SERENUS
WHITE PAPER

serēnus (Latin)
1 Clear, fair, bright, serene, tranquil.
2 That clears the sky or brings fair weather.
3 (figuratively) Cheerful, glad, joyous.

EXECUTIVE OVERVIEW

One of the top ten disruptive technology trends today is Internet of Things Software – platforms, standards and analytics. The Internet of Things is driving tremendous innovation, differentiation and value. Companies like Google, Samsung, Cisco, Intel and Qualcomm spent $14B on over 60 IoT-related companies last year.

Still Cisco reports that only 1% of potentially connected devices are actually connected. As the other 99% come online, the opportunities are remarkable. The real value to be mined from the IoT is no longer in the devices. It is in how these devices connect, interact and deliver value to the user. That's the critical role that the network plays, and the IoT opportunity now shifts to network software innovators.

Many commentators say that the Cloud is just a metaphor for the Internet. For the purposes of this paper we make the following distinctions between *The Internet* and *The Cloud* – a Public Cloud is a collection of software and services delivered over the Internet, a Private Cloud is delivered over private network infrastructure, and a Hybrid Cloud is delivered over a combination of the Internet and private networks. Most businesses today are gravitating towards Hybrid Clouds, which offer a variety of services, performance characteristics and price points, catering to specific business needs.

From the beginning, the simple answer for Cloud connectivity has been the Internet. But that's not a suitable answer in all cases. As a result, the assortment of connection types and architectures has grown over time in response to the varying uses and prioritizations and the integration level needed by the cloud customer. It could be argued that the Cloud model has shifted much of the cost and complexity of software, processing and storage, to the network.

The adoption of Cloud services by business is growing at a tremendous rate. However we see that most of the activity to-date has focused on the data centre and we believe this is only half the story. We view the Cloud as not just what takes place within data centres, but everything involved in the end-to-end delivery of services to end user devices including networks, Internet, mobility, security, analytics, and management systems.

Serenus looks beyond the data centre to develop systems that address end-to-end performance management of the Cloud *ecosystem*. And this is of vital importance to businesses as they strive for productivity and efficiency gains by using Cloud services.

CLOUD ECOSYSTEM

Serenus is an Australian company specializing in Cloud Computing innovations. Serenus is a passionate advocate for the benefits and future viability of Cloud Computing for the business market. However we see that most of the activity to-date has focused on data centre services IaaS and SaaS, and we believe this is only half the story.

We view the Cloud as not just what takes place within data centres, but everything involved in the end-to-end delivery of services to end user devices including networks, Internet, mobility, security, measurement, control and management systems. We look beyond the data centre to develop systems that address end-to-end performance management of the Cloud ecosystem.

Cloud Ecosystem
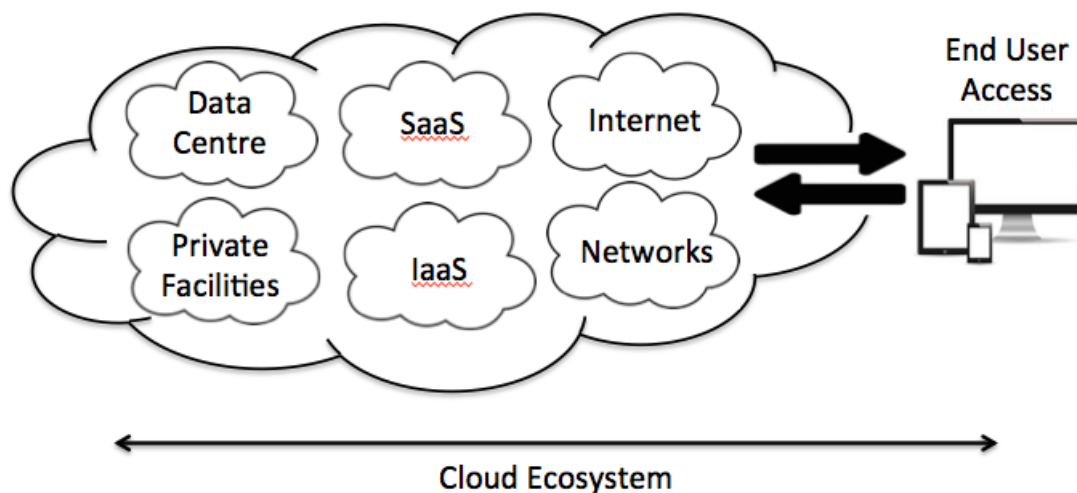
The Cloud is placing ever-increasing reliance on access networks, private networks and the public Internet, to deliver a high quality end-user experience. It stands to reason that as businesses move IT processing off-premise, they also create greater physical separation between data sources, data processing and end users. This gap has introduced added complexity such as network interconnectivity, increased latency & variability, multiple access technologies, security, management and control issues. On the one hand, the Cloud has simplified and lowered the cost of data processing and storage but, on the other hand, shifted cost, complexity and risk to the network.

