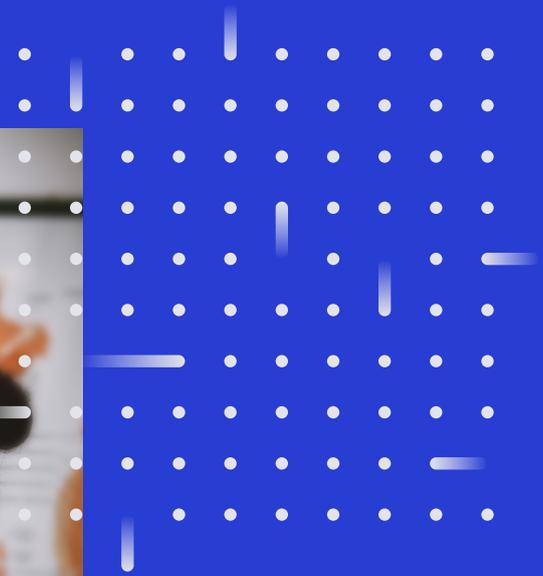
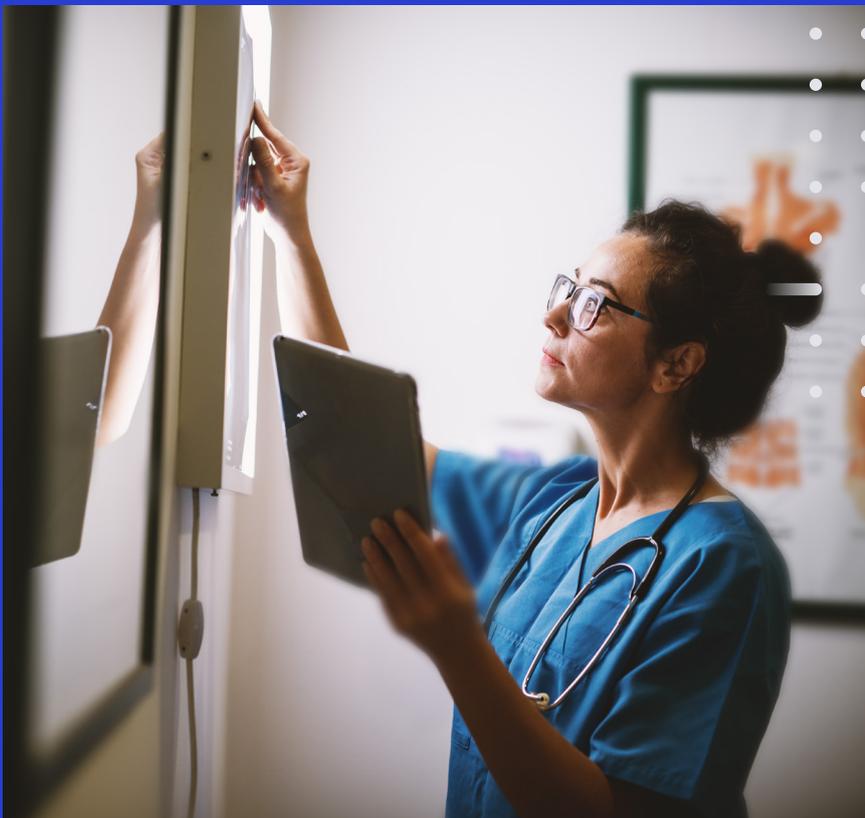


White Paper

How to Improve (VDI) End-User Experience in Healthcare

Testing reduces end-user complaints and minimises costs



Executive summary

Virtual Desktop Infrastructure (VDI) continues to gain popularity within the Healthcare sector, as more and more desktops migrate to the cloud. While IT organisations within the healthcare sector roll out specialised EMR-applications like Epic, Cerner, Chipsoft, and McKesson, end-users' desktop experience on each device continues to grow. IT departments within healthcare must rise to the challenge of delivering outstanding services while reducing the complexity and costs associated with infrastructure. For end-users, IT departments, and businesses many issues boil down to performance.

