



VDI AND THE FAST ACCESS TO PATIENT DATA CHALLENGE

Justin Beardsmore
Infrastructure Manager
St George's Healthcare NHS Trust
Justin.Beardsmore@stgeorges.nhs.uk

EMC²

Table of Contents

The Perfect Storm	4
Putting Down the Foundations	7
Placing VDI in the IT Vision - What's the story?	11
The Challenge.....	12
Single Sign-On and Authentication Management	14
Managing the Complexity.....	16
Architecture Design Considerations	19
On-premise Infrastructure Options.....	19
Desktop-as-a-Service	20
Persistent vs non-Persistent Desktop	22
Personalisation and Application Managements Layer.....	25
Printing (Ignore at your peril)	27
End Device	29
Licensing	31
Deployment.....	32
Is healthcare unique?	32
Deployment Tips	35
Measure Success	36
References	39
About The Author.....	40

Table of Figures

Figure One	The Perfect Storm.....	4
Figure Two	Forces Shaping Health IT Today.....	6
Figure Three	Primary benefit of VDI to End Users (U.S. vs. EMEA).....	8
Figure Four	Primary benefit of SHVD for IT (U.S. vs. EMEA).	8
Figure Five	Annual Employee Productivity Comparison: VDI vs. PC.	10
Figure Six	EMC IT Virtual Desktop POC Roadmap.....	12
Figure Seven	VDI and the C Suite	13
Figure Eight	VDI Support IT Team Structure.....	17
Figure Nine	% Age Distribution at St Georges NHS Healthcare Trust.....	33
Figure Ten	% Age Distribution at BARTS Health NHS Trust.....	33
Figure Eleven	% Age Distribution at The Johns Hopkins Hospital.....	33
Figure Twelve	Generalized Communication Preferences of Different Age Ranges...	34
Figure Thirteen	Extracts from a Sample Imprivata Deployment Report.....	36
Figure Fourteen	Extracts from a Sample One Imprivata Deployment Report.....	37
Figure Fifteen	Example Single Sign-On Progress Report.....	38
Figure Sixteen	Example VDI Daily Connections Report.....	38

Disclaimer: The views, processes, or methodologies published in this article are those of the author. They do not necessarily reflect EMC Corporation's views, processes, or methodologies.

The Perfect Storm

Converging drivers have created a perfect storm within healthcare, creating extreme pressure on IT and clinicians. In the United Kingdom (UK) alone, the 'Nicholson Challenge' has mandated the NHS to find efficiency saving of £20 billion by 2015. The challenge is about searching for and implementing strategies at every level in the organization to produce more value from the same amount of resources¹. It is not about cuts. In the first instance, this is where a lot of organizations seem to have focused their attention².

Determined to apply pressure in the United States (US), the Obama Administration Health Information Technology for Economic and Clinical Health Act (HITECH) bill is encouraging the adoption of health information technology (HIT) via incentive payments. This will see the "U.S. market for electronic health records experience a compound annual growth rate of 18.1%, climbing from about \$2.2 billion in 2009 to about \$6 billion by 2015."³



Figure 1: The Perfect Storm⁴

On an organizational level, whether it is between hospitals, community services, mental health, social care, or education, there is the drive for more shared working. On a local level, this can involve integrating secondary care services, which are usually provided in a hospital setting, with primary care services usually provided by a community services type organization. This is done with the aim of reducing time and costs spent while in a hospital bed. On a wider level, this can be about realigning diagnostic services across geographical and even national boundaries. Digital pathology enables the reporting to be done away from the lab, which means the pathologist can be anywhere.

Some people are already beginning to question the need for large hospitals and see distributed technologies, which can be used to deliver telecare and telehealth initiatives, to provide long-term care in the home environment⁵. Pulling no punches, Lord Warner, the ex-UK Health Minister, comments: "Scientific and technological advances make it necessary to concentrate more highly on specialist health services in fewer hospital centres, but also to deliver more routine procedures closer to home with lower overheads"⁶. The four principal digital areas for technological and scientific advancement seen by Eric Topol M.D. are genomics, wireless biosensors, and imaging and Health Information⁷.

There is also the human factor. Technology-literate clinicians have become accustomed to simple, ubiquitous access to, and sharing of, information, just as they are used to in their personal lives. The consumerization of IT has definitely entered the clinical working environment. On the other hand, there are still many technology-averse clinicians and patients navigating the digital world.

Commenting on what he sees as the convergence of all six major technological advances (cell phone, PC, Internet, digital devices, sequencing, and social networking), Eric Topol, M.D. reflects on the innovation challenge ahead.

"These extraordinary accomplishments from dissecting and defining DNA to creating such pervasive electronic technologies that immediately and intimately connect most individuals around the world, have unwittingly setup a profound digital disruption to medicine. Until now we did not have the digital infrastructure to even contemplate such a sea change in medicine. And until now the digital revolution has barely interested the medical world. But the emergence of powerful tools to digitize human beings with full support of such infrastructure creates unparalleled opportunity to inevitably and forever change the face of how healthcare is delivered."⁸

In short, everyone is being asked to do more with less, improve patient outcomes, improve service integration, and of course make information available anytime, anyplace, and anywhere, for clinical staff and patients alike.

"Our vision is for a fully integrated digital patient record across all care settings by 2018 and that can only be realised when NHS providers are connected to the flow of information... It will only be achieved with the commitment and involvement of staff across all disciplines including clinical, management and finance – not just the IT community."⁹

For the healthcare Chief Information Officer (CIO), this means fast tracking his or her organization to paperless or paper-light status, whichever term is currently in vogue, whilst navigating shifting sands and conflicting levels of expectation from their frontline clinical staff. For the humble Infrastructure manager, it is about being able to keep the on-demand supply of data centre storage, network, and computer power needed to support the CIO's

aspirations. Allocations of extra funding can also be a burden for the over-worked, over-stretched local IT department.¹⁰

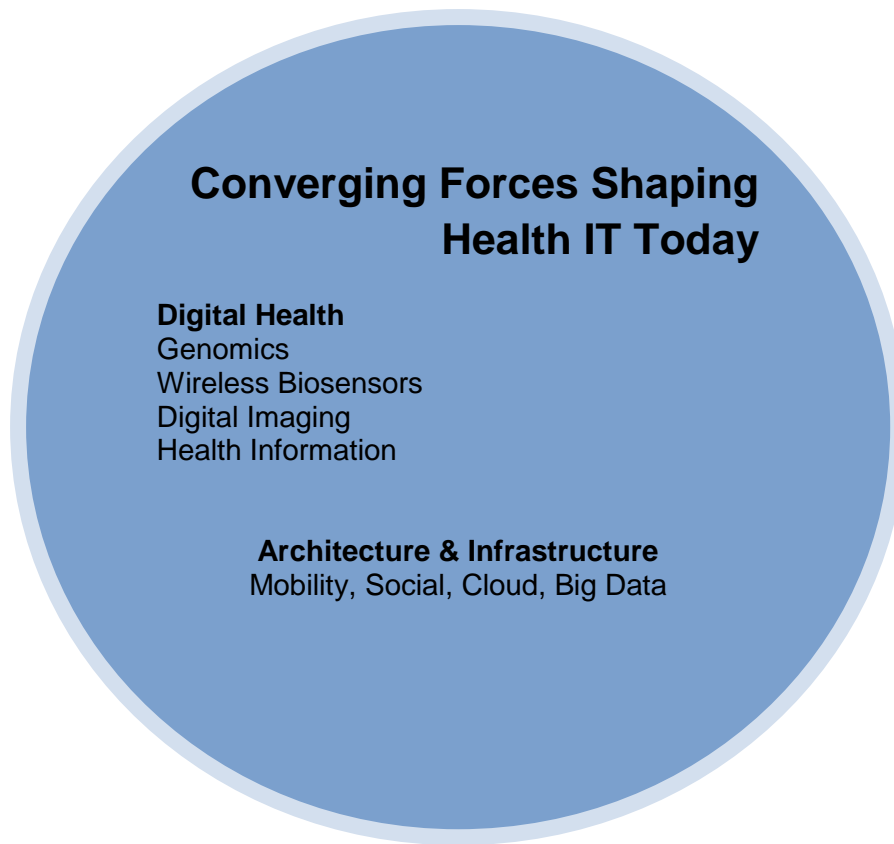


Figure 2: Forces Shaping Health IT today.
Note that "Social" Includes Networking and Unified Communications.

Putting Down the Foundations

CIO's are looking to provide a consistent and fast desktop-access experience across their traditional desktop estate. They are also looking to take this into the End User Compute (EUC) space, which includes desktop, but now also mobility and Bring Your Own Device (BYOD), amongst others. The rationale, more often than not, is that they cannot begin to solve the big ticket items of integrated care records, inter-organisational data sharing, and faster adoption of Electronic Patient Records (EPR)¹² if they are in a constant Groundhog Day debate with clinical and executive management teams on the state of desktop PC within the organisation.

Until consistency is injected into the estate, it is going to be an uphill struggle to satisfy the technology-savvy clinician who is constantly comparing functionality against the new device they purchased online a few days ago, or the clinician still submitting test requests via paper forms. Once this obstacle is out of the way they can begin to transfer the risk from IT back to the organisation. Once the estate is consistent, fast, and secure, with ease and variety of access, then the barrier to faster adoption of EPR systems will be removed. The tension between IT and the organisation will be eased. Therein lies the challenge.

The drivers usually break down into the following areas:

- Standardisation of desktop infrastructure (application virtualisation, better release control process).
- Simplified desktop support for the user and IT department.
- Security and Governance (Data does not leave the data centre).
- Operating Systems (OS) migration (can solve the Windows XP migration).
- New indicatives and projects (BYOD, organisational mergers).

The research highlights that Health CIO's are looking to Virtual Desktop Infrastructure (VDI) and Server Based Computing (SBC) technologies to provide consistency in their desktop estate. According to Imprivata's third annual study on Desktop Virtualisation Trends in Healthcare, SBC and VDI is expected to increase during 2014. EMEA respondents to the CIO survey-based study report a 74% growth in VDI over the next 24 months, which will surpass VDI deployments in the US for the same period.¹¹ Unofficial estimates from Atlantis Computing and Devon IT put the installed VDI user base in 2012 at 15-20 million, with a forecasted growth to 25-30 million by 2013¹³.

