1.0   Background

There is an intrinsic link between the Medical School at Dundee University and the National Health Service (NHS) with staff and students working at NHS sites as part of their learning, teaching and research activities. These activities are heavily reliant on fast, secure access to vital IT services.

Back in 2006 it became evident that access to the Dundee University email system was not permitted on NHS systems and it was made clear that there was a requirement to access Dundee University email for both staff and students working from NHS systems. As well as denying access to web based University IT services including email, many external online learning and teaching resources were not accessible from NHS systems. In addition to the stringent internet filtering blocking access to critical web services, the desktops deployed in NHS sites were presenting challenges in particular the reliance on Internet Explorer (IE) 6 as a web browser and the lack of required media players or browser plugins.

2.0   Project Scope

It was clearly identified that there was a need to provide a standard, secure and easily accessible route to using University IT systems from beyond the University network.

The initial project scope was defined as "To provide School of Medicine staff and students access to the University of Dundee information systems, to which they have authorised access, from NHS Tayside sites."

In 2007, the University embarked on an "off-campus access" project, working in consultation with the NHS and a commercial partner. Following a detailed scoping and analysis exercise, a solution was identified and purchased based on Citrix Presentation Server 4.0. In 2008 the system was upgraded to Citrix Presentation Server 4.5[1] and is known internally as Connect2Campus.

3.0   Technical Overview

Citrix XenApp is an application delivery solution that allows windows applications to be virtualised, centralised and managed then delivered as a service to users anywhere on any device.

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[1] On February 11, 2008, Citrix changed the name of its Citrix Presentation Server™ product line to Citrix XenApp™.

The Citrix Infrastructure at the University of Dundee comprises:

- 2 x Citrix Secure Gateway (configured in a redundant pair using NLB)
- 4 x Citrix Presentation Server (configured in a Presentation Server farm)
- 1 x Citrix License Server
- 1 x Citrix Data Store (MS SQL Server)

The Citrix Secure Gateway (CSG) servers are used to secure access to the Citrix Presentation Server farm by encrypting and authenticating all user connections - in effect providing a secure internet gateway between Citrix components and client devices. All data traversing the Internet between remote devices and the Secure Gateway is encrypted using SSL.

The Citrix Presentation Servers host the applications and allow delivery of the applications as a service. With Connect 2Campus these applications are delivered as part of a published desktop, providing users with a similar, managed environment to what they would have if using a University desktop.

The Citrix data store provides static information relating to the Citrix Farm and the license server provides a central point for storing and accessing Citrix licenses.

Figure 1 - Dundee University, Server Overview
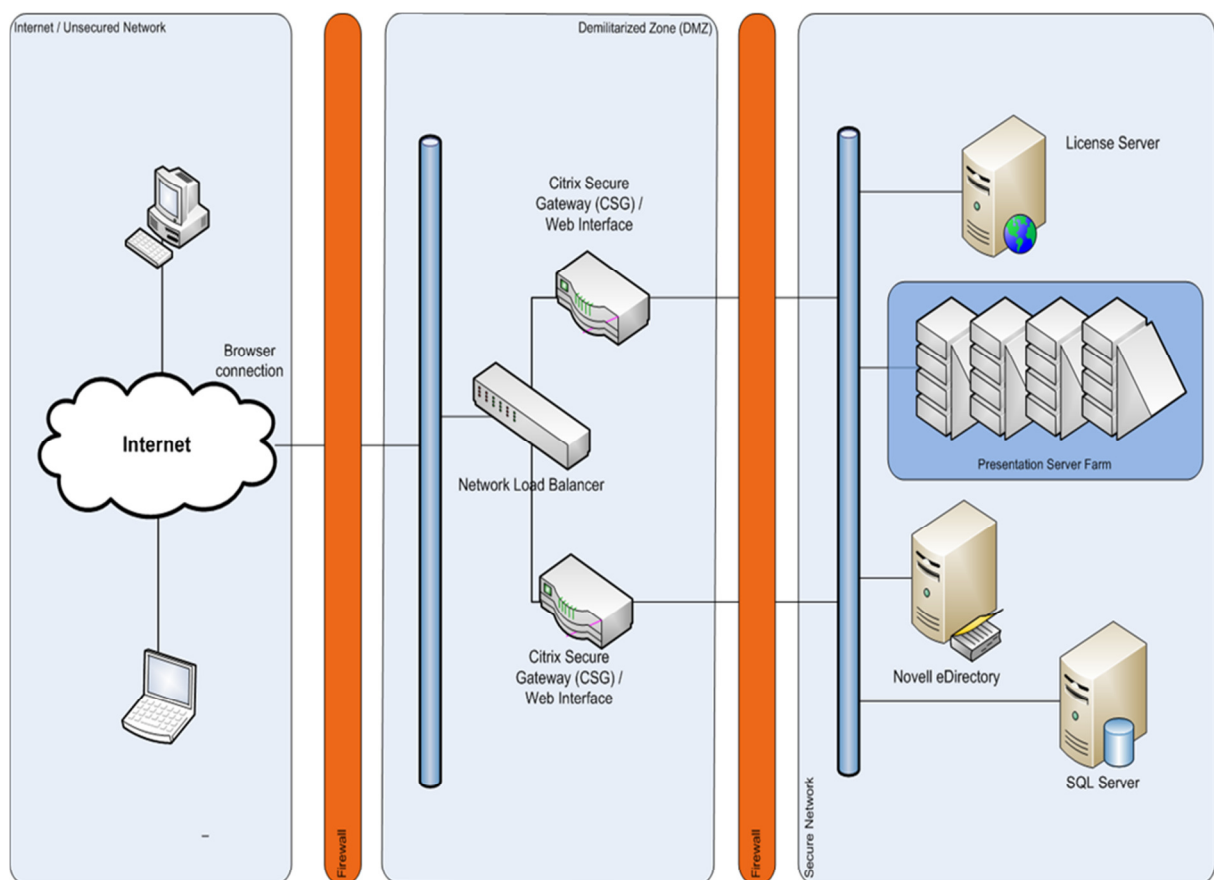
Citrix Secure Gateway deployment securing Citrix Presentation Server