In complex environments within healthcare, with many users sharing centralised servers, storage, software, and even GPUs, the IT department faces added difficulty offering the users the same performance they grew accustomed to on their fat clients and notebooks. When centralising—whether the environment uses Citrix Virtual Apps and Desktops, VMware Horizon, Microsoft Remote Desktop Services (RDS), or Windows Virtual Desktop for application and desktop virtualisation — IT departments quickly run into resource limitations leading to degraded performance. Often the root of performance problems can be averted by proactively testing performance.

Storage innovations over the past few years have certainly eased the problems associated with sharing resources. Yet, the introduction of so many storage solutions has added complexity to IT environments and the broader market: there are myriad options and configurations now available. As a result, nearly every IT environment is unique, and some combinations of resources and technologies have never been tested before.

Performance testing is crucial in new desktop virtualisation projects, pilots, proof of concept, and production phases. Because of the countless unique technology and service options to consider when undertaking a new VDI project, capacity planning and load testing the environment is essential to moving confidently into production.

Testing should always be performed at scale with synthetic users before real users are live and in production. Project and pilot phase due diligence will help ensure a smooth transition to production: the last thing an IT department needs is a poor end-user

experience in the first few weeks because systems are stressed.

Once in production, successful centralised desktop environments are managed and maintained with a disciplined approach to release and change management that includes (automated) performance tests. Software application updates should be tested for their impact in each IT department's specific environment; without this testing, at some point, the business will suffer the consequences of downtime. In each phase of a desktop virtualisation deployment, the IT department should strive for three areas of insight:

Predict

What is the performance impact of necessary updates and upgrades?

Validate

How many users can my infrastructure support before performance suffers?

Manage

How do I stay ahead of support tickets from end-users and understand performance from the end-users' perspective?

The indirect value of testing makes the direct capital investments (time plus software) needed to execute testing sometimes hard to justify. The goal of this white paper is to help all involved to understand better, and be able to explain, the business case behind VDI testing.

Performance: The Crucial Factor

IT departments within the healthcare sector would like to offer their virtual desktop users the same rich desktop experience they were accustomed to in their fat client environments. End-users expect a great experience, and performance—perceived and actual—is tied to the overall experience. Because of the centralised processing of functionality and the central storage of data, the speed, capacity, and configuration of the centralised servers are key success factors in delivering a great experience in virtualised desktop environments.

Meanwhile, poor desktop performance is the primary end-user complaint in virtual desktop environments. Desktop performance issues have a negative impact on productivity within the IT department and the larger business. Consequences of unpredictable performance include:

- Productivity loss
- Frustration and acrimonious working relationships between users and IT
- Support tickets that cannot be closed because the source of the problem can't be identified
- System failure resulting from a software update can cost the IT department weeks of time

The impact of not testing (productivity loss, time to repair and restart, and system failure) can add up to hundreds of thousands of pounds.

A structured approach towards testing in every phase from project to production, combined with the best tools available in the industry today, will help organisations enjoy the benefits of top-performing centralised desktop infrastructures at the lowest cost possible.

Testing in Transformation Projects

During the planning stage of critical IT projects in the healthcare sector, such as the implementation of Electronic Patient/ Medical Records (EPR or EMR), the primary value of testing is building the best possible infrastructures at the lowest cost possible.

There are many choices to consider in both software (which broker, hypervisor, antivirus solution) and hardware (which servers, CPU, storage solution). Hardware and software vendors' lab-based claims need to be checked against your real-world environment. To increase objectivity, benchmarking various configurations in your IT environment will yield insight into the optimal setup. Make sure to follow these two steps:

Read vendor whitepapers and reference architectures

When embarking on a new hosted desktop project or expanding an existing one, best practice is to review the relevant test reports, design validations, and reference architectures that vendors publish. Hardware and software vendors, including software-driven storage vendors, base their performance references on the industry standards set and maintained by Login VSI. The simulated user workloads are shared across vendors, making it easy to compare the claims of different vendors.

