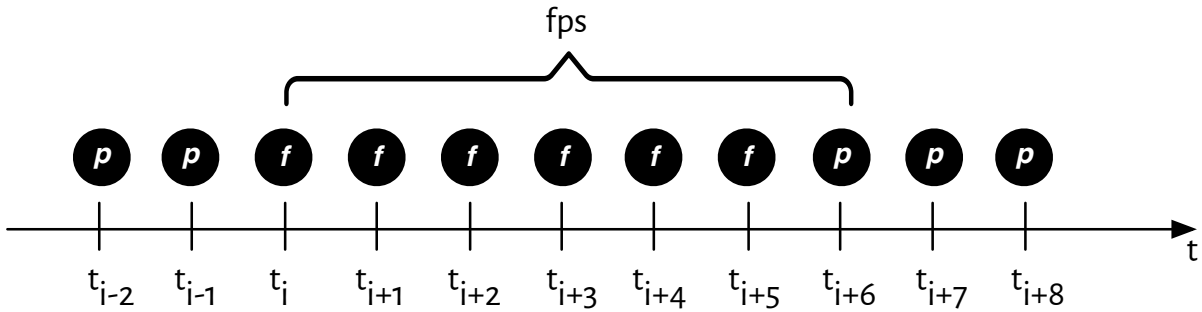

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  - ends with next occurrence of a passed test

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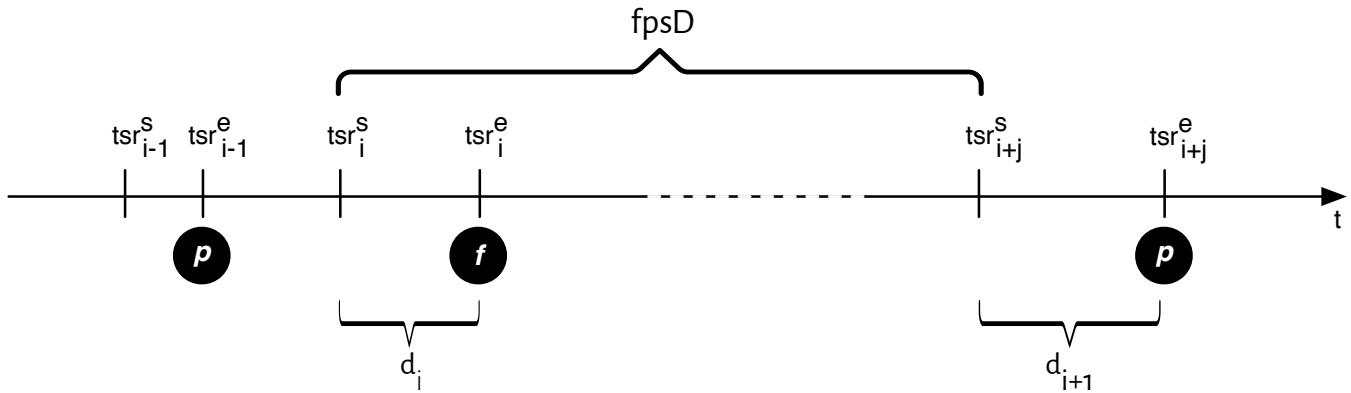

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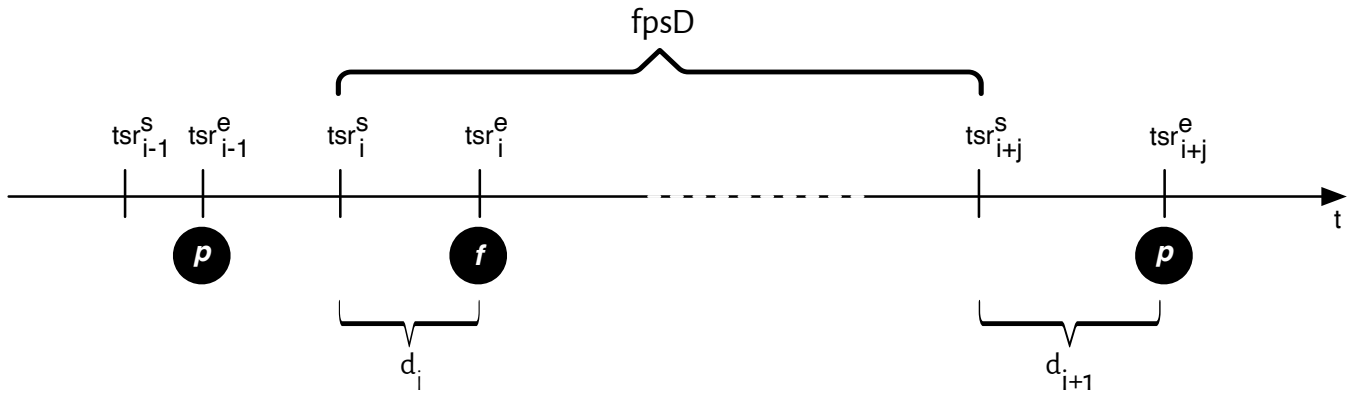