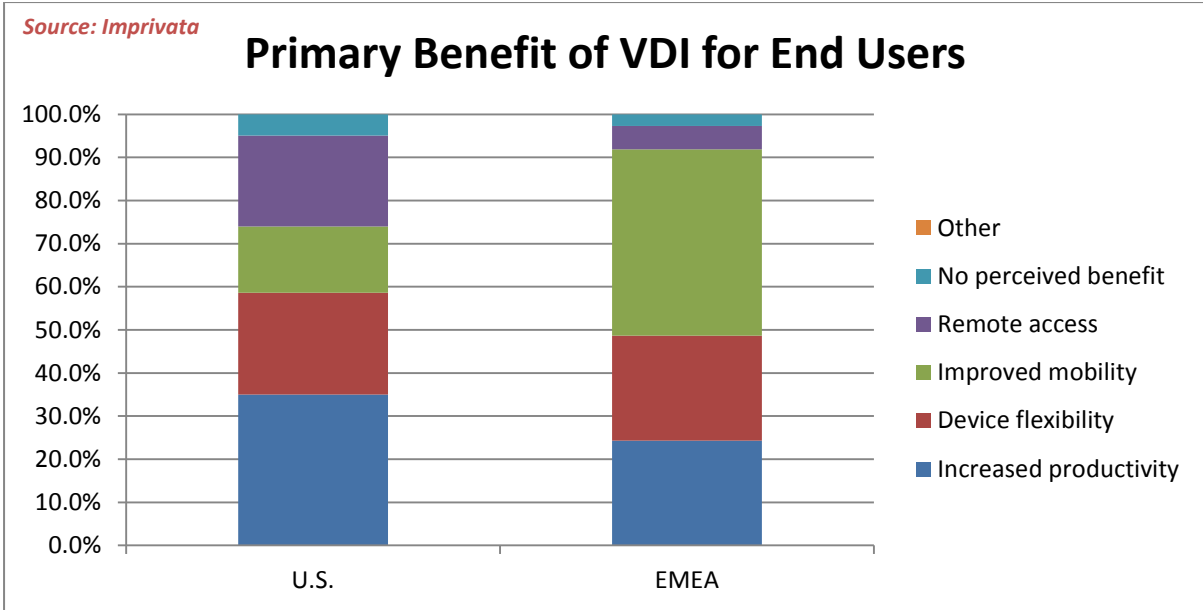


Figure 3: Primary benefit of VDI to End Users (U.S. vs. EMEA). Source: Imprivata.

The graphs show mobility, flexibility, and increased productivity was all prevalent in the survey of 277 IT healthcare key decision-makers from a range of healthcare environments.

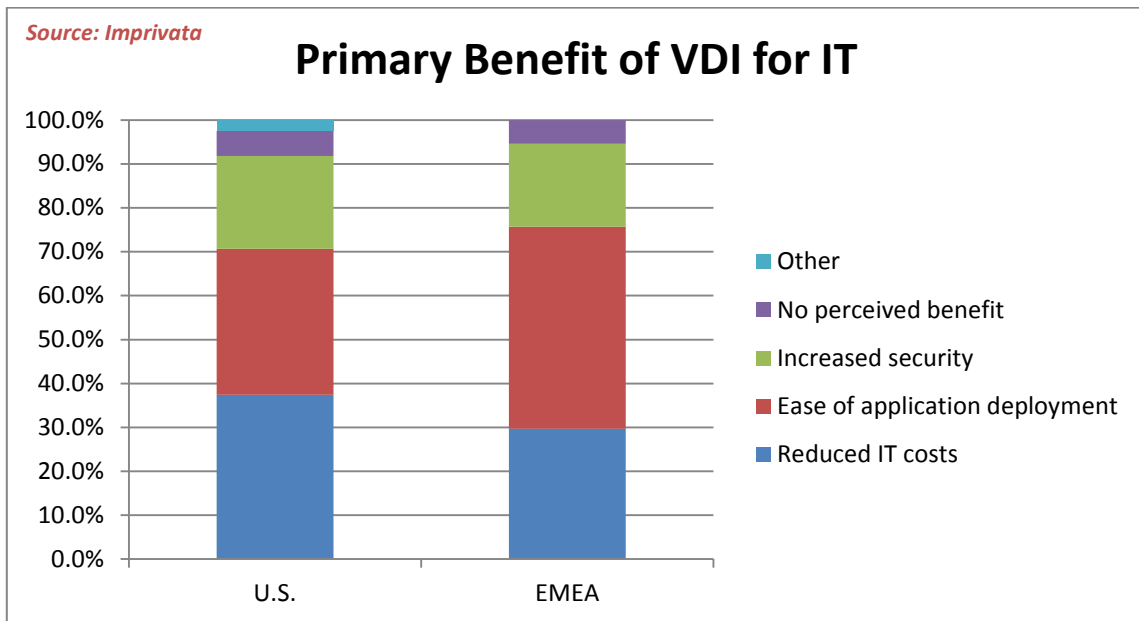


Figure 4: Primary benefit of SHVD for IT (U.S. vs. EMEA). Source: Imprivata.

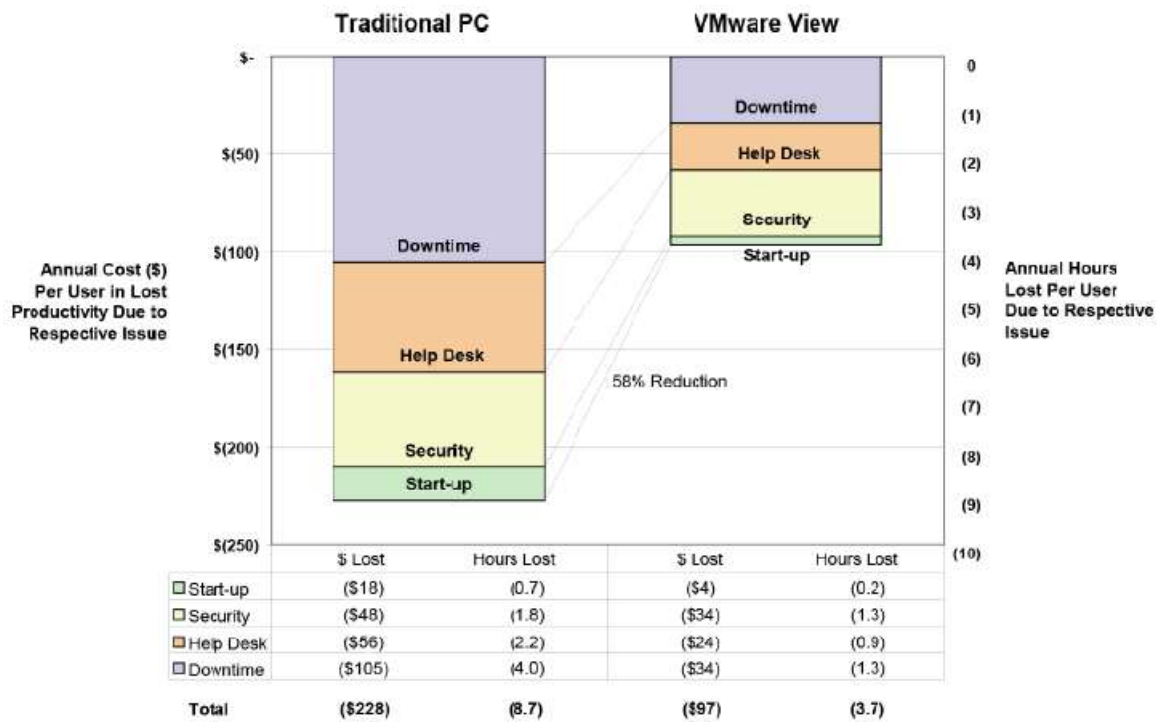
It is no surprise that many analysts see 2014 as the year of the VDI desktop deployment, whether that be on or off-premise¹⁴.

The financial case for VDI also supports transformation projects. IDC, supported by VMware, shows that "the use of VMware View shows that investment in the technology can result in significant business value with very high return on investment (ROI)."¹⁵

Their study of organisations who have deployed VMware View yielded the following observations:¹⁶

- Organizations deploying VMware View saved over \$610 per supported end user per year on average, compared with organizations that use unmanaged PCs. Savings came from lower device and IT staff support costs—which is over \$480—and improved productivity (reduced downtime)—which is equivalent to over \$130.
- Organizations leveraging the advanced capabilities available in VMware View Premier, such as ThinApp application virtualization and View Composer image management, saved an additional \$122 per year compared with organizations that had not deployed ThinApp and View Composer with VMware View.
- With companion technologies, VMware View effectively creates a platform that can address disconnected PC's, mobile, and nonstandard devices. This platform can facilitate the growth of consumerization of IT within the enterprise, and promote organizational synergy.
- To maximize the value associated with the adoption of centralized virtual desktops, organizations must be aware of the limitations of the platform, such as performance, mobile access, and data centre capacity.

Differences in Annual Employee Productivity Loss Due to PC Issues: Traditional PC Versus VMware View



Notes:

- Calculations assume a professional end user with fully loaded annual compensation at \$50,280.
- Model assumes end users remain partially productive (on average 50%) during outage times.

Source: IDC's Business Value Research, 2011

Figure 5: Annual Employee Productivity Comparison: VDI Vs PC. Source: IDC.

The comparison diagram (Figure 5) shows that user experience with the service desk is reduced along with downtime by 57% and 68%, respectively. In a VDI environment with non-persistent desktop problems, desktops just get reset. No time has to be spent troubleshooting in the first instance.

Placing VDI in the IT Vision - What's the story?

Of course, the business quantifying case needs to be made. Numbers need to be crunched and the return on investment (ROI) worked out. However, this should not be at the expense of creating and defining the vision. Rolling out VDI to over 90% of an organisation is a transformation process. The sight of this should not be lost. The vision is to provide faster access to patient data, anytime, anyplace, anywhere. This, in turn, will improve efficiency, which in turn leads to better patient care. There are cost savings, and it does allow the IT department to make its own efficiency savings, but these savings are for the CIO and the Chief Finance Officers (CFO) only. Out in the clinical front office areas, it is the Vision which is going to hold the project together during those early setbacks.