By introducing an apples-to-apples comparison, Login VSI has added coherence to the hosted desktop industry, critical when the market is complex and fast-changing.

Test different infrastructure options in your environment

While vendor reference architectures give insight into the capabilities of the different software and hardware options in clean lab environments, actual performance and scalability will depend on your real-world production environment where other factors are at play.

Testing with a production load reveals the potential flaws in a proposed infrastructure (whether the plans are from a vendor, consultant, or internal IT department). It helps in choosing the best performing and the most cost-effective solution. Login VSI's flagship product, Login Enterprise, for load testing is an easy and cost-effective way to reveal and validate the actual capacity of the proposed or existing infrastructure.

Testing in Production: Maintain Excellent Performance

In healthcare, offering a good user experience to end-users can save lives. Performance testing of production environments helps the IT department maintain excellent, predictable performance and avoid infrastructure slowdowns and failures. Integrating testing as a standard and ongoing business practice into the virtual desktop product life cycle is key to avoiding the costs of business and IT disruptions.

Healthcare organisations that have experienced the damage from slowdowns or failures seek a way to prevent such problems. Organisations that have not yet experienced the business impact of performance issues need to make sure performance continues to be a non-issue. With software updates required so frequently (think of Windows 10 builds, security patches, and application updates), performance problems can hurt your crucial business processes at any time if tests are not performed.

Every update, upgrade, or other change to your environment can negatively impact end-user productivity. This is true for larger and smaller production environments (of 50 to 100 desktop users). The savvy IT director does not rely on vendors to test software: each update will have an extraordinary impact depending on the unique environment.

When moving from pre-production to production, many exceptions can be caught before going live and real users being impacted. However,

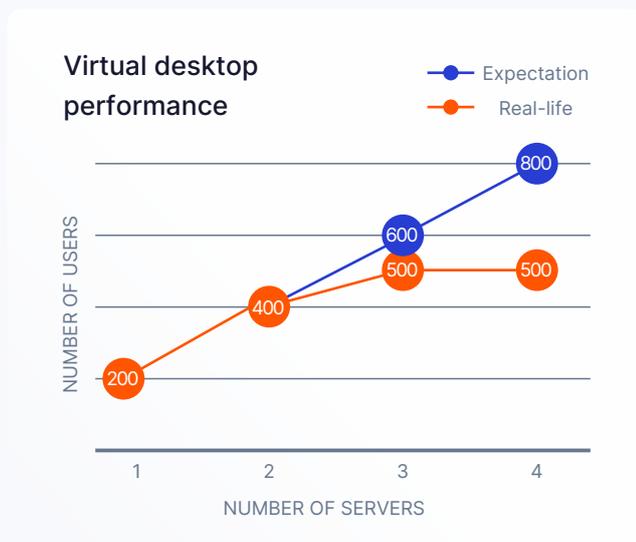
something can always slip through the cracks, or a component fails. As Murphy's Law dictates, anything that can go wrong will go wrong. It's best to be prepared. That's where it's beneficial to simulate user activity, day and night, from within your data center or any remote site to your on-premises VDI environment, cloud desktop, or software-as-a-service application. The ability to mix with real users and perform tasks similar to real production usage will alert you to any fluctuations in performance and availability.

In this mode, rather than going through 500 applications, focus on the most important ones for business continuity. If you're a hospital, this could be your electronic health records application, for example, Epic or Cerner. And it doesn't stop at just starting the application. You should continuously validate whether processes are running as they should. For example, can you still look up a patient record? Is the application still responsive if you run a monthly report? There is no better feeling than knowing that all your 500+ apps will work when you make any changes.