  - this definition of *fpsD* is agnostic to test durations

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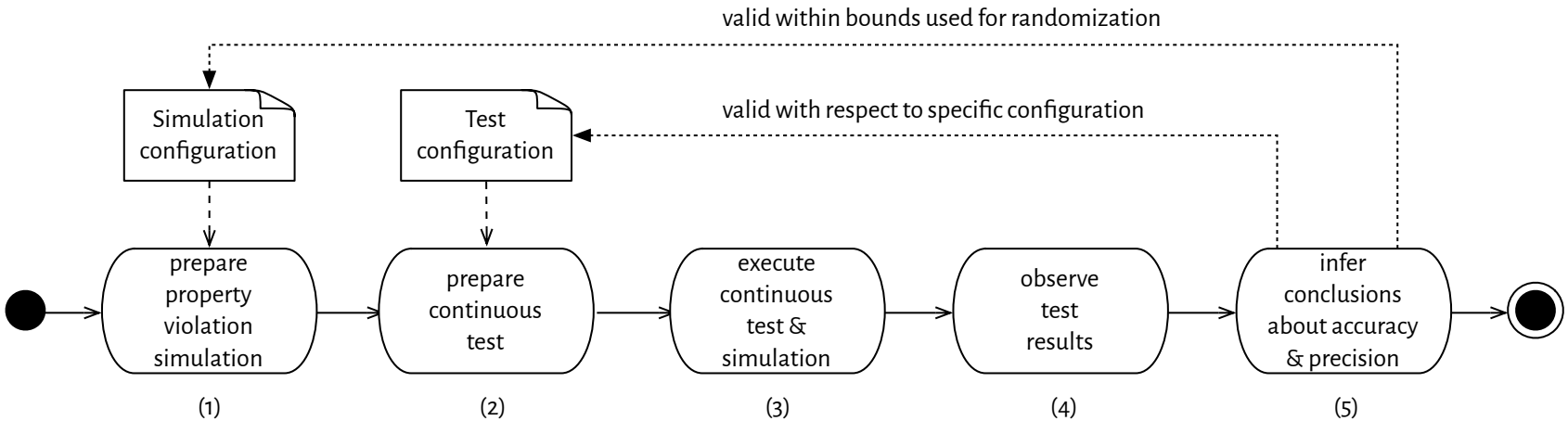
  - permits us to reason about the satisfaction of cloud service properties within a predefined period of time, e.g. measure yearly downtime

Evaluating test-based certification techniques

Overview process



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- define bounds $[pveD^L, pveD^R]$ and $[pveW^L, pveW^R]$ randomize duration and waiting time of each $pve \in V$

Performance measures

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  - compute precision using confidence intervals for sample mean, allowing for conclusion such as *We are 95% confident that the mean error a true negative fps makes when estimating a property violation event is 2sec%±0.2.*

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Application

Setup & Environment

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  - $IaaS^{OS}$: IaaS instance provided by OpenStack Mitaka
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- Evaluation engine
  - hosted locally (run after experiment)
  - statistics calculated using *Apache Commons Math*

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  - *SSHTest*: Connects to $IaaS^{OS}$ via SSH and then test the session using a SSH_MSG_CHANNEL_REQUEST, a test passes if no I/O exception is thrown

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Simulation statistic (sec)	$\mathbf{V}^{\mathbf{PingTest}}$	$\mathbf{V}^{\mathbf{TCPTest}}$	$\mathbf{V}^{\mathbf{SSHTest}}$
$cpveD$	75102.11	75544.07	75706.71
$\bar{x}_{pveD}$	75.11	75.54	75.71
sd_{pveD}	8.97	8.70	8.82
min_{pveD}	60.17	60.38	60.39
max_{pveD}	90.33	90.6	92.58

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Testing resource availability

- Test statistics

Test statistic		PingTest	TCPTest	SSHTest
	$tsrC$	3153	3546	2491
tsr (sec)	$\bar{x}_{tsr}$	12.04	4.38	30.91
	sd_{tsr}	4.51	0.47	44.90
	min_{tsr}	9.01	4.02	0.54
	max_{tsr}	20.03	5.22	127.34
fpsD (sec)	$\bar{x}_{TN}$	81.22	75.13	176.74
	$sd_{fpsD\,TN}$	13.54	23.51	61.04
	$median_{fpsD\,TN}$	79.1	65.2	187.24
	$min_{fpsD\,TN}$	15.83	64.1	123.09
	$max_{fpsD\,TN}$	69.02	130.287	561.76
cfpsD (sec)	TN	78378.36	73481.13	82362.03
	FN	296.37	1099.5	1872.9
	FP	2103.27	818.69	38319.32

