



# SELENIUM GRID — BUILD VS. BUY

Automated testing is essential to software development teams that are moving to continuous integration and continuous delivery in order for them to maximize the investment and efficiency of their CI/CD stack.

When you decide to use Selenium (the de-facto standard for automated testing) as your testing framework, the next question becomes whether to develop your own testing grid or outsource it. This paper compares the hard and soft costs of setting up a Selenium grid on-premises to subscribing to a cloud testing service.

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## EXECUTIVE SUMMARY

Traditionally, software testing has been performed using proprietary, on-premises technology. Physical servers running multiple virtual machines (VMs) functioned as a hub from which devices, or nodes, were controlled. Now, the number of device types to be tested has skyrocketed, as have browser versions, and application types. Additionally, the DevOps approach to building better software faster has pushed QA teams to find new ways to automate testing and drive greater efficiency.

When thinking about their testing grid, small and medium-sized businesses (SMBs) and enterprises alike are faced with a choice — continue to build and maintain on-premises testing, or subscribe to a cloud-based testing service. When we talk about on-premises or in-house testing infrastructure, we mean infrastructure that is set up, maintained, and scaled by your internal IT Ops team. It could be an in-house data center, or servers in the public cloud. Conversely, a cloud-based testing service is a vendor-tailored platform that enables functional testing of web and mobile apps without the need to purchase or maintain physical infrastructure.

Choosing between an on-premises or cloud testing service is critical and affects how apps are built and shipped, it will also affect the company's bottom line. This report assesses the infrastructure and maintenance costs of both options in detail.

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## ESTIMATING THE HARD COSTS

When deciding between an on-premises or cloud based solution QA leaders in SMBs and enterprises must first factor in hard costs, and extrapolate those numbers to a Total Cost of Ownership (TCO) over the long run. They may identify key factors that define costs, and compare expenses for each option in a table. Let's look at one such table that compares the estimated annual hard costs of building and maintaining your own testing infrastructure versus subscribing to a cloud-based testing solution:

	SMB (10 member QA team)		ENTERPRISE (50+ member QA team)	
	On-premises (Build)	Cloud testing service (Buy)	On-premises (Build)	Cloud testing service (Buy)
Ops team <sup>1</sup>	\$150k	\$75k	\$2.25M	\$375k
Test VMs <sup>2</sup>	\$13k (5 VMs)	\$12k (5 VMs)	\$250k (100 VMs)	\$216k (100 VMs)
Data center <sup>3</sup>	NA	-	\$75k	-
Desktop & mobile devices <sup>4</sup>	\$11k	-	\$30k	-
Desktop & mobile devices <sup>5</sup>	\$5k	-	\$15k	-
<b>Total annual cost</b>	\$179k	\$87k	\$2.62M	\$591k
<b>Savings with Cloud</b>	\$92,000 per year		\$2 million per year	

<sup>1</sup> Annual salary of 1 Ops team resource - \$75,000/yr (InfoWorld, ComputerWorld, Robert Half)

<sup>2</sup> On-premises - \$2,500/VM/year (TechTarget, Gabriel Chapman). Cloud testing - \$2,160 - \$2,400/VM/year or lower, depending on volume

<sup>3</sup> Annual data center networking & CAPEX costs - \$75,000/yr for 5 to 10 racks (Ongoing Operations, James Hamilton)

<sup>4</sup> Avg. cost per device (Desktop & mobile) - \$750. Cloud testing solutions may include mobile emulators and real devices in the cloud as part of the annual package cost

<sup>5</sup> Annual software licensing cost (Operating systems, management and monitoring tools, etc) - \$5,000/yr for SMB, \$15,000/yr for enterprise

Let's explore each of these costs in detail.

### Ops team

It takes IT resources to optimize and automate the infrastructure, including the servers, software, Selenium grid, and device lab, as well as other tasks such as maintaining CI, app, DB servers, and so on. Some research shows that IT salaries in Silicon Valley can go over \$100,000 on average, but to be on the conservative side, consider \$75,000 as the average annual salary. From our perspective, and numerous IT forum discussions online, we estimate an SMB would need two IT personnel, while an enterprise would need as many as 30 distributed across its offices globally. A cloud testing solution will not mean that you won't need any Ops support, but it will reduce the size of an Ops team and eliminate the need to maintain an automated testing setup.

### Test VMs

We've considered these to be similar to VMware virtual machines, each costing \$2,500 to own and operate per year. Though there are cheaper and more expensive options available, this cost represents an average, mid-sized VM. Cloud-based VMs that testing vendors provide can be less significantly less expensive per VM than on-premises, particularly at higher volumes.