Traditional network Management Systems (NMS) built for private network protocols such as MPLS and Frame Relay do not cater for increasingly complex hybrid Cloud environments. With worldwide deployments of FTTx infrastructure consumers and businesses will increasingly use broadband as their primary means of Cloud access and enterprise WAN connectivity, leveraging broadband's inherent cost/performance benefits.

But the lack of control, management and scalability of Cloud access becomes an inhibitor to achieving the ultimate goal of low cost, flexible, on-demand computing, whilst still delivering vital end-user performance levels.

For business, one of the biggest inhibitors to a sweeping move to the Cloud is lack of control. The questions arise: "where is my data?" "will I get guaranteed service

levels?" "who's responsible if something goes wrong?" "How can I manage this environment?" Most businesses have invested years of time, effort and cash in building robust, reliable, well managed systems to deliver IT services to the enterprise, and now they're being wooed to "move to the Cloud", trusting that everything will be fine. Understandably the potential risks and uncertainties are overwhelming concerns for CIOs and IT Managers.

New Cloud management tools are required to control hybrid Cloud environments and deliver end-to-end visibility, performance management, infrastructure optimization and autonomous on-demand resource provisioning.

Serenus has developed patented technologies to (a) measure end-to-end Cloud performance – inside and outside the data centre, (b) monitor Cloud infrastructure resource utilization and (c) trigger automatic resource-on-demand requests to Service Providers, to achieve scalability and optimal end user performance.

Serenus' innovations are built on the following enabling technologies:

(a)   Open network management signaling protocols such as SNMP and NSI to gather infrastructure performance characteristics and signal Service Providers to auto-provision resources such as bandwidth-on-demand and processing-on-demand;

(b)   Proprietary software agents to monitor the characteristics of any intelligent device/object within a Cloud environment, including mobile devices, PCs, servers, routers, firewalls, etc;

(c)   Data analytics technology to determine Cloud resource utilization and performance trends, resource bottlenecks, and to predictively determine optimal resource requirements; and

(d)   Java and Openstack based bespoke software platform designed to operate in single user mode or multi-tenant mode to suit the needs of individual customers and Cloud Service Providers.

This innovative Cloud management system can be incorporated into Telco Service provider environments to control and manage the Cloud Ecosystem – encompassing private, public and hybrid Cloud environments – bringing the managed Cloud "edge" right to the end-user device.

One of the key benefits of Cloud Computing is *scalability* - the ability use and pay for additional resources on-demand. Such functionality has been achieved with virtual machines (VM), virtualized data storage and SaaS. However the same degree of flexibility hasn't yet followed through to network services where, despite advances in Software Defined Networking (SDN) technology, Bandwidth on Demand (BoD) is not generally available.

To-date the "solution" to BoD, according to many Service Providers, is to overprovision ie. buy more bandwidth than you normally need so you can meet occasional demand spikes. Some forward thinking Carriers are starting to offer BoD and others have it in their sights. It's inevitable that BoD will become commonplace over the coming years driven by an increasing demand for scalable Cloud connectivity.

Serenus' Cloud management technology has global applicability and is aimed at four distinct market segments:

(a)   Carriers and Cloud Service Providers to manage complex hybrid Cloud environments on behalf of multiple end-customers;

(b)   Medium-to-large enterprises who manage their own Cloud infrastructure or want visibility over multiple Service Providers;

(c)   Hardware vendors to incorporate Cloud performance measurement and resource optimization functionality into networking devices; and

(d)   Middleware vendors to incorporate Cloud performance measurement and infrastructure optimization technology into Software Defined Networking (SDN) systems.

Today Cloud companies offer a plethora of IaaS and SaaS services - in fact these services have rapidly become commoditized. Serenus' vision is to provide a Cloud Access and Management platform which gives customers a unified Cloud environment regardless of underlying infrastructure, network and software services, and regardless of where their end-users are located.