"Forward success will always be followed by maddening setbacks, often with the irresistible urge to go back to what is perceived as "safe", potentially sacrificing vision and a differentiating future for status quo."¹⁷

Some areas where you could organise your vision around include:

- Satisfying clinicians (e.g. giving them solutions that can make their lives easier);
- Improving efficiency and enabling us all to do more with less;
- Ensuring the adoption of the EPR, thus making data and systems efficient, automated, and flexible, and paving the way for predictive analytics based on patient data.
- Providing better care for patients, which is our ultimate goal.

To satisfy clinicians, it is good to emphasise clinical solutions, such as the Roaming desktop, Sign Single On, and Mobility.

If there is a clinical programme of work which delivers new EPR or enhancements to the existing EPR, then align the VDI vision with this programme of work. Have a joint communication strategy to emphasise the connection between both projects. The VDI platform is going to deliver the EPR applications anytime, anyplace, anywhere. This needs to be communicated.

Most of all, focus on the journey and how VDI is the first step in that journey. Point out that accessing a Windows desktop on a tablet device is an enabling first step towards delivering the application natively to the device; clinicians will come to that conclusion themselves very rapidly.

The Challenge

A well planned and executed VDI deployment will offer significant benefits. It will provide faster access to patient data and will provide a consistent platform, enabling an optimised clinical workforce. Decoupling the physical device from the logical (desktop) will enable mobility inside and outside the organisation. It can also be the catalyst for information governance, nudging clinicians away from shared logons, guiding them to store data on network shares, and controlling the routing of print jobs. However, a number of components, people, and processes need to move together in order to achieve this change and create the clinical desktop workspace. This is what CIOs and their IT teams need to deliver, in order to reduce the tension between IT and the organisation and move the debate away from infrastructure to digital health.

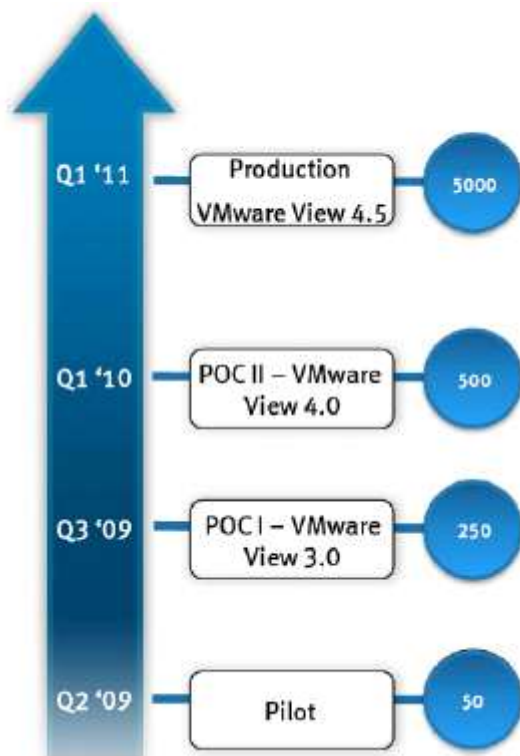


Figure Six: EMC IT Virtual Desktop POC Roadmap

However, before embarking on the journey it is important to understand that it is not a short journey and be aware of project pitfalls. The above figure outlines EMC's internal IT Proof of Concept (POC) roadmap from pilot to production, which took just under two years.¹⁸ This is from an internal high-performing IT department that has over 93% of server virtualisation and is in phase three (IT-as-a-Service) of their cloud journey.¹⁹ We just need to factor in how long the process takes for clinical areas, based on your own internal resourcing. The key point is that spinning up virtual desktops and providing access to form organisational opinion can be achieved relatively quickly, but to make the deep penetration into the organisations - within busy clinical areas - will take time, planning, and communication. Progress will be slowed

further if using the VDI project to drive through good working practices. Steering clinicians to save data through network sharing and use fast access via Identity Card logon will take time, especially for a healthcare organisation with staffing numbering to seven thousand people and above. The advice is to be efficient and effective with your time, resources, and budget, and also to be realistic in the planning and setting of expectations. VDI is about agility, mobility, and long-term benefits—it is not about immediate cost savings.

CEO	CIO
Customer	Supplier
Agility Anticipate and Respond to change	Efficiency Control costs, maximise resource output
VDI <ul style="list-style-type: none"> • Fast Access • Mobility • Consistency • Improved Work flow 	VDI <ul style="list-style-type: none"> • Centralised Management • Security • Long term Operating cost reduction

Figure 7: VDI and the C Suite

Agility and mobility have a symbiotic relationship to fast access to patient data in the modern healthcare environment, but in some static environments, the relationship is not so prominent. Therefore, VDI isn't an essential component to fast data access. There are other options, cheaper and maybe quicker to implement. This is an important point to consider. Environmental Management and Single Sign On (SSO) authentication management applications, usually discussed in the context of VDI, can be deployed to the traditional PC estate. Fast access can still be delivered, but not session mobility. The desktop session has not been de-coupled from the physical device. This is a viable option, worth considering if the IT department has a proven track record of managing the existing PC estate and mobility is not a requirement. However, if there is an existing desktop management problem, then the project will fail to move the debate away from the state of the desktop infrastructure to digital healthcare.

Consideration needs to be given to the EPR clinical programme of works. If the application is externally hosted as part of a managed solution, then due consideration needs to be given to this relationship, especially if presented via its own SBC or application delivery solution, like XenApp. In terms of delivery integration and training, both project teams need to communicate about these topics. This is obvious, but if the VDI project team is staffed by IT infrastructure people, and the EPR by seconded clinicians, managers, etc., then it is all too easy to drop into a silo mentality. An externally hosted EPR application, delivered via its own application delivery solution, like XenApp, needs to be integrated into the clinical desktop so

that the technology is invisible. The experience is of the clinical desktop, regardless of desktop and application hosting. It may well be that the license arrangements around the EPR-managed service make it attractive to use the same VDI vendor, or even to approach integration from the other angle and host your desktop with the EPR application.

Single Sign-On and Authentication Management

Regardless of the decisions around platform, infrastructure, and end devices, in order to improve fast and secure access to patient data within a desktop roaming environment, some form of authentication management combined with SSO needs to be implemented, whether provided by a third application like Imprivata's OneSign, Microsoft's Vergeance or—at least for authorization management—implemented natively within the virtual desktop application. This brokering layer will be the point of access to the clinician. It will be the front door hiding the technology from the clinician.

In a fast roaming environment, using usernames and passwords to logon to a clinical workstation is tedious and obstructs patient care. Doing so encourages bad practices like sharing logons, etc. Generic logons to clinical PCs are not uncommon. This was bad enough in a paper-based world, but as new electronic workflow processes like medication reconciliation, electronic prescribing, and order communications go live it is wholly unacceptable. The fluctuating multi-disciplinary team environment of healthcare can compound the problem further.

"Healthcare team members are often of varying backgrounds, roles, and expertise and they are always shifting. For instance, a new consultant may join the care team when a new problem arises;... Roles are often informally negotiated and therefore agents, tasks, and plans are difficult to manage and optimize. To provide effective care, protect privacy, and reduce error, the healthcare system must accommodate the diversity of participants, the hand-off of responsibilities, and the need for consistent care. Therefore, identity management and user-controlled privacy are also essential capabilities."²⁰

Authentication management addresses these challenges by enabling fast, secure, and auditable clinical access to patient data. Access can be provided by a badge, camera, or fingerprint scan, coupled with an initial PIN. After the initial login, subsequent access to systems and applications involves only the simple tap of a badge, local governance policy permitting. This is termed no click access. The selection of token (something you have, as opposed to the password, something you know), should be made in relation to the IT and organisational strategy. If the organisation already has an identity card which also controls door access, then this card is a natural choice. UK hospitals that use the NHS smart card for spine and EPR access may face a dilemma or an opportunity. Here, using the NHS smart card for the token can be an opportunity to drive through the use of an EPR. If the EPR

system has been rolled out in stages with more advanced functionality going live until the end of the programme, then clinicians may have cards, but there is no real need to use them at present. If the VDI rollout is ahead of this project, then it can be used to drive through the use of these cards. If the VDI deployment is post-EPR deployment, then this card may be the natural choice. Decisions need to be made whether to use proximity tap and go, or to insert a card to make sure the session is disconnected in the end. Likewise, there is a need to mix and match between cards, cameras, and passwords for off-premise access.

Single Sign-on (SSO) should also be combined with authentication management. If the environment still contains horizontal clinical application, then the clinician could be faced with multiple applications after they have tapped into their clinical desktop. Therefore, adding SSO will increase productivity. An example report, quantifying this productivity gain, is outlined later in the article in the Measure Success section. Even in an environment which has consolidated into one EPR system, i.e. EPIC or CERNER, the reality is that there are other corporate and research systems, with their own access credentials.

In addition, authentication and SSO can also be applied to control the behaviour of applications at start up and close down. This opens up possibilities to leverage the present toolset, to supporting existing tools like group policy to resolve various tactical problems as they present themselves. This will be discussed later. Other added values are secure walk away, password reset, and the presence of an existing agent in the desktop, adding potential to provide workflow optimisation, compliance, and auditing. There is also the benefit of integrating printing, which will be discussed later, along with the aforementioned added values. Therefore, it is important to select a solution and provider with a progressive product roadmap and the ability to deliver.

Managing the Complexity

VDI solution architecture is complex. It is a solution, not a technology, which transcends traditional IT department team structures, suppliers, and vendors. This solution can include: security, virtualization networking, servers, storage, application support, desktop support, and the service desk. In smaller departments, there may be more fluidity between teams, but as departments grow in size, so does the thickness of the walls between teams. Controlling and reducing complexity is something which requires close attention.

During the project phase, it is possible to set up virtual teams comprised of staff from other teams. This is assuming that these skills and resources are available in-house. In addition to their core skill set, these engineers should possess the experience and attitude necessary to work in a multi-faceted environment, and of course have customer-facing ability. However, projects have ends dates, and the solution needs to go into production. Therefore, it is important to think about how the new solution not only fits your technology strategy, but also your IT team structure. Figure 8 below maps the technology to an example of a new structure. The Data Centre and EUC teams have prominent roles, but services provided by your teams are also important elements. In a complex solution like VDI, it is important to clarify roles and responsibilities. However, interpersonal skills are just as important as any operational-level agreement (OLA). This support also needs to be 24/7/365 support. Do not underestimate the psychology of not having a desktop, and the impact this has on the IT team responsible for providing the service.