Beyond costs, starting small with just 5 VMs may be an easy option for SMBs, but building in automatic scalability is the challenge. Enterprises would require hundreds of VMs, and fast-growing SMBs may need to quickly provision new VMs to deal with sudden spikes in workload. In these cases, on-premises infrastructure pales in comparison to that in the cloud. Spinning up a new VM



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in the cloud takes just a few seconds, which makes provisioning effortless. (We discuss this in more detail later in this paper.)

### **Data center**

SMBs may house their servers within their office premises, and may not need a data center, but enterprises, with numerous servers, would require a data center. This would incur networking and CapEx costs. On the lower end, these costs can add up to \$75,000 per year, going up in to the millions as scaling moves up. Enterprises that choose a cloud testing service do not require a separate data center, and they can save big on these costs while getting the power of a data center in the cloud.

### **Desktop and mobile devices**

To comprehensively test an app, you need the most popular combinations of operating systems, and browsers that are in use. While Windows and Linux can be loaded on generic desktop hardware that could cost under \$500, iOS requires proprietary hardware that costs over \$1,000 per device. Mobile devices are even more complex, as they require a device lab with a good variety of the most popular devices to be tested. Each of these devices could cost around \$500, and you'd need one of every type of device and OS version. To make things worse, your QA team may not be co-located, in which case, you'll need more than one device lab.

Cloud platforms, on the other hand, enable you to test the full range of browser and device combinations without having to configure each of them manually. For testing on mobile devices, you can leverage cloud-based emulators and simulators that help automate mobile testing across all versions of an operating system. For certain tests that require mobile-specific features like network bandwidth and geolocation, you can test on real devices in the cloud. Testing in the cloud gives you the best of both worlds — emulators to automate a majority of mobile tests, and real devices in the cloud for those tests that require device hardware.

### **Software licenses**

Software licenses include operating systems for the servers, data center infrastructure management (DCIM) tools for performance monitoring, error analysis, issue tracking, and a host of other needs that come with an in-house testing infrastructure. With cloud solutions, you get the benefits of all these software licenses built into the product without having to pay for each license separately. In fact, you even get additional features like test session videos and metadata logging that are difficult to build into an in-house system.

In summary, on the conservative side of the math, using a cloud-based testing service instead of an in-house testing stack can save the average SMB an estimated \$92,000 annually, and an enterprise \$2 million annually. While that in and of itself is a compelling argument for moving to a cloud-based testing solution, there are also soft benefits to consider.

## REVEALING THE HIDDEN SOFT BENEFITS

Though it's easy to think of hard costs as the main criteria when deciding between on-prem or cloud, that is not the complete picture. Considering only hard costs could cause you to discount the more important aspects of testing (that we are loosely grouping under the term soft benefits), which often turn out to be the most significant advantages of cloud testing tools.

Rating legend: Poor ●●●●● Excellent ●●●●●

	ON-PREMISES (Build)		CLOUD TESTING SERVICE (Buy)
	SMB (10 member QA team)	Enterprise (50+ member QA team)	Enterprise & SMB
Scalability	●●●●●	●●●●●	●●●●●
Reliability	●●●●●	●●●●●	●●●●●
Hardware maintenance	●●●●●	●●●●●	●●●●●
Software maintenance	●●●●●	●●●●●	●●●●●
Continuity during attrition	●●●●●	●●●●●	●●●●●
Value-add features	●●●●●	●●●●●	●●●●●
Team productivity	●●●●●	●●●●●	●●●●●

Looking beyond the costs, it's clear there are significant benefits that a cloud stack has over an in-house stack. Let's discuss each of these factors in detail.

### Scalability

SMBs gear towards rapid and sometimes unpredictable growth patterns. This means their hardware should be able to dynamically scale with demand. Using a cloud testing service ensures SMBs have easy scalability, as opposed to on-site hardware servers.

Though enterprises have more predictable growth, when it's time to expand, over-provisioning is often the norm. With cloud, enterprises pay only for the VMs they use. The cloud enables both SMBs and enterprises to scale effortlessly, unlike with on-premises.

## Reliability

SMBs that rely on an on-premises infrastructure may experience downtime because of network clogging between teams, and slow root cause analysis. Enterprises have more to lose when there's downtime, and have learned how to minimize downtime, but on-premises systems inevitably still run into some degree of lag and downtime. Cloud servers, on the other hand, deliver high availability and enterprise-grade SLAs availability, so teams can work uninterrupted with the system performing at peak levels at all times.

## Hardware maintenance

Hardware maintenance on-site is a major obstacle to organizations that consider the on-premises route for their testing stack. This involves configuring an adequate number of servers and VMs, maintaining desktop systems, adding new mobile devices to the device lab as they become popular, and keeping existing devices updated. SMBs may have it easy at the start, but once the team grows and testing needs become more complex, hardware becomes harder to maintain and scale. A cloud testing vendor helps avoid the hassle of configuring and maintaining hardware because their servers and device emulators are in the cloud.