OFFERINGS

Cloud Infrastructure Services

When Serenus started in 2013 it foresaw an opening in the Cloud Networking market for managed Virtual Private Network (VPN) services as a cost-effective alternative to legacy private networks for business. Traditional private WAN services such MPLS and Carrier Ethernet have remained very expensive compared with Dedicated Internet Access (DIA) services – particularly on long-haul international routes - making it cost prohibitive for many Australian small-to-medium sized companies to expand their network presence into new offshore markets such as South East Asia.
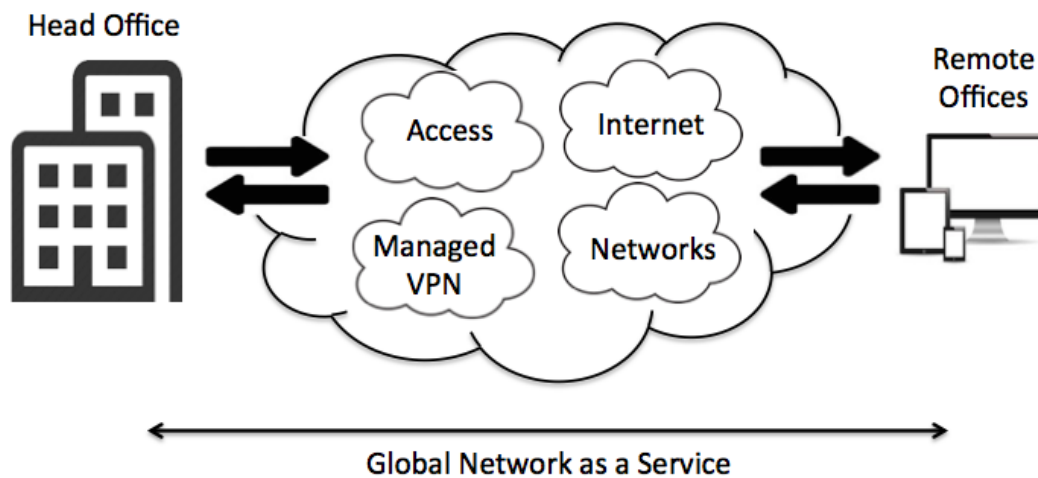
Serenus recognized growing customer demand for a one-stop-shop approach to sourcing public and private Cloud Networking and Backup services from a single service provider. Particularly for multinational companies wanting to centralize procurement and avoid foreign contracting and support problems. Serenus extended its offering to provide a fully integrated Cloud networking, computing and backup platform with extensive national and international coverage. We provide a one-stop-shop procurement facility for managed Internet, network and infrastructure services in Australia and 200 countries worldwide.

Network Services

Serenus offers private Network Services such as Ethernet and MPLS, as well as Dedicated Internet Access, Broadband and VPN services. All network services include local equipment such as routers and are fully managed and monitored on a 24×7 basis. A comprehensive Service Level Agreement (SLA) is offered.

Backup Services

Serenus offers the industry leading Infrascale™ range of backup services. Services include Cloud-based and Appliance-based backup, which is fully automated and based on military-grade data centre security. Enterprise-wide backup coverage includes servers, PCs, Macs and mobile devices.

Computing Services

Serenus offers the IBM Softlayer™ range of Cloud infrastructure services. The

solution offers unlimited processing and storage capacity, accessible via private Cloud or via the Internet. Data is securely stored in IBM data centres. Comprehensive management and monitoring tools are also provided.

Wireless Services

Companies today want greater mobility and freedom across their workplace. Serenus' dedicated WiFi platform is available in 220 countries and includes wireless access points (WAP) and controller devices, with integrated connectivity to Internet and private Cloud. End-user management & security control systems are included.

Cloud Management

In 2014 Serenus was awarded an Innovate NSW R&D grant to develop a Minimum Viable Product (MVP) based on its patented VPNscope technology.

Cloud, big data, mobile, social, and IT security are significant forces that are transforming IT and business. As these technologies move into the mainstream, the network as the common critical infrastructure component will get close to the breaking point. Data centre technology such as server and storage virtualization add ever-increasing demands and complexity to the network architecture and management.

