

NET-CENTRIC COMPUTING: A POSTGRADUATE COURSE

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ABSTRACT

In the past two years a new postgraduate elective course on net-centric computing was developed for a Master's degree in Information Technology. The course evolved around the core subject topics included in the Computer Science body of knowledge as suggested ACM Computing Curricula 2001 report, with a strong emphasis on the relationship between networking technology and global networked applications.

Keywords

Net-centric computing, postgraduate degree, information technology

1. INTRODUCTION

In this paper, we first discuss the meaning and validity of net-centric computing for a postgraduate qualification in the discipline of information technology based on literature sources. We then focus on the philosophy underlying our approach to course design and development. We reflect on the design process challenges and evaluate the effectiveness of course delivery. In the conclusion we comment on the strengths of the course and on our vision of its future.

2. NET-CENTRIC COMPUTING

The contemporary notion of net-centric computing is derived from the understanding of the Internet as a global network environment

used to support software superstructures such as the Web. In the following sections the characteristics of net-centric computing are discussed from several perspectives.

2.1 The academic perspective

The global networked environment as a subject area of net-centric computing study is described by Cole (2001) who defines net-centric computing as "connected computing". According to Cole, in the future computers will be used exclusively in the context of their ubiquitous connectivity. Cole goes on to make the point that net-centric computing is neither "communications" nor "networking" but is inclusive of both.

A similar view is supported by Tilley (2001) who defines the underlying principle of net-centric computing as that of an intelligent distributed environment where applications and data are available on demand.

2.2 The Industry perspective

Net-centric computing attracts significant interest from network and telecommunications practitioners as a vehicle for innovation. One innovation suggested by Smith & Tilley (2001) is to apply net-centric technologies to achieve enterprise-wide integration (for example, legacy systems or business-to-business applications). Three key drivers for the innovative use of net-centric computing are highlighted by Daniel (2001): the emergence of non-traditional computing devices and mobile computing devices, the ever-increasing networking capabilities, and the need for a more sophisticated network management and administration. The key drivers are related to the five growth areas identified earlier by Cross (1997) as net-centric

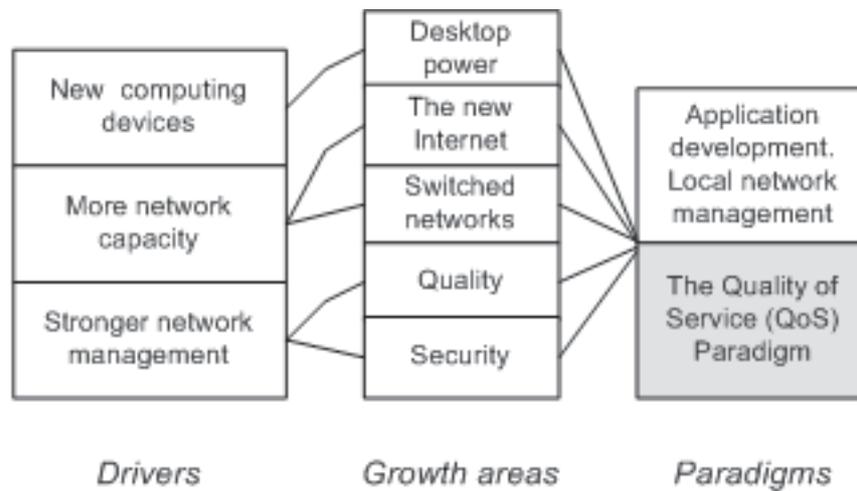


Figure 1. Drivers, growth areas and paradigms in net-centric computing

computing motivators: the increase in desktop computing power, the expansion of the Internet, the trend towards switch-based local area networks, the development of Quality of Service (QoS) protocols, and the need for strong network security.

2.3 Net-centric computing paradigms

Comparing and analysing the academic and the industry perspectives, a number of interesting areas for advanced studies can be identified: network security, network performance, mobile infrastructures and communication protocols and standards. Added to them are the issues that arise at the point of contact between networks and applications - creating the user interface is just one example. Although the definitions outlined in 2.1 are broad enough to encompass this wide spread of topics, there is a need to reduce their range if they are to be used to form the basis for a postgraduate course in net-centric computing. A suggested framework is depicted in Figure 1. It shows the key drivers and growth areas collapsed into two paradigms. The first paradigm is the shift towards applications "written once-run anywhere" (Hamilton, 1996). The second paradigm refers to the provision of a QoS network capable of delivering these applications.

While software development and local network management are typically covered in similarly named academic courses, the issues related to providing QoS are often treated across several subjects including data communications, networking, operating systems, and database design. At the undergraduate level (computer engineering, computer science, information technology, and information systems) such a spread

is justifiable, as learners need to acquire detailed knowledge and specific skills. However, two major challenges face educators at the postgraduate level. The first one relates to the need to develop students' understanding of the global network as an enabler without relying on the sum of the detailed knowledge pertinent to all undergraduate courses mentioned. The second challenge is the need to establish the foundations for a view of the global network as an environment for innovative and not easily predictable developments (Waldo, 2001). Next, three distinctly different net-centric curricula development approaches are described in the light of these challenges.