Making use of existing shared services can also assist with reducing complexity. Existing antivirus and data loss prevention (port blocking) systems that have VDI integration which can be plugged into the existing management and reporting solution will speed up the implementation and reduce transition costs such as training, and reduce complexity. Printing is another example of a shared service; this will be addressed in detail in later sections. On the flip side, linking the old and new worlds has its risks. Changes in one area can have unintentional adverse effects on other areas. This can, of course, be mitigated by implementing checks and procedures, but the trade-off needs to be considered.

New IT Structure	VDI Architecture
Desktop or VDI deployment team	End Device
End User Compute Team (EUC)	Application Virtualisation Authentication Management Single Sign-On (SSO) Environmental Management VDI Application Management
Application and Database Team	EUC Application Databases
Externally Provided Shared Services	Card Management
IT-Provided Shared Service	Wireless Network Remote Access (VPN) Active Directory\DNS\DHCP Group Policy Security\PKI\Certificates Anti-virus & Data Loss Prevention (Port Blocking) Print Services
Data Centre Team (Platform)	Backups Network Load Balancer (NLB) Hypervisor Compute Converged Network Storage Area Network (SAN) Storage - Physical and Appliances

Figure 8: VDI Support IT Team Structure

Based on experience, one area should be kept separate is the storage array, even if the storage array is just there to offload writes from the virtual storage appliances. The significance of this will become apparent during performance troubleshooting. If the array has shared workloads like server hosting, then time can be wasted not only in establishing whether or not one environment is affecting the other, but also in explaining this to all parties involved, which can include external partners, and build a consensus from there. Using a dedicated all-flash array like xtremIO solely for VDI, and an EMC VNX® for shared computer service is a potential solution to this problem.

It is important to think through how the technology will change the department, and how the complexity can be controlled. At the same time, the journey also needs to be considered. VDI can be a both transitional and a destination in the "anytime, anyplace, anywhere" IT vision. Therefore, the team structure and complexity needs to consider for the next phases of the journey.

Architecture Design Considerations

On-premise Infrastructure Options

When engaging a solutions partner to deliver an on-premise VDI solution, the likelihood is that it will either propose a horizontal scale out solution or a traditional vertical integrated solution. Experience shows that the horizontal scale out proposals originated from smaller software-oriented partner companies, and the vertical from storage, computing, and network partners.

The horizontal approach can be considered as a response to the complexity and start-up costs of a traditional vertical infrastructure approach. In this pre-built architecture configured appliances with distributed storage are deployed. Further appliances can be added when scale out is required. The appliances can also be referred to as pods. If a pod fails, the user will need to log back in again and pick up a new desktop. Pivot3 virtual network appliances or Atlantis ILIO are storage technologies that can be used with this architecture. This modular approach can deliver a cost-effective solution that can be deployed quickly and efficiently in appropriate increments. The visible and consistent N number of desktops per appliance approach is also very attractive for those struggling to work out a cost per desktop ratio. Proposals can include all software costs as part of the total package. The problem with this approach occurs when the scale involves large numbers. At ninety desktops per appliance, twelve appliances need to be deployed to provide just under 1000 desktops with N+1 redundancy. This could be 24U for rack space and 24 power outlets, plus networking. This could be achieved better via shared components of a blade enclosure. However, this could be seen as contracting the approach or a hybrid approach. It could also be argued that 90 desktops per host is a safe number, but is, again, not ideal for large deployments. The aforementioned still needs brokering service and traditional load balancing, etc.

The traditional vertical approach addresses the weaknesses of the horizontal approach but has its own problems. Anyone who has had to read through and sign off large architectural projects or authorise payment for consultancy services is conscious of the cost and complexity of these solutions. However, the main concerns have been with the storage architecture's capability to provide a cost-effective and consistent solution. This is especially so for persistent VDI, which is generally considered too expensive to deploy on a traditional disk array as it places high workload on storage performance and capacity. Performance hiccups like boot-storm and desktop recomposes can occur. If the storage array shares workloads—a possibility due to cost—then troubleshooting storage-related performance problems can be difficult at the best of times. Hybrid approaches can resolve the problem by

deploying software appliances like Atlantis ILIO to offload the work from the array to the compute. This extra layer between the application and the storage creates complexity and an extra vendor in the mix. It also consumes local compute resources, which could be used for desktops. However, it is a proven approach and deployments are far and wide.

Fortunately, now there is XtremIO, and potentially other products like it, which some think will change the game again. Flash storage will boost I/O performance in the data centre. However, capital costs are high, and enterprise features such as scalability and high availability are not those of a traditional array. EMC'S²¹ XtremIO's 100% flash-based scale out array design addresses these limitations at a competitive cost. In addition to achieving longevity in the flash media, capacity, and performance, it adds ease of use and tight integration with VMware. The building block architecture scales out to meet future capacity and performance requirements. A disk array enclosure (x-Bricks) is plugged in, and workload is balanced across the entire array (existing and new storage).

These types of solutions will reduce complexity and make the persistent desktop a viable option again, which could potentially change and drive the second phase of VDI deployments, or at least provide a means to solve various current issues. However, what catches the eye is the number of desktops a XtremIO X-Brick can support—potentially between 120-145 per compute host. Again, figures for re-harvested blades currently running software appliance storage show an estimated 20% increase in desktops per host. It will be interesting to monitor how this type of technology changes VDI deployments over the subsequent couple of years. There is no reason why it will not be considered for large 2000-plus desktop deployments, but whether this drives the move to persistent desktops for all users in healthcare will be interesting to see.

Desktop-as-a-Service

VMware's announcement that it is to enter the Desktop-as-a-Service (DaaS) market along with Amazon's announcement that it is already in the market has placed DaaS in the spotlight for 2014. In some respects, it is more evolution than revolution, the next step from cloud hosted email and document share services. It is a viable option for the new small-to-medium enterprises, especially as these types of organisations will be for sophisticated users of SaaS services like salesforce.com. Some see the days of building your own VDI solutions as numbered²². However, as Pat Gelsinger points out, it may not be so straightforward for regulated and geographical industries.²³

Considering the conservative nature of healthcare, DaaS may be a little too new for healthcare organisations planning to deploy VDI in 2014. However, it is worth tracking the

progress of these services over time and identifying which has the greater influence on the development of health-related services; small or large providers. Education has begun to see the benefits.²⁴ Buying 'as a service' is an attractive way to encapsulate all costs—associated license costs, etc.—into a single charge per desktop. The move to buying services rather than delivering them also frees up time and releases resources from 'keeping the lights on' type tasks.

If the healthcare organisation is a heavy consumer of web or SaaS services, like in the UK's NHS mail system, or if they use one EPR system for the majority of their clinical work, then migration should not have too many niggling challenges. There should not need to be too much bespoke configuration of the basic desktop offering. At the same time, it could also be a major challenge for organisations that do not have this level of maturity. DaaS can also provide a low-cost business continuity option to supplement the on-premise VDI. Having a number of low cost VDI desktops off site can be cheaper and less complex than traditional storage and application failover solutions. However, the more services needed, i.e. directory services, card authentication, and SSO, the more associated infrastructure needs to be failed over or made accessible.

One of the major challenges for healthcare would be the procurement of these services. If the organisation is geared towards capital expenditure, rather than revenue expenditure, then the shift from a one-off capital expenditure to an on-going revenue monthly fee may or may not be an attractive business proposition for the organisation: "annual budgeting practices tend to emphasize fixed costs to match fixed levels of funding, rather than variable pricing—even if it is cost-effective to do so."²⁵

Privacy and data lock-in are, of course, major concerns and need to be balanced with the need to share data, provide robust infrastructure, and fast access to patient data. As written back in 2010:

"Methods for ensuring the privacy and security of data, while maintaining such services as general search, retrieval, and computational manipulations on the data will be critical, not just for healthcare, but for most all applications of cloud computing. We currently do not understand how best to enable these kinds of secure services, with such efforts as searchable encryption still in their infancy."²⁶

The UK government's G-Cloud initiative to encourage the adoption of cloud services across the public sector, including health, will simplify the procurement by creating a commodity services pay-as-you-go marketplace, which guarantees visible levels of privacy and security via control of the entrance to the market place. Access will be via the G-Cloud store.²⁷

However, it will be up to the culture of the healthcare organisation to embrace this opportunity.

Healthcare may not be at the forefront of this change, but it is an attractive opportunity that should not be ignored. Like with XtremIO it will be interesting to watch the brave healthcare pioneers incorporate these services into their IT provision. Hospitals are like drilling platforms, essential services have to be encapsulated into geographical areas of the work to support functions and processes like operation theatres and the tracking of medication. There will always be a requirement to have local compute and storage infrastructure. Most of the large electronic prescribing systems have a subset of local data replicated down to individual ward areas in case of application downtime. In this environment, moving the entire VDI deployment to a cloud service model may be scary for most. However, not all services are essential. The trend to transfer services from hospitals out in the community makes DaaS a viable option for mobile distributed services.

What will be interesting to watch is how desktop service providers integrate with environmental management vendors to transfer personalisation settings from their mobile devices to their cloud desktop. Federated authentication is an example. The idea is that the desktop, like the app store App, is one means of accessing the data. The key is to sync personalisation and security across devices and multiple cloud desktops.²⁸ More on this later.

Persistent vs non-Persistent Desktop

It is difficult to write about VDI without touching on the non-persistent vs. persistent desktop debate, and how the debate relates to healthcare deployments and the best way to deploy VDI. The debate, which periodically flares up on various blogs, is a response to the proposed position that VDI should only be deployed as a persistent desktop with a 1-1 user-desktop mapping. A persistent desktop is about moving the desktop to the data centre, keeping the rich user experience of the traditional desktop, but with the added value of mobility and organisational data governance and protection. It is different from centralised management, which then reduces the overhead and locks down the desktop. Non-persistent VDI desktops—also known as stateless desktops, whereby users access a shared desktop taken from a master image—provides this functionality. Deploying non-persistent desktops—the argument goes—is costly and complex. The desired result can be achieved more cheaply using other technologies. Microsoft's Remote Desktop Session Host (RDSH) is usually cited as the alternative option.