VPNscope is a Cloud management system designed to manage public, private and hybrid Cloud environments. VPNscope provides visibility and control over Internet and private network infrastructures for the benefit of business customers and third-party Service Providers. VPNscope is an integrated control platform for enterprise-wide bandwidth capacity planning and control.

VPNscope is designed to maximize business productivity and minimize computing and networking resource costs. It achieves this by optimizing response times and data throughput inside the Private Cloud environment and externally with Software and Infrastructure providers.

Consulting Services

Serenus helps businesses understand how best to leverage the technology and cost benefits of the Cloud. We develop Cloud strategies aimed at achieving broader business goals.

There are hundreds of Cloud offerings on the market. Serenus has experience with leading local and international vendors and can benchmark offerings based on specific business criteria. We can assist businesses by analysing and quantifying costs and benefits to inform management's decision making.

Serenus has a wealth of experience deploying IT and Networks within enterprise and Service Provider environments. Expertise includes international deployments as well as executive level engagement and program governance expertise.

Patented Technologies

Serenus holds two Australian Innovation patents in the field of Cloud computing:

"VPNscope" is a Cloud network management and performance optimization tool

that identifies data flows over Virtual Private Networks, continuously monitors bandwidth utilization and dynamically issues bandwidth on demand requests to Internet Service Providers using Network Service Interface protocol.

Cloud Performance Index "CLIX" is a method of measuring the end-to-end performance of applications operating in a Cloud Computing environment based on the combined performance of individual Cloud infrastructure elements.

The following sections describe these technologies in more detail.

CLIX^{TM}

Cloud Performance Index (CLIX) is a metric for determining the performance of Cloud Computing systems based on the networking and processing infrastructure elements that determine end-to-end system performance.

CLIX provides a way of quantitatively measuring, benchmarking and improving the performance quality (end-user experience) of IT systems in Cloud Computing environments.

Cloud Performance Index (CLIX)
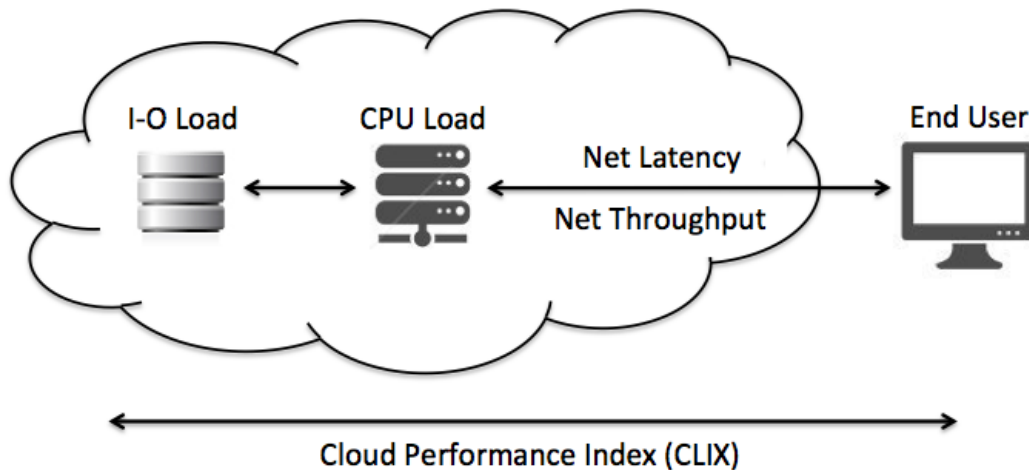
CLIX is measured in the range 0-10 where zero represents the worst possible performance, five represents average performance, and ten represents the best possible performance. CLIX is derived by a formula combining the four individual infrastructure elements most affecting performance of software applications running in a Cloud Computing environment, as experienced by end users.

CLIX technology has applicability for Service Providers, Software & Hardware Vendors, and Enterprise Users to measure Cloud performance:

*   Real-time performance monitoring & control;
*   Measure performance trends over a period of time;
*   Identify sub-optimal performance and capacity bottlenecks; and
*   Measure service level compliance.

As more and more software and processing moves from a controlled "in-house" environment into the Cloud, network accessibility and performance become increasingly important. The Cloud is not simply a bunch of large Datacenters, nor is it the Internet. The Cloud is everything involved in delivering IT functionality right to the end user's device.

New methods are required to measure, monitor and control the Cloud to ensure that the many benefits of Cloud services do not come at the expense of end user performance and a decline in overall business productivity.