Testing Does Not Scale Linearly

You will want to perform your Proof of Concept (POC) with the total number of intended users. The main pitfall in POC tests is to assume that performance scales linearly with the number of servers. Data from limited tests cannot be accurately extrapolated to the full user base. There are many examples of hosted desktop infrastructure test samples of real users that performed well initially but later experienced actual performance and capacity issues when production was scaled out.

A complete environment responds fundamentally different than when testing a subset of users. The most obvious reason for this is the shared systems, especially shared storage. The performance will typically scale linearly for the first several servers. However, scaling quickly becomes non-linear. The graph below illustrates this point. The blue line shows the expected number of desktops on the total number of servers. While the performance of the desktops is acceptable at 400 users, simply adding an extra server at 500 users will not satisfy our needs.



In addition to storage, the other commonly shared components in complex environments may include broker/load balancers, monitoring, power, networking, cooling, antivirus, backend databases, file servers, and application servers or application virtualisation techniques.

An IT department can truly validate that all shared resources are working correctly together by testing at full scale. These are some of the questions you might

have that testing at capacity can help answer:

- Is my environment stable and performing at the desired capacity?
- Are the backend systems handling the load?
- Can my environment handle logon-storms?
- What happens if one of my data centres fails?
- What happens if one of my servers (or racks) fails?

For example, an enterprise's storage device was misconfigured only to use a limited amount of CPU. Initial tests with few users indicated that there wasn't a problem. But as soon as the tests were ramped up to 400 or 500 users, the environment came to a complete halt. After identifying and resolving the issue, the IT department could host the desired number of users in the environment and move to the pilot phase.

The best practice recommendation is to start performance tests with just one machine to ensure it works and is getting the best performance. Following this initial test, begin increasing the test size to full-scale. The same goes for environments that are already in production. When expanding or altering your production environment, it is important to scale your test to the true number of users to know exactly what level of performance to expect.

Windows 10 (and the Accelerating Rate of Change)

While balancing business acceleration and risk management, IT is constantly introducing new solutions, upgrading, and patching applications, systems, and networks to maximise productivity, increase revenue, and secure the business. The pace of these constant changes is only getting faster.

Without these constant changes and upgrades, you cannot achieve business goals. Each update could have consequences for your business: a poor end-user experience, bad application performance, downtime, system degradation, or dramatic overspending.

The Size of the Problem

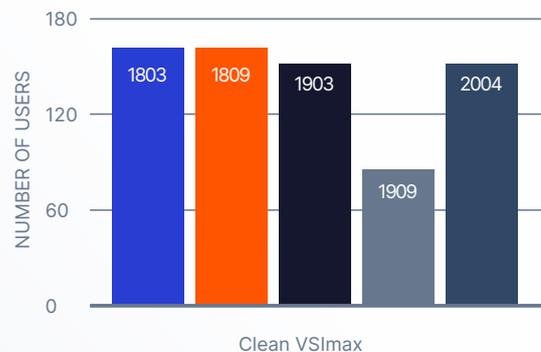
Software vendors are rapidly pushing updates at an ever-increasing rate, driven by a DevOps frenzy that demands incremental updates frequently. But with users (employees, contractors, vendors) anywhere and everywhere, how do you prevent these updates from adversely impacting your organisation – slowing down your business, introducing risk, or disconnecting your data and applications from all your end-users?

In 2020 alone, there were 1,280 Windows 10 bug fixes and security updates. If running Windows 10, your users will face one of these updates at least once a day. And that's just Windows. Now add your hypervisor, storage infrastructure, digital workspaces, and the rest of your application updates.

Besides Microsoft's monthly patches, you also have to deal with the bi-annual Windows 10 feature updates. A newer version of Windows can often mean a change in performance and

scalability. And as with every change or upgrade in your environment, it is hard to predict the impact. So when upgrading to a newer version of Windows 10, it is crucial to test before you deploy to secure application performance and end-user experience.