There is no doubt that persistent desktops are a good use case for VDI. However, until now the associated storage costs have been a problem. New flash disk arrays like EMC XtremIO and virtual storage appliances like Atlantis ILIO are now entering the market. These technologies are seen as catalysts for change, which will broaden the appeal of all types of

VDI deployment and make a persistent desktop a viable option for all. If this is the case, then the persistent desktop has a place in healthcare going forward. Researchers with long-tail applications, or their own developed applications, are other use cases. A BYOD knowledge-worker is another.

Persistent VDI desktops will deliver faster access to patient data, but they will struggle to deliver the consistency and efficiency savings and operational change outlined in the 'Perfect Storm' opening to this article. For added value of mobility and data governance, there is still a requirement to patch and update the Software Asset Management (SAM), and support the user environment. No rebooting is required to re-provision a new desktop to resolve the problem. It could be argued that no change is needed, as IT teams are already carrying out these processes; therefore, deploying persistent desktops is a natural progression. This is assuming that these processes were working, and IT departments are resourced accordingly. The approach is not good for a CIO looking to make a step to change the approach to delivering IT services to the organisation.

It is no surprise, then, that non-persistent desktops are very visible in healthcare environments. If they are considered to be more expensive, then the question remains: why have healthcare providers taken the non-persistent route?

Application virtualisation of some type needs to be used to publish applications which are not installed on the base build into the desktop. Best practice is to keep the base build as generic and flat as possible. The potential problem is that organisations can sleepwalk into creating an application virtualisation industry, especially if they are blissfully unaware of the application sprawl in their respective organisations. There are also troublesome applications that cannot be virtualised. To an extent, this is true of healthcare; getting down to the departmental and researcher level, it has its own fair share of badly written long-tail applications.

However, this need not be true of all healthcare providers who have made the decision to implement VDI. A clinical desktop-base build will have the Microsoft office product suite, PACS Imaging, and EPR applications installed. Other clinical enterprise applications, such as Portals, EMC Documentum[®], Healthcare Solutions, etc., will be web-based. Corporate enterprise applications like Human Resources (HR) and procurement are more likely to be SaaS provided. In this situation, the clinician may only need access to a couple more departmental applications, like an Oncology or Radiology Management System (RMS), depending upon their specialty. In a small, 300-bed acute or community type hospital, the range of specialists won't be extensive. In a large, 1000-bed hospital, there may well be

enough specialities to create a problem. However, the larger the hospital, the more likely there is to be a fully functioning EPR application delivering all clinician services, from PACS imaging, Order Communications, and Medication to specialties like Oncology and Cardiology. This approach will significantly reduce the pressure on the application virtualisation process and the complexity of the VDI desktop environment. Hospitals that use VDI and have consolidated on Epic or Cerner for all their department and specialties are a prime example of this approach. In the UK, the trend to portal technology to present results from distributed applications will have the same effect.

It will be interesting to see if SaaS applications like Microsoft Office 365, including email, can be integrated into these large scale EPR applications, along with associated document storage. If so, it is possible to begin the move away from a VDI desktop for some use cases.

VDI is not necessarily the end of the journey for faster patient access. It is an important part and a large stepping stone, but it could be one component in the toolkit. With the launch of the VMware Horizon Suite of products, there is a case that VDI is only one of three ways within a product framework to deliver faster access to patient data, without losing centralised management. Here, IT departments are not so much purchasing best-of-breed applications but are making long-term investments in a portfolio of products and building a supplier relationship. It would be more common to see this in smaller IT departments than in larger ones where a decision on a product is made within the thick walled silos of teams.

The reality is that everyone has a starting position, including existing vendor relationships, which means added value and preferential pricing can be an important factor. As outlined above, there is also a relationship between the EPR vendor and the VDI vendor. An example of this is Cerner's long term relationship with Citrix. Another is VMware Horizon View, which is currently the only target platform for delivering Epic applications to clinical users.

Some deployments will also take the hybrid approach, using layering applications like Unidesk to manage the application virtualization or environmental management applications to add richness to the persona of the non-persistent desktop. This will be discussed later. Also, of course, it is only an opinion that RDSH is cheaper and easier to manage, a point best left to the bloggers.

Personalisation and Application Managements Layer

The decisions on layering are whether to add application management and personalization to the VDI solution. This is also known as workspace or environmental management. The application management layer manages user rights, permissions, and application control. Some can also provide certified tools for licence compliance. Environmental management centralises the setup and lockdown of a user's persona. It can also add cross-platform personalisation. If deployed, it allows a consistent, personalised experience spanning VDI and physical desktops. Vendors who provide all or part of this functionality are Appsense RES Software, Scense, Liquidware Labs, Immidio, and triCerat. The following examples are problems and the areas where the above tools can be applied:

- Active Directory logon time improvement.
- Location-based printing.
- Location-based application awareness, i.e. launch an application on logon if accessed from an outpatient clinic.
- Licence compliance for non-specialist applications, like Microsoft Visio and Project. This function allows centralised pooling of licences so they can be tracked and re-allocated.
- Map environment setting on the fly, like network drives. One example of this would be when once a month the finance team has use for a legacy application, which needs a non-standard organisation mapped drive. For this case, the drive should be mapped on the application's launch and closed on the application's closure.

Where these tools have not been deployed, the system administrator would use a combination of group policies, scripts, and amendments to the base build to deliver some, but not all, of the above-mentioned functionality.

The benefits of this layer are that it presents a rich scripting environment for system administration to provide a rich, targeted user experience, which could not be achieved so elegantly with native tools, like group policies. It also allows individual penalisation akin to persistent disks with non-persistent disks or shared images. Some organisations will use the said workspace management in their existing PC estate to provide faster logon times. The case here is a personalised and consistent experience across devices, rather than the transfer of an existing session.

The criticism on adding a workspace management layer focuses on the cost and complexity of deploying this layer to the VDI solution. There is no doubt that workspace management can deliver a rich personalised experience. However, at the high end of the market, the tools are expensive if not used to their full potential. Maximising value requires a steep learning curve and time. In addition, the initial capital cost of deployment requires on-going revenue

spend whether on software support and subscription or staff development. Extra complexity to the VDI solution also has its own associated costs.

Think through the following questions when considering whether to purchase and deploy as part of the VDI solution. How well can the problem be solved without deploying? Does the deployment have to be part of Phase One or can it be added later? What is the long term vision of the product? The benefits of deploying SSO and an authentication management layer have been outlined along with integrating a follow-me-print solution. Leveraging these existing components may achieve the same or similar results, which in turn reduces complexity. The SSO will require an agent deployed to the desktop, which will execute trigger events based on pass-through session variables, like user or location. The follow-me print solution will certainly provide location-based push or pull printing.

Even if the deployment of a workspace management layer is required, it may well be better left to a later stage. Licence compliance, for instance, can be added to VDI with the related applications at a later date. This will elevate pressure on existing technical resources and flatten out organisation change and costs. Finally, when looking to having a long-term relationship, think about the future and how this relationship can solve tomorrow's problems. Talking about how some of these workspace vendors are looking to extend personality across platforms, which include OS and SaaS, Brian Madden comments:

"The ultimate goal would be to abstract and then inject user settings and preferences independently from the application delivery itself. A simple example would be Microsoft Word. If a user adds a word to his custom dictionary from Word running on his Mac desktop, that word should also be added to the dictionary in a copy of Word running centrally in an RDSH session. The same could be true for mail settings, wallpapers, photo locations, data files, account numbers, which hand the user likes the mouse in, etc. Unfortunately, we're just barely starting to integrate ways of managing and delivering different types of apps—dynamically injecting user preferences is still a long way off. But it's still worth keeping in the back of your mind." ²⁹

Printing (Ignore at your peril)

VDI is being deployed to drive through change in the organisation. It is the platform of choice and is going to provide the agility, consistency, and mobility required to implement future transformation programmes of work. In the long term, it is going to simplify the infrastructure component of any further large application deployments, in the same way that server virtualisation achieved this in the data centre. It will also provide a platform for the paper-light strategy. Therein lies the problem. If not considered in the first instance, implementing VDI can be challenging, where location printing awareness is needed. In healthcare, this is compounded by the fact that the industry is still heavily reliant on paper-based processes. VDI is part of the paper-light strategy, which will not be achieved until the applications and workflow changes to replace paper have been delivered. Therefore, a credible printing solution, which elegantly sits within the VDI solution but can add value via improving the printing workflow process, needs to be included in the final solution.

There is no better option than implementing a following me-type printing solution, whereby a user prints to a central queue. Users then pull down their print jobs from a compatible print device, via PIN, swap, or proxy card. This eliminates all need for system administration to manage printer mappings and saves the user from having to select the correct printer from a list. Also, there is no need to use workaround group policy settings or a third-party persona management tool, thus reducing complexity in the VDI environment. This idea also complements the mobility characteristics of VDI. The follow-me-desktop and follow-me-print concepts are easily grasped and communicated. If a follow-me print solution is already in place, just plug into the existing one. If not, there are a number of things to consider.

If implementing a follow-me print solution with your VDI deployment that contains a printer consolidation element, try and complete the printer consolidation project ahead of the VDI rollout. Come the VDI rollout, the solution will only need to be connected to the already-established print service. Also, be aware that some clinical applications may handle their own printer mapping data for location-based printing.

If the opportunity arises, align the printing solution with your VDI session authentication process. If using tap-and-go to authenticate your VDI session, the card component is a good option to release print jobs, as well. If your organisation has many cards, managed by different operating units, there is an opportunity to force card consolidation to this selected card by combining printing and system access. As new systems come on-line, this card will begin to be seen as a natural choice, especially if the card has multiple storage options, like barcode, magnet stripe, proxy, and smart chip. In the UK healthcare market, the NHS Smart card is an obvious choice.

Use shared directory services like the pre-session authentication directory if using this to access VDI. This will allow one-stop-shop setup for VDI and printing, which is beneficial for regular junior doctor rotations, which are common in large teaching hospitals. More importantly, it will also mean that control can be taken over the printing workflow process within the VDI desktop, which allows further opportunities to incorporate some of the following:

- Encryption of print jobs both at rest and transition.
- Auditing of print jobs.
- Expiration of print jobs.
- Delegation of print jobs to other print queues (e.g. from doctor to medical secretary).
- Location aware printing.