2.4 Net-centric computing curricula

The net-centric computing oriented course at the University of Melbourne (elective 433-768, a component of several Master's degrees, offered by the Faculty of Engineering) focuses entirely on two very specific areas: cluster computing and grid computing. The choice to develop two topics at a significant level of depth reflects the Computer Engineering (CE) discipline approach to teaching net-centric computing.

At the opposite end of the spectrum is the solution that has been implemented in the advanced networking course INFOSYS730 at the University of Auckland (Faculty of Commerce). This Master of Commerce (Information Systems) course offers a broad overview of technologies and some of the emerging trends without a specific focus on any of them - reflecting the Information Systems (IS) discipline understanding of the relationship between network technologies and information systems.

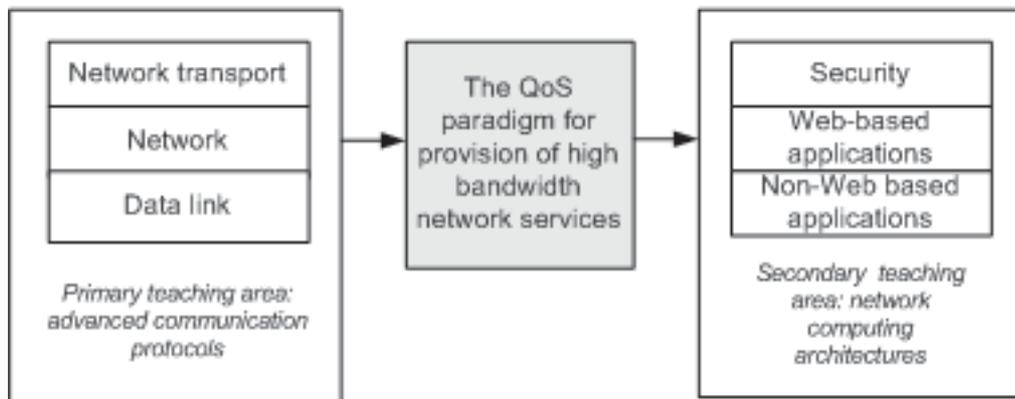


Figure 2. The teaching areas of net-centric computing.

The postgraduate course 408203 “Net-Centric Computing” at Auckland University of Technology (AUT) could be viewed almost as a bridge between the CE view and the IS view. It has a strong emphasis on the services provided by information and communication technologies to distributed applications. Furthermore its intended audience are neither CE nor IS students but students enrolled in the Master of Information Technology (MInfoTech) programme at the School of Computer and Information Sciences. Based on the simplified framework on Figure 1 and guided by the set of core subjects for net-centric computing suggested by the ACM Curricula 2001, the course focuses on the impact of the QoS paradigm on global networks. Relevant topics from two areas are covered - advanced communication standards and network computing architectures (Figure 2). Special emphasis is given to mobile and wireless networking.

Our view is that performance is the key factor for any net-centric system, and that a postgraduate study should focus on the issues related to providing broadband network services of high quality. Accordingly the course framework parallels two separate knowledge hierarchies: the prescribed IS body of knowledge (where telecommunications is a sub-area of one of the three major subject areas) and the prescribed CE body of knowledge with networking as a core topic.

The course provides the CE view of networking (wide area networks) as a broad area with its own specific problems, issues and trends, and the narrower IS view of networking as a necessary support infrastructure. In the next section some of the practical aspects of course development and delivery will be discussed.

3. TEACHING AND LEARNING STRATEGIES

In line with the overall philosophy of the MInfoTech programme (Buchan et al, 2002) this course emphasises project-based learning in which students are engaged and active and their learning experience is one of personal transformation. The idea is to develop a constructive learning environment that values the practical application of knowledge and promotes critically reflective researchers and professionals with strong technical capabilities in the computing discipline.

Students gain an in-depth knowledge in two key areas of computer networking and data technologies (Figure 2) by undertaking research assignments including small projects. This implies a requirement for students to be active learners who take responsibility for their own learning and professional development. The course aims and objectives are achieved by the following learning outcomes.

- ◆ Examine current trends in Web application development
- ◆ Conduct an in depth review of key network security standards
- ◆ Examine key network and data technologies and emerging trends
- ◆ Conduct an in depth review of key network technologies
- ◆ Effectively research current issues in net-centric computing

3.1 Activities

At the beginning of the course students are given a set of pre-readings (typically both academic journal and industry articles). Some lecture notes are available to help them brush up their existing knowledge of networking and to prepare for class presentations and discussions. The following teaching and learning activities are implemented:

- ◆ Personal reading and research assignments
- ◆ Lecturer-led discussion and lecture-style presentation of information
- ◆ Guest talks and mini lectures by invited speakers
- ◆ Student class presentations on pre-selected topics
- ◆ Student online participatory activities
- ◆ Self-directed learning
- ◆ Live demonstrations using available hardware and software resources

