

Spotlight on Cloud Computing Series

Infrastructure as a Service

This brief summarizes the EDUCAUSE webinar “Spotlight on Cloud Computing: Infrastructure as a Service,” held October 22, 2010. The speaker was Kyle Johnson, Associate Provost for Information and Learning Resources at the SUNY Institute of Technology.

Many institutions have begun moving application services to the cloud, but what other kinds of services could move there? What might our institutions look like if desktops, storage, servers, and even the network were delivered via the cloud? This webinar explores the possibilities for infrastructure as a service.

This webinar uses the following definition of cloud computing:

“...the term cloud computing refers to the delivery of scalable IT resources over the Internet, as opposed to hosting and operating those resources locally, such as on a college or university network. Those resources can include applications and services, as well as the infrastructure on which they operate.” (EDUCAUSE, [7 Things You Should Know about Cloud Computing](#))

Cloud computing allows an institution to purchase a service level rather than software and hardware, theoretically making it easy to scale services as needed. (Contractual obligations are a negotiation and policy issue.) Most discussions of cloud computing focus on software as a service, but the cloud also offers options for infrastructure as a service (IaaS), defined as:

“‘Infrastructure as a Service’ is a provision model in which an organization

outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it.” (From [SearchCloudComputing.com](#))

The two definitions are similar, but the focus in IaaS is more on the nuts and bolts of the overall campus IT function through purchasing a service level, not hardware and software.

Steps in Migrating to IaaS

As a first step, an institution might bring in outside resources to assist in managing existing infrastructure. This is essentially traditional outsourcing of support, with the institution still owning all the hardware and making all the major decisions about how to support the infrastructure.

Next, the institution might want to partner with a company that can provide the expertise to design, build, and manage infrastructure. At this point, the institution still owns all the hardware and probably the maintenance contracts, but has moved select staffing resources elsewhere. This stage might reap more benefits as the service provider supplies more hours of service. (At institutions where budget processes or policies make it difficult to exchange capital dollars for operating dollars, this might be the endpoint in adopting IaaS.)

In the last phase, the institution stops purchasing even capital hardware, instead negotiating with a service provider for a given infrastructure. In this case, the institution is bounded primarily by funding concerns and does not have the supply chain management concerns that commonly accompany investments in capital hardware.

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Note that at no time in adopting IaaS does an institution surrender the ability or responsibility to set strategic directions for its infrastructure. The implementational and operational details might change, but the infrastructure still needs to meet institutional priorities.

Considerations

There are a number of factors to weigh in considering IaaS.

- First, there are two meaningful prerequisites.
 - » Institutions need a well-designed and well-implemented identity management plan and system. When systems are all on site, staff can manually manage identity and access controls between systems. But as infrastructure is shifted to the cloud, an institution can't rely on those solutions.
 - » Institutions also need a robust, redundant network. If an institution is bandwidth-constrained or has problems with performance, it will face challenges getting the service level it needs from the cloud.
- Second, there are financial considerations. Moving to the cloud model tends to shift expenses from capital to operational. If an institution doesn't have the flexibility to shift dollars, IaaS will be harder to implement.
- Third, IaaS brings the same legal considerations as software as a service. It is

important to understand where data and infrastructure will reside—that is, in what state or country—and whether an institution will be comfortable with where data resides. Ensure also that IaaS contracts are constructed to meet federal, state, and local regulations.

- A fourth consideration is staffing. In IaaS, staff will need more expertise in procurement, contract negotiation, and managing vendor relationships. Staff will also devote more time to interacting with the institutional community in needs gathering and analysis. Similarly, staff will spend more time on the integration of services. Migrating to IaaS requires different staff skills, so IT administrators need to be careful about how they train and transition staff.
- A final consideration is cultural. In shifting infrastructure to the cloud, it's important to involve members across the institutional community, both to fully understand their needs and to keep them apprised of changes that IaaS might bring. IaaS also requires a shift in culture within the IT division, perhaps including a shift away from tailoring its own solutions when solutions already exist in the cloud. IT also needs to realize that it will lose some operational control, although that loss will be somewhat offset by the ability gained via IaaS to better meet community needs.

Examples of IaaS

Next, consider examples of infrastructure as a service.

Compute Cycles

Research into computing support can be challenging. Often there is uneven demand for the service, a large capital outlay required to get it started, and specialized staff needed to maintain it. This kind of service, when done in-house, doesn't scale down very well. Moving infrastructure to the cloud allows an institution to provision and pay for compute cycles on an as-needed basis, without the need for staff on site to maintain them.

A good example of this is [Amazon Elastic Compute Cloud](#) (EC2), which provides an

application programming interface (API) so that institutions and organizations can create a simple window that allows researchers to access compute cycles as needed, with several options for paying for the service.

Servers

Many challenges are inherent in server management. Many campuses host multiple operating systems that require specialized in-house expertise. Space, HVAC, and power needs can be substantial, even for a small school. Providing failover at a remote location can be expensive if an institution has to duplicate its entire service structure, or it can require difficult decisions about which services won't be duplicated.