These can still be achieved to a degree without integrated directory services; however, being able to track system log-on, print auditing, and application authorisation via a combined directory and workflow process within a healthcare setting will be of value. It will be interesting to see if these solutions evolve into what could be termed a printer integration engine, or publishing workflow application. A middleware workflow, initiated by the user, could solve a variety of tactical problems. Here, print jobs would be sent to the central queue but processed based on rules and input variables of location, application, and authorisation. In this world, jobs can be pull printed, push printed, emailed, or even pushed (i.e. to a document repository), all via one print queue.

The challenge, then, is to have a print strategy that is aligned to the VDI deployment. The strategy should embrace the vision of data access, anytime, anyplace, by having a strong location-based presence. If this can be achieved by a single print workflow solution, which allows print jobs to be released from multiple types of devices based on one's location, then more the better. But, it can also incorporate a combination of technologies, like VMware's Thin print.

The main thing is that what is ideal for corporate and administrative services—which could make up less than 20% of hospital staff—is not necessarily so for a clinical environment. An illustration is in outpatient areas like day clinic consulting rooms. In these areas, the clinician and the patient put a premium on this time together; therefore, asking a clinician to leave the consulting room to pick up a printed information pack for a patient may be something the organisation does not want to implement at this time.

End Device

The end device is all about separating the logical from the physical. The data centre VDI desktop needs to be accessible from a range of current and future devices, regardless of location. Independent of mobility options and BYOD policy, there needs to be a standard default clinical device of some kind. The device, which will be the workhorse of the organisation, will be visible in prime locations like the nurse's station and outpatient clinics. It may also be incorporated into mobile solutions like Workstation on Wheels (WoW) devices.

Some organisations manage the transition from PC to thin client by converting existing PCs into thin clients. This harvesting of value from existing assets can reduce capital spending for the initial deployment, which in turn supports the business case. Here, reclaimed suitable hardware is re-imaged with a locked down OS or custom thin PC image. Microsoft's thin PC is an ideal candidate here, as it enables leveraging of existing management tools like System Center to manage the device, plus other enterprise features such as BitLocker. This approach assumes that the correct Microsoft licensing agreement—a software assurance (SA) benefit—and above-mentioned management tools are in place. If not, then it is possible to achieve the same outcome via locking down the device's original equipment manufacturer (OEM) OS through a combination of group policy, Internet searches, and of course a good systems administrator. The Windows approach has added benefits, in that it has good driver support. The value of this depends upon your printer or card authentication strategy. However, it will need a windows CAL and will be more resource-hungry compared to Linux-based approaches. The 1GB memory requirement may or may not be an issue, depending on the age of the existing PC estate. Five years ago it may well have been an issue.

As mentioned, the alternative approach is to opt for a Linux-based thin PC build; this can be an in-house build or off-the-shelf purchase. Devon IT's VDI Blaster and Dell Wyse PC Extender are examples, to name but two products. The Linux approach generally needs fewer hardware resources, which extends the pool of available hardware. The two examples given can also be managed centrally via a supplier-supported management tool. The downside is less driver support around wireless and card authentication.

Harvesting the value of existing assets may assist with capital spending, but it can have the reverse effect upon revenue spending. Reclaiming, re-imaging, and re-deploying a PC takes time and resources, even more so if the device has to be replaced within a short period because of hardware failure. Then there is user perception, which may or may not be an issue depending on the internally communicated vision—i.e. brand new way of working vs. old way of working can be interpreted in a number of ways. Redeploying old PCs may please the Chief Finance Officer but may not excite the coal-face clinician.

If purchasing in bulk, the cost of purchasing new thin or zero clients is a persuasive argument. The argument for zero clients is about longevity and management overhead. Fewer moving parts equal less component failure; this, in turn, extends the life of the device. The devices also require less setup configuration and less maintenance. Instead of an OS, the devices have a specially designed onboard process tied to one of the VDI-related protocols (HDX, PCoIP, or RemoteFX). The boot-up time of these devices is significantly quicker than other options. Since nothing can be processed locally, they are perfect for improving governance via channelling all activity through the VDI desktop session. The down side is the lock-in to one protocol. The lack of local device manipulation or configuration can cause issues. Therefore, it is important to have established the printer and device authentication strategy before making a decision on a specific zero client device.

The performance of the device is not in doubt; the issue is the lock-in, which contradicts the agility and mobility of modern day computing. One protocol lock-in means that the value of the device to the organisation is dependent upon the in-place VDI software solution. If there is a high likelihood that the environment will remain static, then this should be OK—but as mentioned, healthcare is changing. Mergers are taking place, services are beginning to be moved across sites, and then there is DaaS. As the DaaS market matures, it will be able to provide services like business continuity to on-premise VDI deployments. One protocol lock-in may well limit the choice of offerings. Time will tell how this develops, but it is likely that two healthcare organisations with different VDI implementations may want to begin to work closely together.

Thin clients, on the other hand, have a native OS, usually Linux-based or Windows-embedded, which is the OEM version of the Microsoft thin PC discussed earlier. The devices are configurable, so they are flexible if the printer or authentication processes change. They have local processing power so web-based applications can be used locally, which frees up valuable VDI sessions. However, more moving parts also equal more component failure. Flexible but with more management overhead, sums up the difference from zero clients.

Manufacturers like Praim use the concept of zero configuration with their thin clients. This is a configuration which can be pushed out centrally to all devices. The configuration on the device can be overwritten and updated with a new configuration, which can include new protocols. The configuration can also include specific and bespoke organisational settings, like authentication agents. This approach allows the flexibility of the thin client but reduces the management overhead. A good use case would be for Business Continuity, whereby all the thin client devices could be centrally redirected to the VDI DR site. Once the

configuration is deployed and the device is rebooted, the clinician coming on shift would be unaware of the change.

An interesting evolution, which has been around for a while without taking hold, is the mobile thin client, like Devon IT Ceptor or Dell's Project Ophelia. These ultra-small Bluetooth and Wi-Fi-enabled devices turn any HDMI monitor into a thin client. The ideal is that, once configured with secure VPN or SSL, they can provide a remote means to access the cloud or on-premise VDI environment.

Licensing

Licensing VDI is complex. However, software licences have to be purchased. It is as simple as that. The reality is that existing licensing, probably by device, would already have been purchased in various ways by various departments and staff groups, at least partly centrally, if lucky. Existing agreements may also be in place, that where not designed for the new roaming world. The old world, therefore, needs to be mapped into the new. It is very easy to tie everyone—including the CIO—up in knots when working out the various permutations. A little knowledge can be very dangerous in this situation. However, not addressing this at the beginning and finding, half way through the project, that further funding is required, is far worse.

The correct way to address this is to seek advice from the software vendor. Most large account resellers (LAR) will have this skill set in-house, accessible as a free pre-sales service. The extra advice is to help reclaim and re-harvest existing licences from the estate. If replacing PC's with thin clients, the PC needs to be reclaimed. Do not leave it in situ for longer than needed. If it is a standard image, then, in addition to the CAL licence, it will also probably be taking up a Microsoft office licence. At a minimum, re-harvesting licences will reduce the complexity of any internal or external audit. Finally, come to your own independent understanding of the existing licensing position and what needs to be purchased. This opinion should be informed by the organisation's existing software asset management (SAM) system and documented information acquired from your own research. If you are still unsure, present your findings to a senior respected colleague, preferably one who has accountability for the project, for closer scrutiny.

Deployment

Is healthcare unique?

The general opinion is that healthcare is different. This opinion states that change cannot be delivered in the same way as in other sectors like finance or manufacturing. Deployment war stories from other sectors usually describe a scenario in which staff went home on Friday and returned to work on Monday to find their PC removed and replaced with a terminal. This could be described as the "I understand what you are saying, but this is what you are getting" approach. To an extent, this article can also be accused of feeding this opinion. In terms of rollout, it is not so much about difference, but does it affect the rollout of the end solution?

First of all, people go home after work, but roles do not. A large acute care hospital is a 24/7/365 operation for inpatient areas. As one shift goes home, another one takes over. Also within this shift pattern it is not uncommon to find locum and nurse agency staff. Any big bang rollout will need to factor in 24/7/365 working and short-term contract agency staff. To support this, the NHS in the UK employs over 1.3 million people.³⁰

Inpatient ward areas also have what can best be described as horizontal management structures. There is a ward manager, ward sister, or charge nurse who is responsible for care delivery on the ward, including cleanliness. They are also responsible for managing how staff provide care and interact with patients and visitors.³¹ However, other clinical staff, from pharmacist to physiotherapists, work and visit inpatient areas. Then there are the consultants, doctors, and doctor rotations to consider, along with associated administrative staff, service, and general management.

Age distribution in healthcare tends to be evenly spread. The following three graphics—two from England and one from the United States—illustrate this point. In the European Union (EU) the employment rate for the 55-64 age group in work "increased by 5.9 percent from 2000 to 2005 and amounted to about 42 percent in 2005. The employment rate of individuals between 15 and 24 years has decreased by about 1.3."³² Here, the point is not about how older workers embrace technology change compared to younger workers. It is about highlighting that no one generation dominates the workforce in healthcare and how that affects one's training, rollout, and communication plan.

