Developing Server-Side Infrastructure for Large-Scale E-Learning of Web Technology

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ABSTRACT

The growth of E-business has made experience in server-side technology 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). In response to this, many educational organisations have developed E-business courses, but their approaches cannot generally be applied in the distance learning context. Providing server-side infrastructure is important to allow students to gain an appreciation of concepts as well as experiencing aspects like network operation, time delays and failure and 'just-in-time' collaboration, which are basic characteristics of distributed applications. Here, the development of a scalable architecture and successful provision of access to a set of server applications for a very large number of students is described. A key objective is to establish a framework that can be applied in education and commerce to support very large-scale deployment of web applications and services for applications with varying properties.

Keywords: Distance Education, Distance Learning, E-Learning, Online Course, Scalable Web Applications, Server-Side Platforms, Technology Education, Web Application Architecture, Web Technologies

INTRODUCTION

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, are 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 through the installation steps and which can also try to ensure that the platform is suitable for the software to function properly. This type of software typically includes 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 with the course software presents one source of potential problems. In practice, the occurrence of problems can be greatly reduced by careful engineering of the installation, rigorous testing and, for example, providing a fully independent installation. An independent installation may duplicate support-
ing 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 importance of 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) 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 created and deployed. The only means by which student work can be assessed in this way, in a distance learning setting, is by providing a standard server platform onto which students can remotely deploy and test their own work.

In the following sections the development of an architecture is outlined which provides support for running a very large number of instances of a web application called ‘Axis2’. This web application has been chosen as an illustration as it provides the appropriate facilities for students to deploy and manage their own web services on a server, which is a non-trivial task in itself, and this is an interesting component used in a new course developed at the Open University (OU).

However, the architecture has far wider relevance in education and commerce for supporting very large-scale deployment of web applications and services. The same architecture and principles involved can be employed to support very large numbers of users accessing a single (multi-user) web application or service, or to support large numbers of instances of any other web application.

A CASE STUDY: WEB SERVICE ARCHITECTURE

A new course at the OU ‘E-business technologies: foundations and practice’ (Open University, 2009) introduces the wide range of rapidly changing technologies and business aspects underlying modern E-business models. The course helps students to develop skills to enable them to understand, appraise, select and manage complex solutions based on the evolving set of protocols and E-business technology standards.

The decision to attempt to include practical server-side technology aspects into the course was generally viewed as high-risk because of the novelty of this component and the possibil-
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