CLIX can be incorporated into System Monitoring and Management tools and Openstack implementations to provide a reliable, consistent, quantitative means of measuring, trending and improving the performance of Cloud Computing environments.

VPNscope™

VPNscope is a next-generation Cloud management system designed for Public, Private and Hybrid Cloud Computing environments. VPNscope automatically detects data flows in Cloud networks and continuously monitors performance and infrastructure utilization in real-time. VPNscope dynamically calculates optimal resource requirements and issues "on-demand" requests such as Bandwidth and CPU capacity requirements to ISPs and Cloud Service Providers.

VPNscope is designed to maximize business productivity and minimize infrastructure costs, by optimizing data flows across an organization's private Cloud or intranet, as well as between the organization and its external Cloud service providers.

Examples of managed Cloud elements include data centres, Cloud infrastructure (IaaS), Cloud software (SaaS), Head office WANs and LANs, remote Branch offices, and any Internet Virtual Private Network (VPN) connections.
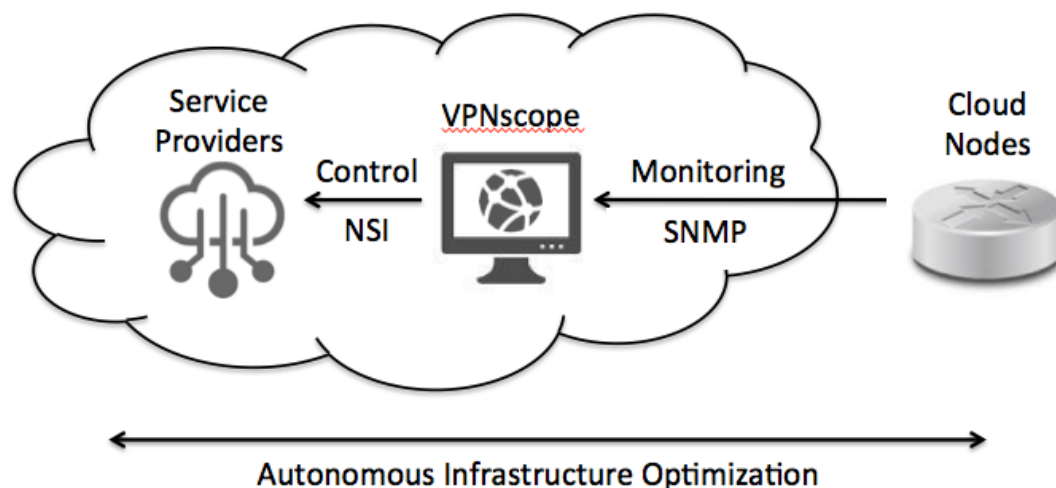
VPNscope provides graphical views of all data flows within a Cloud ecosystem, encompassing public Internet and Private networks, and third party Cloud services.

Traditional Network Management Systems operate at Layer-2 and monitor private Wide Area Network (WAN) links. VPNscope is designed as a native Cloud system operating at Layer-3 to monitor data flows over any physical or virtual network regardless of the underlying transport layer.

VPNscope dynamically triggers Bandwidth on Demand requests to Internet Service Providers and Cloud Service Providers via Network Service Interface (NSI) and OpenFlow standard protocols. Additional service interface protocols can be supported as required.

VPNscope can operate in single tenant mode to manage a discrete enterprise Cloud environment or it can operate in multi tenant mode to allow Service Providers to manage multi-client environments. It runs either on a dedicated server or is accessible as Software as a Service.

INDUSTRY PERSPECTIVES

The Role of the Network in Cloud Service Delivery: Building it Right – Verizon Business White Paper 2014 (synopsis)

When optimizing Cloud service delivery, it's all about the network. The network has always been a key business and technology necessity. No matter how you're looking at Cloud service delivery – from the perspective of the end-user, app developer or business strategist – the network and proximity to your end users, partners and customers are two of your most important considerations. Without localization and fast, predictable network interconnections, you cannot take advantage of the valuable opportunities the Cloud computing market offers your business.

This paper examines the role of the network and how proximity to customers is critical to end-user quality of experience, application performance and growing your addressable market.