Windows 10: number of users per server, after each update



Testing is no Longer Time-Consuming or Expensive

Testing hosted desktop environments involves a very tangible capital investment in expensive test software suites and specialised test hardware. The traditional test process involved weeks or sometimes months to install the test software. This was on top of the time needed to build and perform the actual tests. Professional testing engineers were required to install the test environment, build and run the tests, and read and understand the performance test results.

Even if some organisations recognised the risks of not testing, the costs of traditional testing were still so high that many organisations opted to wing it. This approach sometimes can have disastrous results.

Login VSI makes VDI testing easy and cost effective

Login Enterprise simulates the common workloads of real-life users and does not require any additional infrastructure beyond a testbed. Login Enterprise was designed by experienced specialists who saw the need for testing solutions that were easy to implement and easy to use. The product is based on decades of combined experience in hosted desktops in real-world customer environments. Because Login Enterprise tests can be deployed very quickly, the software allows you to profit from the benefits of testing in every phase of a desktop virtualisation project.

Easy installation

Where traditional test environments take up to four weeks to be installed and started, Login Enterprise can be installed and ready for use in less than four hours.

Quick and easy test creation and execution

The industry-standard workloads make starting a test easy and quick. The flow-based interface makes test building and execution easy for non-test professionals.

Reliable and useful test results

VSI_{max} is the industry standard that indicates the maximum number of virtual users that the tested infrastructure can serve with acceptable performance. Because it is a standard measurement in the industry, it is possible to make scalability comparisons between different tests.

Investment pays for itself

Where traditional testing environments were very costly to buy and maintain, Login Enterprise makes testing affordable for all stages of a hosted desktop environment and any size environment.

Using Login Enterprise as part of a disciplined approach to testing, organisations can build more flexible user environments while increasing productivity and reducing costs.

Performance goes beyond the project phase

Phase	Project	Production
Business Questions	Which VDI product? How much hardware?	Can we still grow? What happens if... How do changes impact performance?
Test Objectives	Benchmarking Proof of Concept Capacity Planning & Production Readiness	Load Testing and Stress Testing Continuous Testing & Monitoring HW/SW Change & Impact Analysis
Test benefits	Best fit product Optimal resources	Future ready Protect performance
Test value	Make the right decisions Reduce risk and optimise spend	Stay out of trouble Optimise & protect performance

In the project phase

Benchmarking different infrastructure options in the project phase helps you:

- Compare and select the best performing products (and avoid technical problems).
- Compare and select the most cost-effective products (which helps to save costs).
- Make choices based on objective tests (rather than speculation).
- Compare old and new environments (which helps to build sound business cases).

Capacity planning and production readiness in the project phase help you:

- Validate sizing estimations and calculations (and avoid over-or under-spending).
- Make a budget based on facts (and avoid financial disappointments later).
- Test the entire infrastructure before going to production (and avoid performance issues).

In the production phase

Load testing and stress testing in the production phase helps you:

- Determine your systems maximum user load (which helps to support planned growth).
- Prepare for non-standard peak-usage scenarios (which helps to prepare for unplanned loads).
- Get an objective baseline of performance (and reduce expensive production problems).

Testing the impact of every change in your VDI production environment helps you:

- Avoid unexpected performance problems (and avoid problems instead of fixing them).
- Test potential improvements upfront (and improve your infrastructure without risk).
- Safeguard the health of your environment (and therefore reduce problems in production).