Moving this infrastructure to the cloud lets an institution select a core operating system based on need rather than the availability of in-house knowledge. The provider will be responsible for failover and often already has the necessary facilities and plans in place. With this solution, an institution can also avoid building another new data center infrastructure.

To phase in this kind of service, an institution might start with remote support for some of the systems for which it lacks on-site expertise. Next, the institution might look into heavier virtualization and engage a partner to design, build, and manage the infrastructure. After that, a logical final step would be to migrate all virtual infrastructure off site.

Amazon EC2 is an example of this service, and with the addition of the [Virtual Private Cloud](#) extension, provides this infrastructure on an isolated network with a virtual private network connection back to campus. [Rackspace](#) and [GoGrid](#) are designed for permanent server installations at an off-site location. States and regions sometimes offer government or not-for-profit options that can provide this service. In New York State, for example, the SUNY schools have access, for a fee, to the [Information Technology Exchange Center](#) (ITEC), which supplies virtualization hosting and other support.

Storage

The problem of meeting the increasing demand for storage space can be compounded

by different and competing needs for enterprise and individual storage. A storage area network (SAN) infrastructure can require significant capital outlay, in an era of shorter and shorter refresh cycles. With cloud-based storage, adding capacity is just a phone call or e-mail away, with options to customize solutions to meet enterprise and individual needs.

Moving infrastructure to the cloud does not necessarily save money

Phasing in this service might start with a remote contract for SAN support. A next step might be to mirror your SAN infrastructure at an off-site location. As an institution migrates its server infrastructure to the cloud, some enterprise storage will likely migrate with it. Different services can then be contracted to provide cloud-based solutions for individual storage needs.

Examples of this service include [Nirvanix Storage Delivery Network](#), an appliance that resides in an institution's local data center. On the back side, it attaches to various cloud-based storage mechanisms. To the institution's local infrastructure, it looks like a large pool of local storage. To serve individual needs, an institution can look at services like [DropBox](#) and [Box.net](#), which provide storage that integrates into the user's desktop. For short-term needs, Amazon offers the [Simple Storage Service](#) (S3).

Backup

As the volume of data storage changes, backup tape or disk management can get complicated. The need to be compliant with e-discovery and retention laws, and the fact that much institutional data does not reside on central servers, can compound the issues.

Moving backup to the cloud can simplify data and compliance management and mitigate the need to worry about tapes and disks. Cloud-based services can also include desktop/laptop backup options, so an institution can be more confident about the recoverability of that data.

[Iron Mountain](#) provides an enterprise backup solution, and places like [Mozy](#) and [Carbonite](#) provide relatively inexpensive desktop and laptop backup options.

Desktops

One of the most significant challenges of desktop management is desktop application and patching. In addition, software in computer labs on campus is not available to off-site or distance learners. As desktop refresh cycles move to three years or less, pressures on both capital and staffing resources increase.

With cloud-based delivery, an institution can provide virtual services to local desktops via thin client or software client, with only a few central images to manage. With this model, users can also access computer lab resources more easily when they are off campus.

Companies like [Panologic](#) and [NComputing](#) provide hardware thin clients, while companies like [ICC Global](#) and [Secure-24](#) can provide the back-end infrastructure for a virtualized desktop.

Telephony

Even the campus phone service is a candidate for migration to the cloud. Many campuses consider land lines a necessary evil, but not necessarily a place for investment. Many institutions today run on unsupported analog PBX systems. Moving a telephony system to the cloud eliminates the need to manage a complicated PBX or VoIP system. The only things to manage on premises are handsets.

[PAETEC](#) provides a hosted IP telephony solution. [Apogeenet](#) provides this service for students in residence halls.

Network

In essence, networks are the linchpin for all the other services provided on campus, but

they are complicated and expensive to maintain. The increase of services on networks requires increasingly specialized expertise. Networks, too, do not scale down well.

Moving this infrastructure to the cloud can provide access to the skills and expertise needed to monitor and manage a sophisticated network 7 × 24. It can better scale both down and up, and it can stabilize costs (albeit using operating dollars instead of capital funds).

Phasing-in of a cloud network might start by outsourcing resources for specific network activities. The next step might be to partner with a firm to design, build, and manage a network for you. A final phase would be to purchase a network service level from a provider. The network never really goes off campus, which will still house hardware and wiring, but the operational and potentially capital responsibilities shift off site.

Examples of network solutions include [Nfrastructure](#), and Apogeenet for residential networks.

Final Considerations

Moving infrastructure to the cloud does not necessarily save money. Money an institution might save by not investing in an individual server could end up being spent on additional bandwidth. The importance of IaaS is that it allows institutions to hand off commodity or non-differentiating services so that staff can focus on things that do differentiate the institution.

In thinking about migrating to IaaS, campus IT administrators would do well to consider three potential challenges:

- Make the data center you have *the last one you will ever need*.
- Everything doesn't need to be sourced to the cloud at once, but *start somewhere*.
- When opportunities arise, *take them*.

Access this and other briefs in the Spotlight on Cloud Computing Series, as well as recordings, transcripts, and slides from the webinars, at <http://www.educause.edu/Resources/SpotlightOnCloud>.

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