

## Chapter 15

# Large-Scale Server-Side Infrastructure for E-Learning: Development, Design, and Experience

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### ABSTRACT

*The rapid growth of E-business has greatly increased the demand for technology graduates with experience in server-side technology and has thus become an increasingly important area for educators. Server-side skills are in increasing demand and recognised to be of relatively greater value than comparable client-side aspects (Ehie, 2002; e-skills 2011). In response to this many educational organisations have developed E-business courses, but their approaches cannot generally be applied in the distance learning context. Here the design, development, and subsequent experiences of a scalable architecture for the provision of a set of server-side applications to a very large number of students are described. This infrastructure is intended to allow students to gain valuable experience of server side technology such as directory services, deployment, and management of Web services and other administrative applications. Whilst students can be supported in installing the server software used in courses on their own machines, it is not possible to guarantee that this type of sophisticated software will function on such a wide range of platforms and in the context of other conflicting software, without very prolonged intervention, which is not practical within the timescales of a course. To allow server side aspects to be included as a component of the course's assessment with some fairness it is necessary to guarantee students access to such facilities even if this is not possible on a student's own machine.*

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## INTRODUCTION

Providing server-side infrastructure is important so that students gain insight into central concepts behind server applications and management but also provides experience of other related aspects such as network operation, transmission delays and failures and ‘just in time’ collaboration, which basic characteristics of many distributed applications.

A key objective of this work is to establish a framework which can be applied in education and commerce to support very large-scale deployment of web applications and services for applications which themselves may have quite different purposes and properties.

Many E-learning and E-business technology courses use some specialist software which, along with other course materials, such as Portable Document Format (PDF) documents and video, is distributed on Digital Versatile Disc (DVD) or by download.

Client-side software can be installed on student machines with the aid of a ‘wizard’ which guides the student, step by step, through the installation and which can also try to ensure that the platform is suitable for the software to function properly.

This type of software may typically include web browsers, programme development toolkits, libraries and Integrated Development Environments (IDEs), such as eclipse (<http://www.eclipse.org/>).

The range of student platforms and pre-existing software which can interact or conflict with the course software presents a significant source of potential problems. In practice, the occurrence of problems can be greatly reduced by careful engineering of the installation, rigorous cross platform testing and, for example, providing a fully independent installation.

An independent installation may duplicate supporting software which is already installed on the machine to ensure, for example, that appropriate software versions are used. A good example of this is the installation of Eclipse for which java may be installed, even if java has been installed

on the machine previously, so that Eclipse runs on a known version of Java.

The rise of network computing and Internet based applications running on web and application servers has resulted in a greatly increased demand and importance for providing students with reliable access to server-side applications and middleware. Understanding, skills and experience of server-side aspects are of relatively greater value than comparable client-side aspects (Ehie, 2002; e-skills 2011) and in increasing demand.

In response to this a wide range of higher education establishments have developed E-business courses which include server-side components and there have been evaluations of a range of the mainstream alternative platforms that can be deployed to support server applications (Sandvig, 2007).

Providing server-side facilities for students on their own machines is far more problematic than installing simpler client-side applications. Server software is more sensitive to platform variations and requires substantial expertise for configuration, management and the diagnosis and resolution of any problems.

Students cannot in general be expected to come with the necessary skills to successfully install and manage server-side software unaided. In addition, in the context of a course aimed at information technology management, students cannot be expected to be equipped with accomplished programming or software configuration skills. The consequence of these factors is that any provision of experience in server-side areas in a purely ‘at a distance’ E-learning context is extremely unusual.

There is also a need to provide a ‘level playing field’ for students and to be able to assess their work on a server-side platform. In terms of a level field it should be the case that a student should not be disadvantaged because they have some unforeseen problem installing the software against another student for whom the software installs without problem. For assessment purposes it is useful to be able to actually run, rather than rely on inspection alone, the server-side solutions which students have

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