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Testing resource availability

- Evaluation of PingTest, TCPTest and SSHTest to test availability of $IaaS^{OS}$ based on the failed-passed-sequence Duration ($fpsD$) test metric

Accuracy & Precision measure		PingTest	TCPTest	SSHTest
$efpsD^{TN}$ (ms)	$\bar{x}$	5749	-569	98050
	$\widehat{x}$	3643	-6386.5	100754
	sd	14143	21996	61586
	min	-11586	-25467	32372
	max	75692	61613	498360
	$E^{95\%}$	895	1378	5606
$efpsD^{TN}_{rel}$ (%)	$\bar{x}$	13.22	19.77	126.27
	$\widehat{x}$	9.22	14.94	116.49
	sd	14.74	18.41	83.69
	min	0.26	0.32	35.66
	max	119.39	91.26	786.01
	$E^{95\%}$	0.93	1.16	7.62

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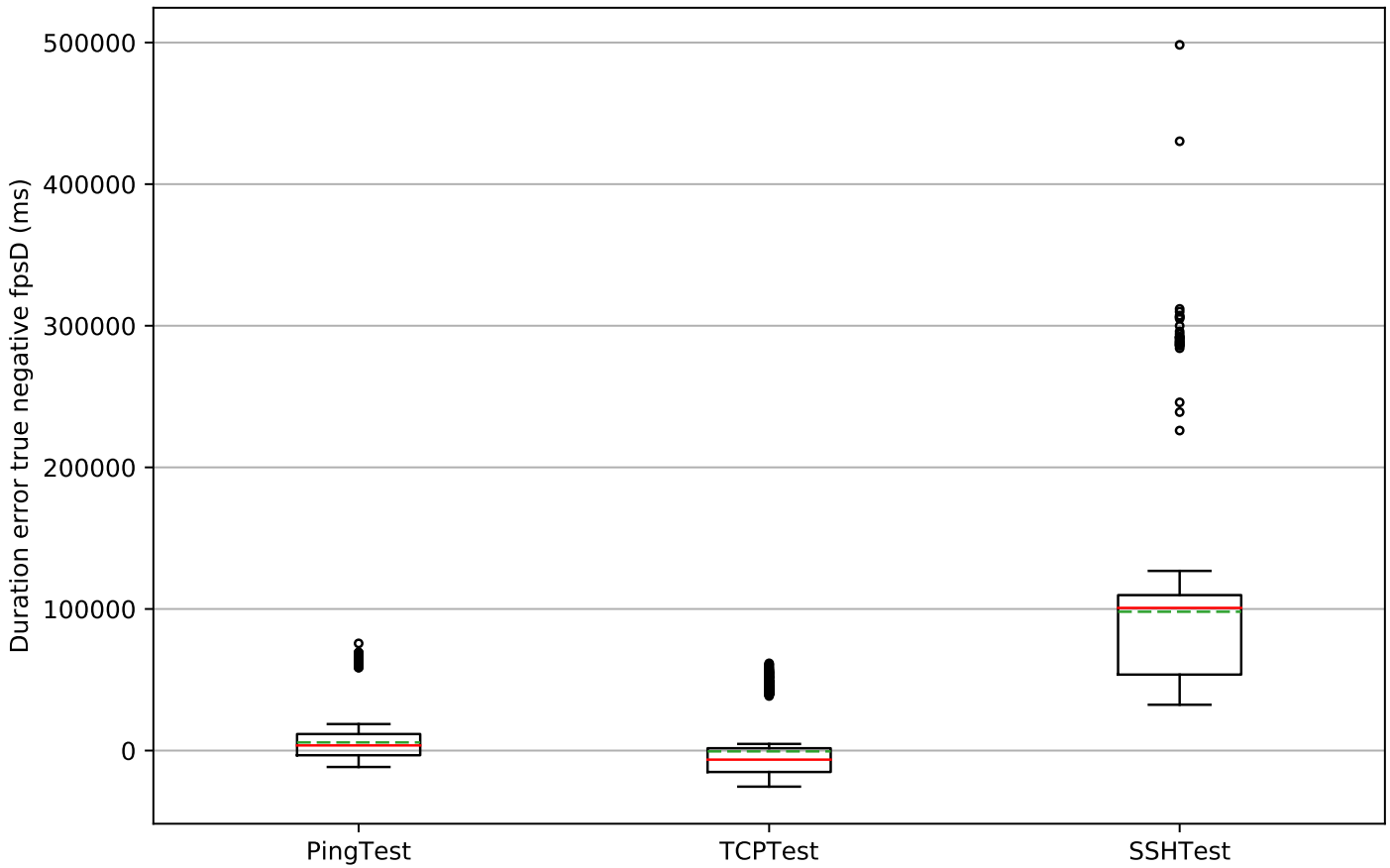
- Duration error of true negative fps ($efpsD^{TN}$) of PingTest, TCPTest, and SSHTest