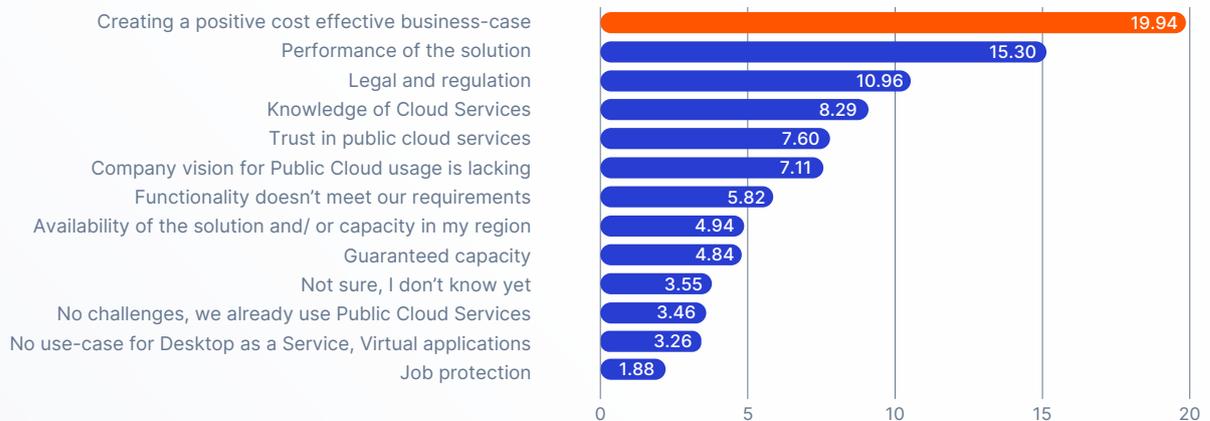
Cloud Ahead

The cloud has recently proven to be a vital tool for many organisations to deal with the pandemic by enabling employees to work from home. COVID-19 has clearly shown that work doesn't need to happen at the office. It has strengthened our belief that working from home is going to be the norm for many. Moving to the cloud introduces many technical challenges, even though it takes away some of the complexity of maintaining an extensive IT infrastructure. But it also adds a new layer of complexity to an already complex IT landscape. Besides the technical shift, we can also see a change in responsibility and accountability.

The desktop is the hard part; it's where everything comes together

Imagine moving your desktops over to Windows Virtual Desktop (WVD) on Azure or Citrix Cloud. Suddenly, Microsoft or Citrix is responsible for delivering the desktop that runs your applications to support your business. How far does the vendor's responsibility reach? Is it just the infrastructure, or are they also responsible for the applications' availability and performance? Am I - as an IT director - still accountable, and how can I provide insights about this?

What are the biggest challenges in using or adopting Virtual applications and desktops in public cloud?



At the same time, we see an ever-increasing rate of change. To handle this increased growth rate, an organisation shouldn't merely lift and shift its workloads to the cloud. Instead, they should also review and modernise their operations. Agile and DevOps have been around for quite some time in the realm of software development. We believe organisations should also incorporate these concepts into their IT management processes to facilitate change instead of controlling it.

Login VSI prioritises guaranteeing the availability and user experience of the digital workplace and, thus, the employees' productivity and continuity. On the one hand, we do this by supporting the change management process with data about the impact a change will have on production systems and automating change in the digital workplace. On the other hand, by continuously testing production environments, including desktop applications (whether in the Cloud) for availability and performance and reporting on this clearly and simply.

Our vision is that deep integration of our automation and test platforms enables the customer to implement changes faster and with higher quality, both on-premises and in the cloud.

When to use Login VSI?

For benchmarking and Proof of Concept:

- 100% vendor independent and 100% objective
- Out-of-the box standard workloads make product comparisons easy
- Login VSI is used by all leading virtualised desktop technology vendors

For load testing, stress testing and determining baselines:

- Different standard workloads are available for different scenarios
- Login VSI allows for (close to) simultaneous logons or workloads
- Workload content and phasing can be adapted to reflect real-life usage

For capacity planning and production readiness:

- Easy to use through out-of-the-box workloads
- Precise through easy workload customisation (when needed)
- Used for sizing by Systems Engineers at Cisco, HP, Citrix, VMware and other IT vendors

For change impact prediction:

