



## 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 long-standing de facto standard for automated testing) as your automation tool, 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-premise against subscribing to a cloud-based testing platform.

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## EXECUTIVE SUMMARY

Traditionally, automated software testing has been performed using proprietary, on-premise technology. Physical servers running multiple virtual machines (VMs) functioned as a hub from which browser/OS images and devices, or nodes, were controlled. Today, however, the number of device types to be tested has skyrocketed, as have browser versions, OSs 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-premise testing, or subscribe to a cloud-based testing service. When we talk about on-premise 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-premise or cloud testing service is critical and affects how apps are built and shipped, it will also impact 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-premise 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>	\$160k	\$80k	\$2.4M	\$400k
Test VMs <sup>2</sup>	\$22k	\$12k	\$430k	-
Hardware & Data center <sup>3</sup>	\$22k	-	\$360k	\$90k
Desktop & Mobile Devices <sup>4</sup>	\$11k	\$1.5k	\$30k	\$3k
Desktop & Mobile Licenses <sup>5</sup>	\$5k	-	\$15k	\$15k
<b>Total annual cost</b>	\$219k	\$93.5k	\$3.24M	\$508k
<b>Savings with Cloud</b>	\$125,500 per year		\$2.7 million per year	

1. Annual salary of 1 Sys Admin, 5 years experience \$69K + 20% benefits = \$80K ([Netwrix](#))

2. VMWare VSphere Enterprise plus licensing costs \$5.9L/license/year ([VMWare](#))

3. Enterprise rack space cost \$1,000/rack per month, enterprise cost based on 5 racks ([Ongoing Operations](#))

4. Average device \$750; Cloud testing solutions may include mobile emulators and real devices in the cloud as part of the annual package cost

5. 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 Personnel

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, we took \$69K from the Netwrix annual survey, added 20% for benefits, and arrived at \$80,000 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; annual licensing for such machines runs from \$1,500 on the low end to nearly \$6,000 per VM on the high end. We used the published VMware rate of \$4,300 per year. Though there are cheaper and more expensive options available, this cost represents an average, mid-sized VM service. Cloud-based VMs that testing vendors provide can be significantly less expensive per VM than on-premise, particularly at higher volumes.

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-premise infrastructure pales in comparison to that in the cloud. Spinning up a new VM in the cloud is measured in seconds, which makes provisioning effortless. (We discuss this in more detail later in this paper.)

### **Data center**

For an SMB, we assumed any increase in data center costs would be negligible, but there would still be a need to purchase hardware. To calculate hardware costs, we purchased a single server, storage unit, a modest amount of disk space (about 1/10th of the unit's capacity) and averaged the costs over four years. The enterprise version has ten times as many racks, requiring 512TB of storage capacity that's used by a dedicated storage server. All equipment is replaced every three years.

Assuming that one more rack does not add significant data center cost is generous for an SMB, but we cannot be that generous with an Enterprise. While the [published cost to support a rack](#) in terms of electrical, air conditioning, space, and so on is expected to reach \$1,200 to \$1500 per month, we assumed that by going it alone and only adding incremental cost to the data center, the company could do the work as low as \$1,000 per month. That cost totals \$120,000 per year for ten racks. 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 and/or a composition of the combinations your app users have in place. 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. This is a more likely problem as software work becomes increasingly remote-first, in which case, you'll likely need redundancy in physical hardware, and employees willing to

contribute their own personal closet space. We assumed an annual budget of \$10,000 for the build it yourself SMB and \$30,000 for the Enterprise.

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.

Yet some people want to “feel” the device in their hands. A great deal of this is done with personal devices. Still, we put in a budget of \$1,500 for the SMB and \$3,000 for the enterprise. Assuming a three-year replacement policy, that is twelve hand devices for the SMB or twenty-four for the enterprise in a three-year time period.

### **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, these software licenses are built into the product which you rent by the hour. The vendor might spread those costs out of over a dozen customers, all using the hardware at different points in time. Cloud testing also spreads out the cost of development and integration of new features or open source tools, which can result in 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 \$142,000 annually, and an enterprise well over \$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-premise.

### Reliability

SMBs that rely on an on-premise 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-premise 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-premise 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. Mobile labs present an even greater challenge; let's say someone grabs the iPhone 12 and updates iOS to the newest version; the tester assigned to exercise the app on latest.version minus one now has to find another iPhone 12 and provision it with the older OS.

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 video recording, screenshots, 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-premise. 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 serious 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.

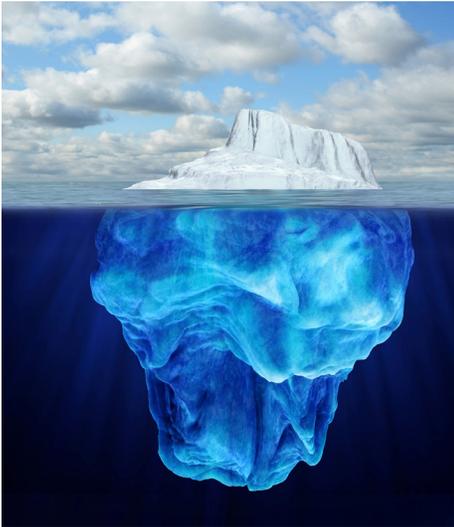
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## RETHINKING ROI – THE ICEBERG MODEL

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-premise — \$142,000 in the case of SMBs, more than \$2.5 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.



## ABOUT SAUCE LABS

Sauce Labs is the leading provider of continuous testing solutions that deliver digital confidence. The Sauce Labs Continuous Testing Cloud delivers a 360-degree view of a customer's application experience, ensuring that web and mobile applications look, function, and perform exactly as they should on every browser, OS, and device, every single time. Sauce Labs is a privately held company funded by Toba Capital, Salesforce Ventures, Centerview Capital Technology, IVP, Adams Street Partners and Riverwood Capital. For more information, please visit [saucelabs.com](https://saucelabs.com).



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