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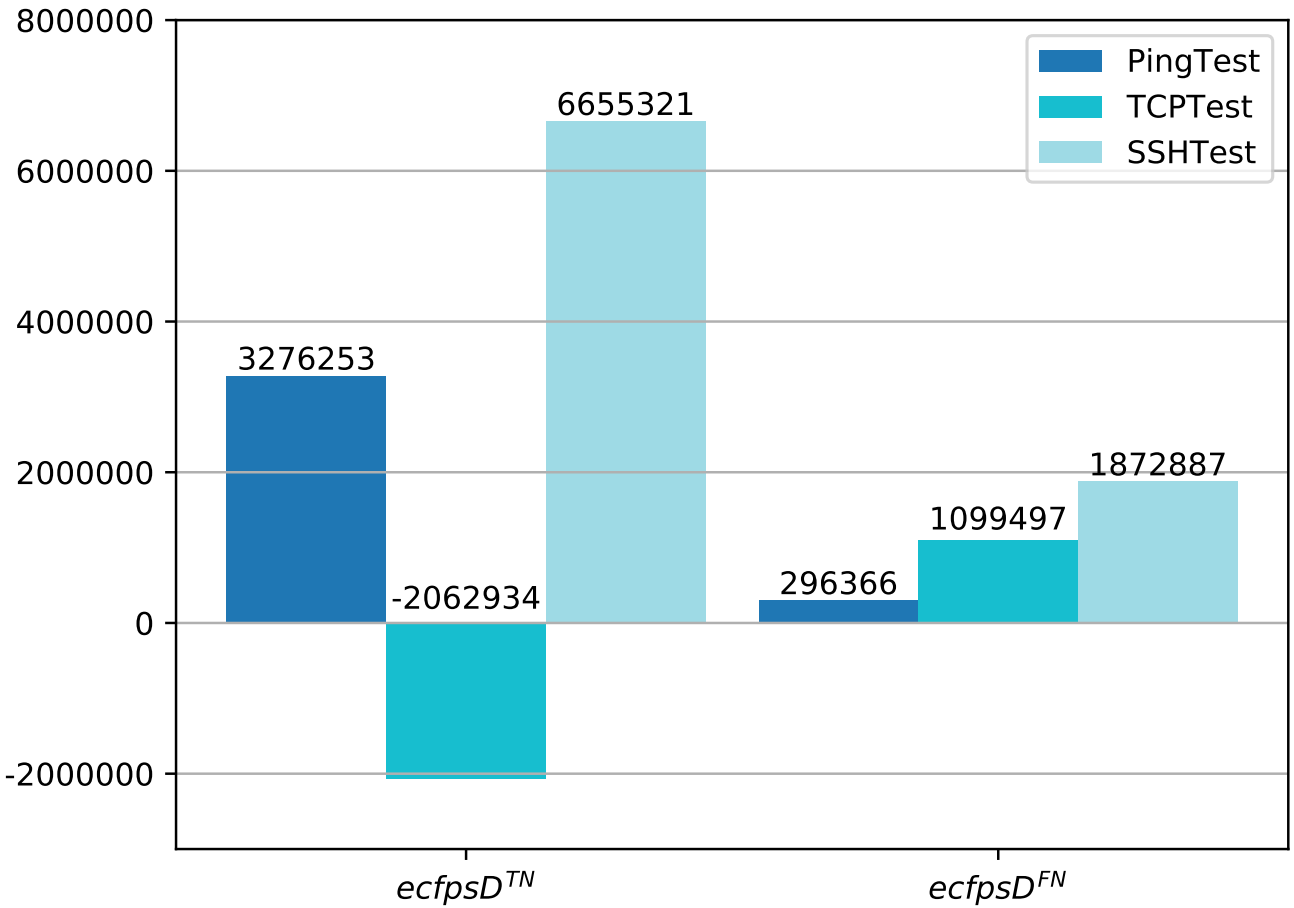

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  - a scenario driven approach which allow to select the assurance and precision measure most suited for that particular scenario
  - simulating property violation events approximating those observed in the wild
  - consider other characteristics determining which test-based technique is most suitable for a given scenario, e.g., overhead incurred

Questions?