- Ease-of-use allows for testing each intended change before implementation
- Large end-user organisations use Login VSI as a part of their Development, Testing, Acceptance and Production (DTAP) process
- Subscription licenses provide value for money and lifetime performance protection

Benefits of testing for the organisation

- Fewer frustrated desktop users
- Reduced costly business interruptions
- Better ROI on virtualised desktop projects
- Reduced risk to the business

Benefits of testing for the IT manager

- Maintain management support
- More successful virtualised desktop projects
- Happy end-users, fewer trouble tickets
- More responsible administration

Appendix A: Recognising the risks of non-testing

When considering your virtualised desktop environment, whether you are in proof of concept, project or production stage, the following are some questions to consider:

Why invest in benchmarking different infrastructure options?

- When evaluating hardware and software relating to your virtualised desktop hardware and software, how will the claims of vendors translate to your unique environment?
- What is the cost/benefit of purchasing Login VSI for benchmarking so you optimise your infrastructure investment, predict performance and scale accurately?
- What is the risk to end user productivity and to the business if a software upgrade goes wrong?

Why invest in load testing, stress testing and establishing a baseline?

- How often do usage peaks occur?
- Are they predictable (like logon-storms)?
- Are you 100% sure your new system is powerful enough to survive usage peaks?
- As your company grows, can your virtualised desktop environment take on more users?
- Do you know the maximum capacity of your system?
- What would be the biggest benefit of knowing the maximum load of your current system?

Why invest in capacity planning and production readiness?

- How do you test how much servers and storage you need to maintain a good user experience?
- Can your current environment support more users coming on board?
- What is the financial impact of buying too much capacity?
- What is the business impact of not buying enough capacity?
- What is the most significant risk of not having enough capacity?

Why invest in change impact prediction?

- How important is performance to end users?
- Can you identify the source or replicate end user performance problems?
- Do you fear performance loss after installing a new version, update, upgrade, or patch?
- What would be the costs of an upgrade that goes wrong in terms of time and money?

Appendix B: Best practices to avoid performance problems

- Read the relevant test reports, validated designs and reference architectures that infrastructure vendors publish based on tests using Login VSI.
- Test all infrastructure options proposed by different vendors in your own business environment.
- Size and scale hosted desktop infrastructures based on test data before going production.
- Test all intended infrastructure changes before implementation for possible performance impact.
- Test with the real production number of users. Subsets not always reveal all potential problems.
- Test the entire infrastructure. Testing components or single servers will not reveal all problems.
- Test to validate SLAs of service providers.

About Login VSI

Login VSI is the only solution in the market guaranteed to maximise the end-user experience for digital workspaces. We reduce risk and ensure business continuity by safeguarding application and desktop performance. We use synthetic users to automatically test and validate the impact of change in physical, virtual, and cloud-based workspaces.

Login VSI's flagship product, Login Enterprise, integrates application compatibility testing, load testing, and performance and availability testing into a single platform. Login Enterprise also includes standard "out-of-the-box" application template workloads.

About Forfusion

Forfusion specialise in digital transformations empowering companies to prevent risk, plan for the future and optimise business performance by partnering with Login VSI we can help you procure and implement the only solution in the market guaranteed to maximise the end-user experience in your digital workspaces.

Forfusion combines years of multi-sector technology engineering and consulting with an ambitious attitude and a meticulous approach to designing, deploying and supporting market leading vendor technology solutions. By honing our tried and tested methodology using highly experienced and accredited personnel in alignment with vendor best practice and industry standards, we deliver high-value projects both reliably and predictably.

Challengers and problem-solvers, we uncover our customers' requirements and work with them in a long-term partnership. Our straight-talking nature and painstaking attention to detail ensure that we deliver expert services without compromise. And because we're committed to conducting business with strong moral principles, our clients can count on us to do what's right for them every step of the way.

Improve your VDI end-user experience. Speak to one of our experts.

[Book a demo →](#)

Interested in learning more about Login Enterprise?

[Head back to our toolkit →](#)