3.2 Teaching Resource Development

Currently, two lecturers are involved in teaching and developing course material. Based on their expertise and interests, the course development workload has been equally divided between them. Course resources include lecture notes and an annotated selection of readings. Assessment includes research assignments and participatory activities. Research assignments relate to topics in the teaching areas. Some past and current examples are listed below:

- ◆ A survey of the wireless and/or mobile technology industry in New Zealand
 - ◆ Tools for network performance management
 - ◆ Public Key Infrastructure (PKI)
 - ◆ Deployment of broadband technology in New Zealand
 - ◆ Developing a software tool for teaching and learning LAN design
 - ◆ Issues and trends in grid computing

Course material is regularly updated to incorporate new developments and latest technologies. A number of additional sources of information such as the AUT Library and eLibrary are available, and recommended Web sites are used to support student capabilities

development. An online learning platform (BlackBoard(c)) is used to enhance student learning and course administration.

3.3. Course Assessment

The teaching team keeps a check on the assessment programme and the instruments used to ensure the validity and consistency of the assessment process. This is especially important as we move away from examination as the major form of assessment: assessment becomes interleaved with delivery (Carter & Boyle, 2002). Pre-moderation of assessment is compulsory and is peer-based, with a separation of the roles of the assessor and the moderator.

Three summative assessment instruments assess student performance - the two research assignments and a participatory task based on the principles of hybrid learning based on using BlackBoard(c) (Petrova, 2001). The assignments contribute jointly 90% towards the final grade; the remaining 10% are allocated through participation. The minimum pass in each assignment is 40% but an overall average mark of 50% is required to complete the course.

4. CONCLUSION

We ran this course for the first time in semester 2, 2002 with a very small class. Students achieved consistent B+ on the average, and the overall pass rate was 100%. Students evaluated their experiences as positive. Their responses included comments such as “deeper knowledge has been gained” and “problem solving skills have been acquired”. Students expressed appreciation of the strong support received throughout the course.

We see the strengths of the course in its coherent structure and the opportunities it provides for student-centred learning. Future development work will continue with industry-sought input on curriculum updates, further deployment of innovative assessment instruments such as a “live” course Web page, and even stronger focus on contemporary net-centric computing content. Personal engagement of staff, potentially publishable student work and strong links with ongoing research are the key success factors associated by Fincher et al(2001) with effective computer science education, and we hope to make these factors the hallmarks of the course.

REFERENCES

ACM (2001) Computing Curricula 2001, DRAFT (March 6, 2000), Chapter 6, Defining a Curriculum.

- Accessed May 3, 2003. <<http://www.acm.org/sigcse/cc2001/NC.html>>
- Buchan, J., Clear, T. & Hughes, J. (2002) "Computing the Profession: Crossing the Chasm with a New Master's degree in Information Technology", Proceedings of the NACCQ2002 Conference, Hamilton: pp.13-19.
- Carter, J. & Boyle, R. (2002). "Teaching Delivery Issues: Lessons from Computer Science", Journal of Information Technology Education, 1(2):65-90.
- Cole, B. (2001) "What is Net-Centric Computing?" Embedded.com. Accessed January 25, 2003. <<http://www.embedded.com/story/OEG20010313S0111>>
- Cross, J. S. (1998) "Enterprise Management Solutions Are Needed!". CAUSE/EFFECT, 21(3). Accessed March 1, 2003. <<http://www.educause.edu/ir/library/html/cem9838.html>>
- Daniel, N. (2000) "An Architectural Foundation for Net-Centric Computing". Dedicated Systems Magazine Q1. Accessed March 1, 2003. <<http://www.dedicated-systems.com>>
- Fincher, S., Petre, M. & Clark, M. (eds) (2001) "Computer Science project Work: Principles and Pragmatics", Springer: p.37.
- Hamilton, M. (1996) "Java and the Shift to Net-Centric Computing", IEEE Computer, 29(8): 31-39.
- Petrova, K. (2001) "Teaching Differently: A Hybrid Delivery Model", Proceedings of GBATA 2001, Istanbul-New York: pp.717-727.
- Smith, D. & Tilley, S. (2001) "On the Role of Net-Centric Computing in Enterprise Integration Architectures". Proceedings of the ASERC Software Architecture Workshop 2001.
- Tilley, S. (2001) "The Era of Net-Centric Computing", SEI Interactive, 1(1). Accessed February 2, 2003. <http://www.sei.cmu.edu/interactive/Columns/1998/June/Net_Effects/Net_Centric.htm>
- University of Auckland (2003) INFOSYS "Advanced Computer Networks". Accessed May 12, 2003. <www.business.auckland.ac.nz/postgraduate/cons/pdf/PostgradHB2003/PG_MSIS.pdf>
- University of Melbourne (2003). 433-678 "Cluster and Grid Computing". Accessed February 2, 2003. <http://www.cs.mu.oz.au/courses/mbc/mse_subjects.html>
- Waldo, J. (2001) "When the Network is Everything", Communications of the ACM, 44(3): pp.68-69.