Beware The Pitfalls within Networking For Hybrid Cloud: Networking Has a Ways to Go to make Hybrid cloud simple – Forrester White Paper March 2015 (excerpt)

While we would all like hybrid cloud configurations to be simple and easy, the current economic, physics, and security realities result in infrastructure integration challenges that can be complex and costly to get right. Setting up the correct types of connections is crucial to meshing public cloud platforms and on-premises resources securely and with predictable quality of service. Even though standard Internet connections may have sufficed in your pilot phase of cloud use, a seamless production hybrid demands more thorough engineering.

Success in fusing internal and cloud resources requires a series of interconnected discrete services that offer survivability, dynamically change with business conditions, and meet customer expectations. This report explains how infrastructure and operations (I&O) professionals can best match the various transport and connections options available for your cloud maturity level, along with overcoming some of the challenges in an environment that is relatively new and has a limited set of options.

From the beginning, the simple answer for cloud connectivity has been the Internet. But that's not a suitable answer in all cases. As a result, the assortment of connection types and architectures has grown over time in response to the varying uses and prioritizations of these use cases and the integration level needed by the cloud customer. Many of these uses cases and the solutions chosen to support them have their flaws.

Multi-Cloud Connectivity for a Successful Hybrid Cloud Strategy - Frost & Sullivan Stratecast June 2014 (extract)

Stratecast believes that as enterprises increasingly make cloud an integral part of their IT infrastructure, they will place more emphasis on the networks that connect the various pieces (on-prem cloud, private data centers, public cloud, co-location facilities, managed hosting) of their hybrid IT deployment model.

The future enterprise IT infrastructure will be a combination of in-house data centers, dedicated off- site hosting, and private, public, and hybrid cloud solutions. Commonly, enterprise IT departments optimize their use of multiple cloud service providers by choosing cloud providers based on workload type. As businesses embrace cloud services, and take measures to make them an integral part of their IT infrastructures, they are looking for a simplified approach to implementing their cloud strategies.

The success of cloud computing will depend on how well cloud services integrate with existing enterprise IT infrastructure. Networks play an important role in interconnecting the various platforms. A network-enabled cloud can help enterprises seamlessly integrate cloud into their existing IT and WAN infrastructures. ECX addresses the critical need for a simplified approach to direct connectivity to multiple clouds.

As Cloud Adoption Grows, So Do User Expectations – Equinix Paper 2015 (extract)

As more and more customers rely on cloud computing, providers need to be prepared to tackle the challenges that are inherent to widespread cloud adoption and optimize their service performance. That performance will make or break a cloud service provider in today's competitive cloud landscape. And, if delivered successfully and consistently, can also differentiate providers from the pack. Achieving an optimal level of performance isn't simple. It's a multifaceted challenge, and Cloud Service Providers (CSP) have many customer requirements to meet. Providers must be able to demonstrate proven and auditable processes and expertise on security, data privacy and compliance to satisfy enterprise customers.

If the global data center is the foundation of a service delivery strategy, then the quality of connections it provides is what allows CSPs to execute that strategy and deliver optimal cloud services.

To succeed in today's world, simple connection is not enough. CSPs need interconnection – the ability to connect to end customers, networks and each other in an instant. A truly global data center should offer the CSP a robust and inter- connected ecosystem, providing access to their choice of Network Service Providers to achieve the high level of performance that customers are demanding. And forging relationships with other Cloud Service Providers, Managed Service Providers and System Integrators within the ecosystem can also help in optimally delivering cloud services. Because the ability to connect via private connections rather than the public Internet can address security concerns.

Hybrid cloud growth leaves enterprises scrambling for control – ZDNet Feature 2015 (extract)

While the uptake of hybrid cloud has been solid this year, enterprises are now scratching their heads about how to bring governance and control back into their business. Earlier this year, cloud adoption was still ramping up. But now, as 2014 draws to an end, Accenture Australia's cloud computing lead Alison Cairns said the market has moved so quickly it has done a complete flip. "We've now reached

the point where everyone and anyone out there are trying the cloud," she said.

Cairns said there are three distinct customer groups that are emerging as a result of the mass uptake. "The first are called native, which means you're born in the cloud, so if you've got some unique piece of business or you want to do something new, you usually go out and purchase the cloud so it's not coupled to your legacy," she said. "The next one is transformational, where clients are saying, 'I've had a taste of the cloud and now I want to move my traditional data across the cloud'. "The third group is what we call legacy, where there are certain workloads that some will never move from legacy - or not that we can predict in the next five years."