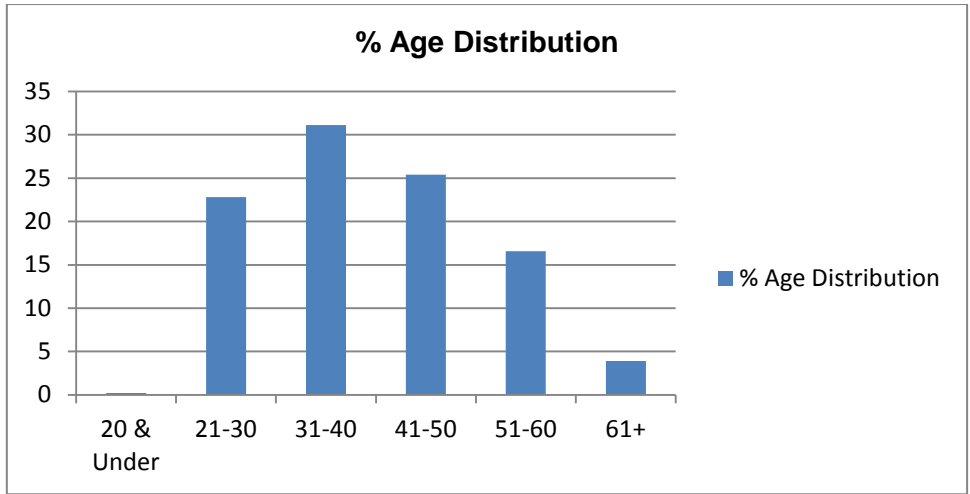


Figure 9: % Age Distribution at St. Georges NHS Healthcare Trust. Total staff count 7902.³³

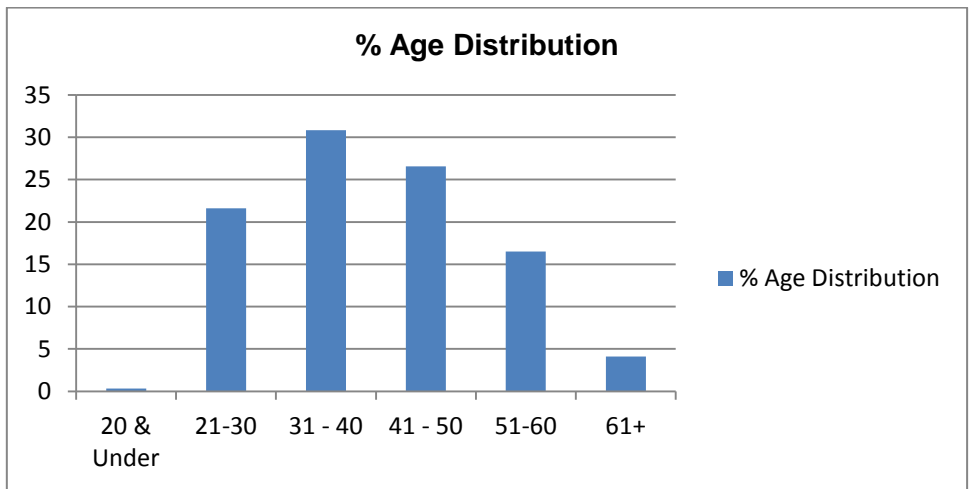


Figure 10: % Age Distribution at BARTS Health NHS Trust. Total staff count 14188.³⁴

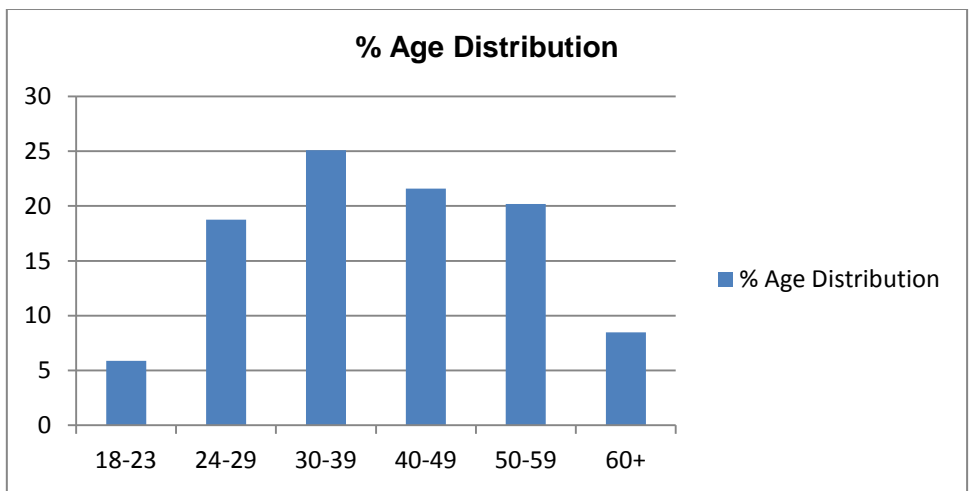


Figure 11: % Age Distribution at The Johns Hopkins Hospital. Total staff count 14388.³⁵

Note: Figures are for employed staff and not Full-Time Equivalent (FTE) posts.

The principle author of the research project Meyers goes on to conclude:

"firms with higher proportion of younger employees are more likely to adopt new technologies... Firms that have enhanced teamwork and have a higher proportion of employees between 40 and 55 years are more likely to adopt new technologies compared to firms without workplace reorganization."³⁶

The empirical research was based on a data set of 365 German service sector firms from the knowledge-intensive services and IT services. However, it highlights how enhanced teamwork can drive through technology change within the aging workforce of modern economies.

Characteristics	Ages 18-32	Ages 33-52	Ages 53-68
% in Workforce	29%	35%	33%
Communication Technology	Text or Social Media	Email and Text Messaging	Telephone
Communication Preference	Online, Mobile and Text Messaging.	Email or text	Preference for Face-to-Face, but telephone or email if required.

Figure 12: Generalized Communication Preferences of different age ranges.

However, the main thing to remember about healthcare is that it is a people-focused environment. People who choose to work in healthcare place a high value on communication, even more so in community care environments. Hence, the technology needs to be invisible, and be seen as an enabler of patient care. Chuck Christian, then CIO of Good Samaritan Hospital in Vincennes, Indiana and current CIO at St. Francis Hospital in Columbus, Georgia, reflecting on his SSO deployment, goes on to say:

"Communication with users is critical to success. People are averse to change – even when it is for the better. Don't spring a new technology on them. Send email messages, hang posters communicating the benefits of SSO and SA. Let them know what's in it for them. Let them know that their workflow won't change."³⁷

Deployment Tips

As a sector, Healthcare has its own characteristics, which should be respected, but not feared. Once the Proof of Concept and trial are complete, along with an optional soft launch to get those final user-feedback improvements incorporated, the product is ready to be deployed. There is no point in going softly at this stage. Time is eating away; revenue licensing, hardware support, and subscription renewals draw closer by the month.

Deployment should be completed safely, but quickly.

The best policy at this point may well be to hand it over to a dedicated deployment team. This can be made up of engagement, deployment, and post-deployment troubleshooting teams. However, the main point is that it is a deployment and transformation exercise. If IT staffing levels are low, then look to bring in deployment contract staff, with an emphasis on customer-facing skills rather than technology. This way, the team members can be moved around to refresh their energy levels during face-to-face engagement in clinical areas.

It is important to not become obsessed with the end device deployment. It is easy to show progress by deploying end devices, especially if adding and not replacing existing PCs. However, saturating the environment with end devices does not necessarily generate activity. It will do so, to a point, but not in an efficient way. The goal is to generate people using the new system (Activity). This is how efficiency savings are going to be made. Night shift staff will not use the new end devices if they have not been introduced to them; they will gravitate to the existing PCs in place. In order to transform, the focus needs to be on the user and the logical desktop.

Therefore, it is important for staff to continue with post deployment visits to the clinical areas in order to deepen the activity. A staff uniform, even if it is just a shirt and name badge, is the ideal way for deployment staff to advertise their presence and availability without encroaching upon busy staff. It is common for the new users to have an issue within the VDI environment; that is not a VDI issue. Therefore, cross training the deployment with the other main applications like the EPR application, will not only provide added value, but also will drive activity. It will also support and show an integrated approach between desktop and clinical workflow which is the central argument of this article. Plus of course, show confidence and reduce pressure on the service desk.

Measure Success

Measure and report on the deployment phase of the project. This needs to be done at regular intervals. Weekly reporting will be good for your own teams in order to steer your own deployment, but monthly reporting, at the least, should be provided for the organisation. If there is an existing departmental performance reporting process up to the executive, then use that vehicle, as well. It is a transformation project, so it shows continuous progress. This reinforces the vision and supports requests for future funding. The main points are to keep it simple and to not turn it into an industry. Do not exclude the qualitative and anecdotal feedback received during the rollout. Healthcare is people-focused. Try to weave this information into any reporting mechanisms. If it comes from clinical opinion formers in your organisation, it is even better. Also, if the feedback has led to improvements in the solution, then make sure that this is visible, as well.

In terms of statistical reporting, the statistics need to show that progress is being made and the deployment targets are being met. However, where possible, show any efficiency savings that are already being made, no matter how small. It is a journey, which needs to be emphasised.

If deploying thin or zero clients as part of your deployment, a simple graph showing how your physical PC estate is declining is a simple but powerful image. It can be accompanied by a short explanatory passage along with projected forecasts.

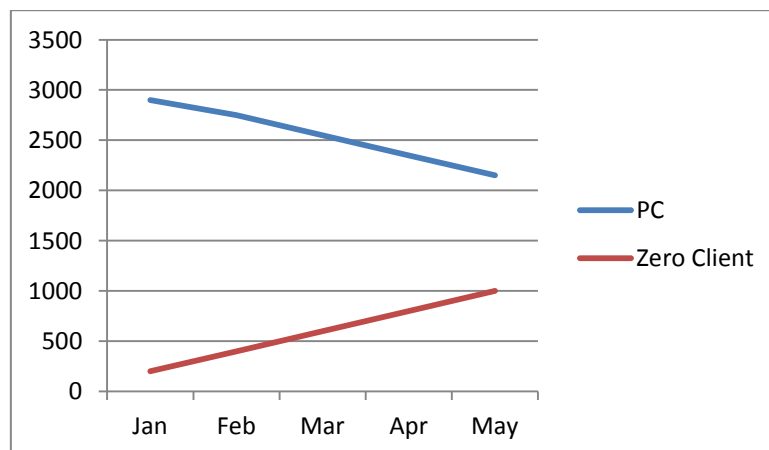


Figure 13: Example progress report showing PC and Zero Client direction.

The graph is easily created via counting host names in Active Directory. This can be scripted, but hosts names will need to be removed from Active Directory on a regular basis in order to get accurate reporting.

Even though this process needs to be reported on, swapping out an end device alone does not transform your organisation. As outlined previously, the project needs to drive through activity. Therefore, it needs to report on activity, as well. It is activity that is going to make a difference. The following two reports are taken from Imprivata's standard deployment reporting tool. The bottom report outlines logon activity during a seven-day period. It breaks down logon activity into password, chip and pin, and chip only. It also shows logon activity as opposed to re-connection.