## Software maintenance

The difficult part of maintaining software in a testing stack is ensuring every combination of OS and browser version is available for testing. SMBs may find it easy to get a basic Selenium grid up and running, but it soon becomes difficult to keep every OS and browser up-to-date. On top of that, tools for infrastructure management, log analysis, and root cause analysis are required to monitor and control the stack. These are time-consuming tasks that are better left to a cloud vendor that has all this functionality built into their product. Cloud testing solutions ensure your platform is always up-to-date with the latest operating systems and browsers, and they even have older versions available for testing.

## Continuity during attrition

Dedicated Ops teams (and as a result, QA team workflow) will be affected by attrition and changes in roles within your team. When change happens, finding experts for the automation, build, or run processes can take a couple of months, and may slow down or even bring your testing process to a temporary halt. SMBs can be hit hard by this problem as they have small teams where every member plays a vital role in ensuring the system runs as needed. Enterprises may have more backup resources, but still run the risk of fragmented teams and people taking their experience with them when

they leave. With a cloud-based testing solution, your team can focus on core development and QA activities, and not be constrained by a dedicated in-house Ops team.

### **Value-add features**

A cloud testing solution provides advanced testing features like screencasts, detailed logging, and metadata that would take months to build in-house.

Additionally, some vendors may offer analysis tools that help Devs resolve bugs faster and provide deeper visibility into the testing grid. These features equip Dev and QA teams with timely information, and enable them to collaborate more closely. These value-add features are the little surprises that can transform previously mundane tasks into a delightful experience for both QA and Dev teams.

### **Team productivity**

Though it's not considered when calculating ROI, team productivity can be the most rewarding benefit of choosing a cloud testing solution over on-premises. Getting the mundane maintenance tasks out of the way allows QA to focus on automating and optimizing the testing process and the underlying infrastructure. A cloud testing solution helps free your QA team from low-value work, and gets them thinking strategically about testing. This is the sort of culture that fosters innovation, and as an offshoot, improved morale.

In the decision to build or buy software testing infrastructure, the hard costs are scrutinized carefully, and soft benefits are often ignored. This is a costly error that comes back to bite teams once they start using their testing environment. As this paper shows, hidden costs can have a bigger impact on the quality of your software product and the productivity of your teams than hard costs. When making this decision, a new way of assessing costs that considers both hard costs and soft benefits is needed.

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## **RETHINKING ROI — THE ICEBERG MODEL**

To draw a parallel from the popular Iceberg Model, hard costs are only the visible tip of the iceberg — while soft benefits are the significant, yet unseen costs that define not only how much you invest, but how much value your investment brings.

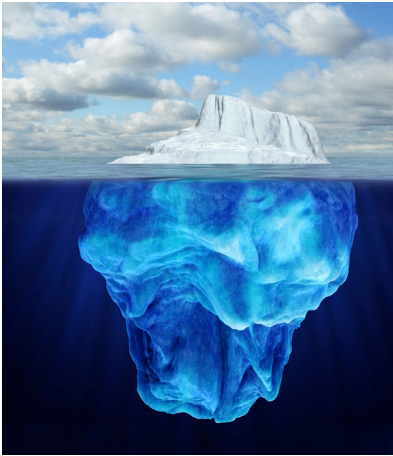


### Hard costs:

- Dedicated Ops team
- Test VMs
- Data center
- Desktop & mobile devices
- Software licenses

### Soft benefits:

- Scalability
- Reliability
- Hardware maintenance
- Software maintenance
- Continuity during attrition
- Value-add features
- Team productivity



The decision to build or buy a testing grid doesn't just come down to hard costs; it hinges on the ability to factor in all soft ROI factors as well.

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## CONCLUSION

Testing architecture is crucial to the success of your testing operations, and if done wrong, it can take a heavy toll on the quality of your apps. Though it's easy to get up and running with a single server setup, in the real world, maintenance of a mature testing infrastructure is complex and expensive. Dedicated IT resources and complex communication chains can cripple your Ops and QA teams, and that will eventually show in the quality of your product. In-house testing infrastructure can quickly become outdated as organizations migrate to cloud-based testing solutions.

The reasons for this move are clear. Cloud-based testing enables you to champion the cause of quality across teams, beyond QA. Testing in the cloud certainly delivers cost efficiencies over on-premises — \$92,000 in the case of SMBs, and \$2 million in the case of enterprises. More importantly, it results in a more confident, empowered, and productive QA team. Cloud-based testing gives you the best of both worlds — tangible cost savings, and soft benefits that far outweigh those savings.



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