However, a majority of enterprises - from industries including media and communications, technology, the public sector, logistics and transport, financial and insurance, and resources and energy - make up a combination of all three customer groups, which essentially means that they are all leveraging hybrid cloud infrastructures, Cairns said. "Six to nine months ago, people were saying they wanted to get into cloud, but only in private. The public cloud has come so far so quickly that people want to put their stuff out in public, as well as private, and move their workloads around," she said. Cairns explained that the reason why there has been such a quick uptake in such a short period of time is because enterprises have realised the advantages a cloud environment can provide, such as the increased freedom to be agile and innovative. "It's almost the freedom to fail quietly. So you can go out and be innovative, and if it does work, you can expand madly on public and on private. It's just so much more accessible," she said.

But because the uptake has been so rapid, Cairns said many enterprises are now wrangling with multiple cloud accounts, while learning how to balance shifting workloads from legacy and into the cloud. "Some of our clients are saying they think they have about two or three cloud accounts, but it turns out they've got as many as 20, mainly because the cloud is so incredibly accessible you don't need to go to IT; you can just get your credit card out and log on. It's happening across the board, be it from the home user to enterprises," she said.

In turn, enterprises are realising the need for a cloud management solution to bring the governance and control back into the business so that the company has a single view of its entire cloud operation, Cairns said. This covers knowing about all the cloud contracts that exists within the business, when workloads are spun up and down, what workloads exists in the cloud, who has access to it, and whether the business is getting the best out of its private and public cloud. "It's a great problem to have, but at the same time you need to bring the governance and control back in as well," Cairns warned.

More specifically, Cairns said enterprises are demanding help in two areas when it comes to cloud management. The first is around managing and provisioning their own virtual machines, and the second is around how to manage their cloud infrastructure before it's too late. "We don't want them to turn around and go, 'How do I manage this?'" Cairns said.

QUOTES

"The network is the computer." – John Gage, Sun Microsystems

"Cisco estimates that 50 billion devices and objects will be connected to the Internet by 2020." – Cisco Systems

"Flying by the seat of the pants must have been a great experience for the magnificent men in the flying machines of days gone by, but no one would think of taking that risk with the lives of 500 passengers on a modern aircraft. The business managers of a modern enterprise should not have to take that risk either. We must develop standard cloud metrics and ROI models, so that they can have instruments to measure success." – Dr. Chris Harding, director for interoperability at The Open Group

"Worldwide revenue for the cloud systems management software market was $1.8 billion in 2013, representing growth of 48.5% year-on-year. The market is expected to experience double-digit growth for a number of years as SMB, enterprise, and service provider customers embrace cloud architectures and build up their investments in cloud-based applications, services, and infrastructure." (IDC)

"The Internet of Things is driving tremendous innovation, differentiation and value. Buyers like Google, Samsung, Cisco, Intel and Qualcomm spent $14B on over 60 IoT-related companies last year, doubling the number of acquisitions and increasing spending 40-fold." – Jeff Brown, Vice President Corum Group

"We see the applicability of this new (Serenus) technology for customers such as telecommunications service providers who need to optimise network performance whilst minimising network operational costs" (Michael Lawler, CEO Selera Labs Australia)

"VPNscope is an impressive tool with the potential to realize efficiency gains for many organisations involved in the delivery of Cloud based services. As providers of managed services and Cloud based hosting to a number of organisations in the private health and aged care sectors, we are certainly looking forward to trialing the tool within our client base – this area of the ICT industry is highly competitive and requires constant innovation to remain relevant and internationally competitive." (Dale Jenkins, Managing Director, Microsolve Australia)

"Businesses don't want to take a leap of faith with vital company information. Yes they want the benefits of Cloud, but they still want to have visibility & control over their data and how it's being delivered to them – this is what Serenus' technology is all about, it's about giving visibility and control back to the customer" (Ross Goodfellow, CEO Serenus)

SERENUS IP

CLIX technology Ⓟ Australian Innovation Patent No. 2015100348 registered by Serenus Pty Ltd.

CLIX™ is a trademark of Serenus Pty Ltd.

VPNscope technology Ⓟ Australian Innovation Patent No. 2014100466 registered by Serenus Pty Ltd.

VPNscope software system © Serenus Pty Ltd.

www.serenus.com.au

www.vpnscope.com

www.yurruunng.com

www.yurung.com