To access Connect2Campus, a user would connect to the web interface at
https://c2c.dundee.ac.uk. Users would then authenticate against the directory service at
Dundee University allowing the relevant published applications to be enumerated. This list
currently includes a full desktop and the Internet Explorer 8 application. After the relevant
application has been selected, the license server is contacted followed by the delivery of the
application over SSL with ICA embedded.

Figure2 – Windows XP Desktop delivered by Citrix ZenApp
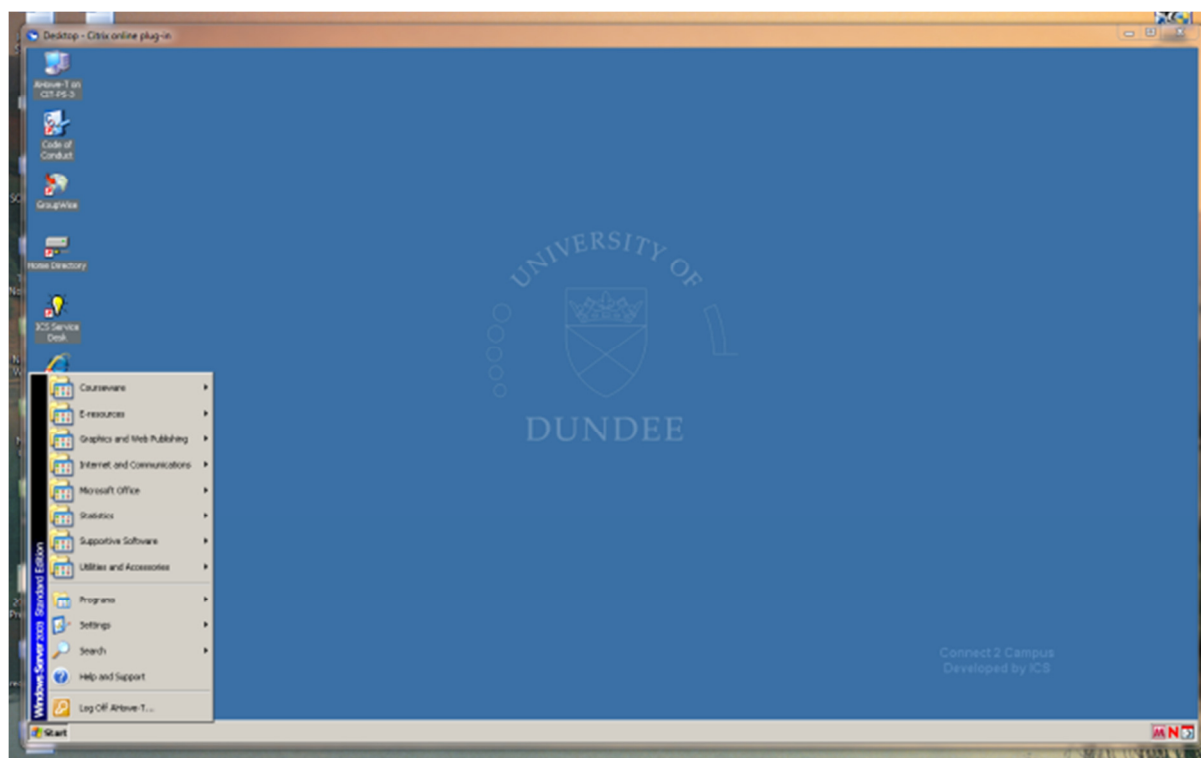
There are over 200 applications that make up the Windows XP desktop that is delivered; these
include Microsoft Office, Internet Explorer and an email client. Many of the clinical teachers use
Connect2Campus to access online teaching content currently blocked by NHS firewalls and only
require a web browser. With this in mind we have started publishing Internet Explorer as a
standalone application allowing for quicker and more relevant access for certain staff groups.