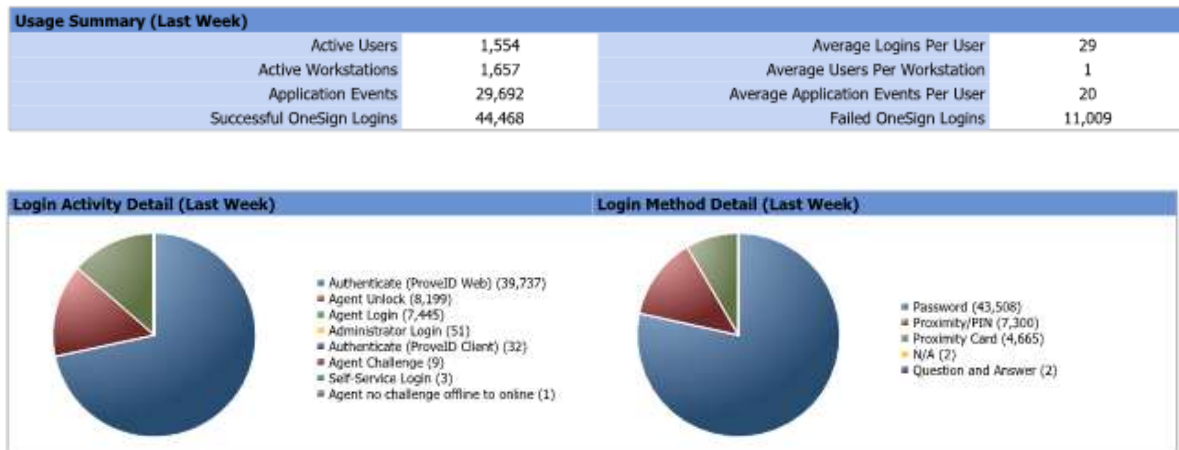


Figure 14: Extracts from a sample Imprivata deployment report.

The top report summarizes active users, application events (SSO), and average logins per user. This is all very good and easily obtainable. However, it would be good to start to add value and report on efficiency saving. Figure 15 breaks down SSO login events by application name. Adding an average logon time calculation to the report shows efficiency savings in terms of hours saved over a given period. The report can even be expanded. If the staff grouping is known for the EPR logons—say 60% Doctors and 40% nursing staff—it would be possible to factor in the cost. The finance department usually will be able to provide a cost for this. It is normally factored at mid-pay band.

Single Sign On (SSO) Weekly status report			
Application Name	Enrolled users	Logins (Last Week)	Hrs Saved*
EPR	1500	16,900	140.83
PACS	2100	4050	33.75
IT Self Service Portal	2500	3900	32.50
Theatre Management	250	530	4.42
Radiology Management	200	400	3.33
Total		25,780	214.83

*Average 30 second Application Logon

Figure 15: Example Single Sign-on Progress Report

One of the benefits of a VDI estate is centralised management. Therefore, look to harvest the information that is at your disposal. Figure 16 shows daily activity in the VDI environment for a seven-day period. The graph highlights the number of people connected and the number of connections which works out to a ratio of 3:1. It also shows the week builds up then tapers down towards the backend of the week.

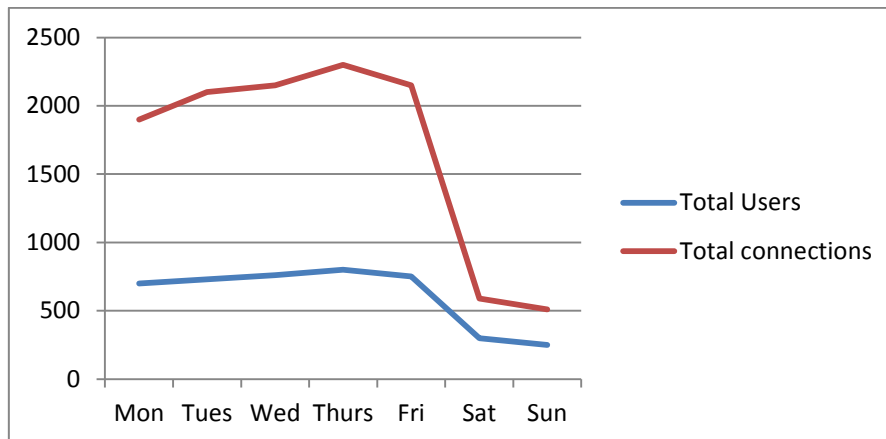


Figure 16: Example VDI daily connections Report

The graph was generated from queries run against the VMware View database. It is an example of how a custom report written with your report writer of choice can be used to make meaning of your organisation's working practice. The advice here is to start small. Get to understand the data sources available, along with their data structures, then begin to build reports which show transformation. However, most importantly, share the fruits of your labour with others.

References

1. <http://www.publications.parliament.uk/pa/cm201011/cmselect/cmhealth/512/51208.htm>
2. <http://www.nao.org.uk/report/progress-in-making-nhs-efficiency-savings/>
3. UCSanDiego|Extension. Healthcare IT Research Report 2011. sAN Diego Workforce Partnership 2011.
4. The Perfect storm idea is from a presentation I delivered with Andrew Harris at the best practice show case theatre EHI live 2013 (<http://www.ehilive.co.uk>). Jen Ryan worked on the developing the perfect storm concept with us.
5. For further reading: Professor Corrigan P., Mitchell C. The hospital is dead, long live the hospital. Reform, 2011, p.15.
6. Warner, N. A Suitable Case for Treatment (The NHS and Reform). Grosvenor House Publishing Limited 2011, p307.
7. Topol, E. M.D. The Creative Destruction of Medicine (How The Digital Revolution Will Create Better Health care). Basic Books 2012.
8. ibid p5.
9. NHS England. Safer Hospitals Safer Wards (Achieving an Integrated Digital Care Record. NHS England 2013
10. <http://www.ehi.co.uk/news/EHI/9098/%C2%A350m-of-tech-fund-rolled-over>
11. Imprivata. 2013 Desktop Virtualization Trends in Healthcare: A global perspective. Imprivata, 2013.
12. US and Asia may use the term EMR instead of EPR, the M denoting "medical." The main point here is that both are Hospital-specific. For further clarification, see: <http://healthcareinformatics3000feet.blogspot.co.uk/2007/02/accurate-definitions-emreprehr.html>
13. Madden. B, Knuth. G, & Madden, J. The New VDI Reality. Burning Troll Productions, LLC. 2013, p274.
14. http://www.reportlinker.com/p01816844/Virtual-Desktop-Infrastructure-VDI-Market-in-UK.html#utm_source=prnewswire&utm_medium=pr&utm_campaign=Marketing
15. IDC. Quantifying the Business Value of VMware View (white Paper).IDC, 2011
16. ibid.
17. Apsite. A, and Huq, R. Quantifying The Business Value of VMware View Hosted Virtual Desktop Solution. VMware World (San Francisco) 2013.
18. EMC. EMC IT's Journey To The Private Cloud: Virtual Desktop. December 2010
19. EMC. EMC IT's Journey To The Private Cloud: Server Virtualisation. December 2010
20. Graham. S, Estrin. D, Horvitz .E, Kohane. I, Mynatt. E, Sim, I. Information Technology Research Challenges for Healthcare: From Discovery to Delivery. Computing Community Consortium 2010.
21. EMC. Introduction to the EMC XtremIO Storage Array: A Detailed Review (Ver 2.2). June 2013.
22. <http://www.brianmadden.com/blogs/brianmadden/archive/2013/12/20/think-you-can-do-vdi-cheaper-with-better-performance-more-reliability-and-more-securely-than-a-daas-provider-how-arrogant-are-you.aspx>
23. Gelsinger, P. Executive Roundtable VMworld 2013 San Francisco. <http://www.youtube.com/watch?v=CmGRuttgbB4>
24. Wyld, C. Moving to the Cloud: An Introduction to Cloud Computing in Government. IBM Center for the Business of Government. 2009.
25. ibid p41. Original source (Miller, J., 2008).
26. Graham. S, Estrin. D, Horvitz .E, Kohane. I, Mynatt. E, Sim, I. Information Technology Research Challenges for Healthcare: From Discovery to Delivery. Computing Community Consortium. 2010.
27. <http://govstore.service.gov.uk/cloudstore/>

28. Madden, B, Knuth, G, & Madden, J. The New VDI Reality. Burning Troll Productions, LLC. 2013, p. 236.
29. *ibid* p. 237.
30. Warner, N. A Suitable Case for Treatment (The NHS and Reform). Grosvenor House Publishing Limited 2011, p96.
31. <http://www.northerntrust.hscni.net/about/1233.htm>
32. Meyer, J. The Adoption of New Technologies and the Age Structure of the Workforce (Discussion Paper No 08-045). The Centre for European Economic Research 2008.
33. St George's Healthcare NHS Trust. 2012/2013 Annual Report. September 2013.
34. BARTS Health NHS Trust. Annual Report 2012/2013 Delivering the Barts Healthcare Vision. BARTS Healthcare Trust July 2013.
35. The Johns Hopkins Health System Corporation Department of Human Resources. Annual Report for Fiscal Year 2013. October 2013.
36. Meyer, J. The Adoption of New Technologies and the Age Structure of the Workforce (Discussion Paper No 08-045). The Centre for European Economic Research 2008.
37. Imprivata. *Expert Advice - 20 Practical Tips on Authentication and Access Management from Practiced Professionals. Imprivata 2010*

About The Author

Justin Beardsmore is an experienced senior healthcare IT manager currently working across operations, projects, and transformation within a large South London acute hospital and community care environment. He has over 14 years of IT experience, with the last seven in healthcare. He has a solid background in the Virtual Data Centre (VDC) storage and compute space, and his primary focus and interest as end-user computer lead, for the past two years, has been leveraging technology to win over doctors and nurses and begin the transformation of St. George's into a fully-roaming device-independent virtual clinical desktop environment. Justin has a Masters degree (MSc) in Computer Science and is a certified EMC Proven Professional Cloud Architect and Virtualized Infrastructure Specialist.

EMC believes the information in this publication is accurate as of its publication date. The information is subject to change without notice.

THE INFORMATION IN THIS PUBLICATION IS PROVIDED "AS IS." EMC CORPORATION MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WITH RESPECT TO THE INFORMATION IN THIS PUBLICATION, AND SPECIFICALLY DISCLAIMS IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Use, copying, and distribution of any EMC software described in this publication requires an applicable software license.