A University Datacentre for Virtualised Services

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Executive summary

Server "virtualisation" is rapidly transforming the way in which commercial computing services are provided. It enables services to migrate around a pool of shared hardware, with potentially dramatic savings in cost and power, as well as increased reliability and flexibility.

A central University "datacentre" would be capable of providing a facility for both central and school services. The full benefits of the virtual infrastructure could be realised, without taking control of the services themselves away from the existing providers.

The University is in a strong position to exploit these advantages - Informatics, for example, has commercial consultancy and research connections in the area.

There is clearly an implication in terms of financing and hardware provision. However, the the most critical aspect is the organisation - the area is developing rapidly, and some dedicated staffing would be necessary to consolidate the necessary expertise. Any provision would also need to be sufficiently robust and responsive to gain the confidence of potential users.

This paper expands on these issues and makes the case for a University-wide datacentre.

Background

Virtualisation

"Virtualisation" technology, such as VMware[1] or Xen[2], allows a a number of "virtual" machines to be hosted on a single "physical" machine. Apart from the performance degradation due to sharing, software running in the VMs is unaware that it is not running on a dedicated physical machine - different VMs may run different operating systems for example, even on the same physical machine. VMs can also be "migrated" between physical machines, without disturbing the running software ("live" or "hot" migration).

Few services use the full power of their dedicated server hardware continuously - average Windows Server utilisation is often less than 20%. Depending on the demands of the services, and the type of hardware, it is typical to see tens of VMs running on a single physical machine.

If the VMs become sufficiently busy simultaneously, and their total requirements exceed the capacity of the physical machine, then some VMs can simply be migrated on to another physical machine.

This ability to aggregate the load can yield dramatic cost savings, especially for lightly-loaded services. In addition to the hardware cost, there are also associated savings in power and system management – central management of a smaller number of physical servers allows consolidation of the effort, expertise, and maintenance (3-10 times fewer administrative staff is quoted as typical[3]). Note that the content and control of the VMs is completely independent and they are often managed by a different organisation from the physical machines.

The flexibility to migrate between physical servers also provides some additional benefits: services are more robust because they can easily be transferred to another server if one fails. And extra capacity is immediately available to any service that requires it – there is no need to purchase or configure extra hardware. Some further advantages are discussed in [[4]] (see chapter 3).

These benefits are being proven by the success of virtualisation in the commercial environment. Amazon EC2[5] is perhaps the most well-known service, but many applications require more infrastructure, such as shared storage, and other hosting providers are offering this type of infrastructure as a commercial service (Xcalibre[6], for example).

Current University Experience

Both IS and individual schools have recognised the potential benefits of virtualisation. Chris Adie convened a small group to share experiences, and it is clear that

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[1] http://www.vmware.com/
[2] http://www.xen.org/

[3] These figures are quoted by VMware on the basis of their experience, but are almost certainly a little optimistic for the University environment
[4] http://www.sage.org/pubs/18_vmware/
[5] http://aws.amazon.com/ec2/
[6] http://www.xcalibre.co.uk/index.html

several schools are investigating the technology, and using it to varying degrees in their own areas.

Within Informatics, I am working on a KTP (Technology Transfer) project with Xcalibre (Flexiscale[7]) to investigate automatic migration of virtual machines in response to load changes. I also chaired the LISA workshop on Virtual Infrastructures[8]. These activities provide important contacts with research and commercial providers.

The virtualisation area is complex and it is developing rapidly. It is difficult for individuals to make progress on a part-time basis, and it seems as if a more dedicated/coordinated effort is necessary to develop and maintain the necessary expertise.

Proposal

A University Datacentre

A University datacentre offering VM hosting to IS and schools would provide several benefits:

❏ The duplication involved in Schools maintaining and managing their own server hardware would be considerably reduced. But the "customers" would still retain full control of their services inside the VMs.

❏ There would be an overall saving in terms of hardware cost, power, and system management.

❏ Services would be more robust because they could easily be migrated off failed hardware.

❏ Services would be more flexible because extra resources could be provided for short periods of high demand.

❏ VMs could be easily added for short-term or experimental purposes, and removed when they are no longer needed.

❏ "Appliances" are virtual machine images containing "pre-packaged" version of common services. These would allow users to establish common services quickly and easily (and in a uniform way).

❏ Running specialised services would become viable for small schools without the resources to manage their own hardware.

❏ Servers would be housed in properly-serviced server rooms (power, air-conditioning, etc.).

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[7] http://www.flexiscale.com/
[8] http://homepages.inf.ed.ac.uk/group/
lssconf/iWeb/lssconf/2008.html

Some Issues

The potential benefits are high, but there are a number of challenges:

❏ Credibility in the system is absolutely crucial. The concept has clear advantages for schools (and IS), but they must be convinced that it will provide a sufficiently flexible, reliable, and cost-effective service. This probably involves commercial-grade guarantees on levels of service. It also requires some way of ensuring that the service continues to evolve in line with new technology and changing user requirements.

❏ Access to shared storage from the virtual machines is likely to be a significant issue.

❏ Appropriate staffing is extremely important. The facility must include someone with the time and ability to follow and understand the rapid developments in the field, and their implications.

❏ The concept has proven to be viable, even in a fully commercial situation, but an appropriate costing model would need to be established for the University. "Pay-as-you-go" schemes are possible (and typical in the commercial field), but something more would probably be needed to cover the initial costs at least.

Suggested Way Forward

IS (Tony Weir & Mike Baker) are prepared to consider hosting a prototype service. While the resources available initially would be limited (both hardware & staff time), it is expected that there would be a very good case for additional support if the prototype proved successful.

"Buy-in" from Schools is clearly essential to the success. This implies a commitment to use the service, and Schools must therefore have an opportunity to contribute both their requirements, and their technical experience from the earliest stages of the project.

If CCPAG agrees that this is worthwhile, it is suggested that a small working group is formed to discuss the issues with IS and formulate some more detailed proposals. This should include technical requirements, management procedures, and potential charging models.