4.0   Financial

Although the Citrix offering provides an excellent service, the Citrix licensing model makes the
service expensive. Dundee University currently has the infrastructure and the licenses to support
150 concurrent connections. The total expenditure to setup the system including hardware,
software, external consultancy, training and a maintenance contract was in excess of £130k. To

fully appreciate the financial implications of a Citrix XenApp implementation, Figure 3 details the costs associated with adding a new user.

Figure 3 – Cost per additional user

Item	Cost	Estimated Cost Per Staff User	Estimated Cost Per Student User
Additional Citrix license	**£238.18** (£198.48 ex VAT)[2]	**£238.18**	**£238.18**
Additional Terminal Server Client Access License (device CAL) for a member of staff	**£3.48** (£2.90 ex VAT)	**£3.48**	-----
Additional Windows Desktop Services External Connector License (per server) for students	**£2,135.38** (£1,779.48 ex VAT)	-----	**£42.71**
Additional Windows Server External Connector License (per server) for students	**£508.13** (£423.44 ex VAT)	-----	**£10.16**
Microsoft Office 2007 license	**£47.22** (£39.35 ex VAT)[3]	-----	**£47.22**
Additional physical server	**£3,861.60** (£3218.00 ex VAT)[4]	**£77.23**	**£77.23**
Cost per additional user		**£318.89**	**£415.50**

As well as the capital expenditure there are recurring costs associated with providing the Connect2Campus service. The University currently has a 3rd party maintenance contract costing £7,099.20 per year and a Citrix support license (Citrix Subscription Advantage) costing £6,274.92 per year. Based on the 150 licenses, this equates to a yearly cost of £89.16 per user.

5.0   Consultation with the NHS

Connect2Campus was developed in consultation with NHS Tayside who permit access to the web interface from NHS PCs (host PC). Users of Connect2Campus are still governed by the Universities "Regulations for the Use of Computing Facilities" and the JANET "acceptable use policy". NHS Tayside mandated that there must be no interaction between the host PC and the Citrix environment therefore the use of the clipboard and local drive mappings has been disabled. Although we have the support of NHS Tayside for this service, Dundee University has

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[2] Subject to the Pound-Dollar Exchange rate
[3] The Microsoft campus agreement does not apply to students
[4] Based on 50 users per server and the cost of the last server purchase

students attending clinical attachments at NHS sites all over Scotland. We are in the process of seeking support from all NHS boards to allow access to the Connect2Campus web interface.

6.0 Issues

The general feedback about the system is positive. The system allows staff and students to access University IT systems and online learning and teaching resources from NHS sites. The negative feedback was focussed in two main areas:

- Speed

  This has been addressed primarily with the implementation of the N3 JANET Gateway. Prior to June, 2010 all Connect2Campus traffic was routed through the N3 internet gateway and at certain times of the day the service was unusable. Now this traffic is routed through the N3 JANET Gateway and the feedback suggests that speed is no longer an issue. In support of the system, NHS Tayside have also prioritised ICA traffic.

- Lack of Access

  Citrix requires either a certain version of the JAVA runtime environment (JRE) or an ICA client in order to deliver applications. The JRE on many NHS PCs is old due to its requirement to support legacy NHS applications and this was preventing Connect2Campus functioning correctly. NHS Tayside have now installed the Citrix ICA client on their latest desktop build allowing applications to be successfully delivered using Connect2Campus.

  To access the internet on an NHS PC, an NHS LDAP account is required. Dundee University have a process with NHS Tayside that all students are given an account but there is no such process for students who attend clinical attachments at sites governed by other NHS boards. This is a topic for further development.

7.0 Summary

Due to the current practice of stringent internet filtering and the reliance on IE 6 within the NHS, it is necessary to have a solution that allows University staff and students working at NHS sites to access University IT services and online learning and teaching content. Citrix ZenApp, although expensive, meets these requirements whilst adhering to the Governance and security considerations outlined by the NHS. When the current infrastructure requires replacing it may be a good time to look at less expensive alternatives including Microsoft Terminal Services and Genuits ThinWorx although the ideal solution would be fast, unrestricted access to the required systems and content direct from the host NHS PC.