A Perspective on Distributed Computing

Engineering Computing
University of Waterloo
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Engineering Computing

Engineering Computing has a long track record as a highly productive and efficient organization. The functions we perform are done so in a cost effective manner and promote efficient distributed computing.

Engineering Computing has initiated many projects because needs exist within our systems or our user base. Some of these include:

Notes:
1. *all are used campus-wide with the exception of OFIS*
2. ***** *= currently managed by IST*

- Acct   - distributed account management
- Computing Kiosks   - unauthenticated workstations and enclosures
- Wireless Printing   - allows users to easily print on campus from laptops
- ONA*   - distributed network manager
- MyWaterloo   - email/file interface for users
- OFIS   - On-Line Faculty Information System
- Emerge*   - campus-wide emergency notification
- NAA*   - wireless user management
- MinUWet*   - wireless device security
- FlexLM License Manager   - distributed license manager
- audit   - workstation management
- XAS*   - distributed accounting for printers, etc.
- Cerberus   - Windows server security
- Othello   - workstation security integrity tester
- Nexus   - a wide range of distributed technologies, including
  - user account management
  - shared software delivery
  - security, management and accounting
  - administrator knowledge sharing
  - an array of productivity enhancements
  - high degree of knowledge sharing across campus

Our projects have a particular slant; they often involve distributed management so that we can more effectively share resources with people in other faculties and departments.

For example, any System Administrator in Engineering can manage accounts and workstations for his/her users on Engineering Computing equipment. Similarly, we developed ONA to share management of network switches with the departments and IST.

Our designs include a high degree of automation, which means they can scale up to the campus-level without requiring more FTEs to manage them. An example is the very rich Nexus environment with 'thick clients' containing almost all the software users could want to perform their tasks. Due to the automation and pervasiveness of our solutions, they are highly cost efficient. The following figure shows how the use of Nexus has grown since its development in 2001; EC now manages more than 4,000 Nexus workstations campus-wide.
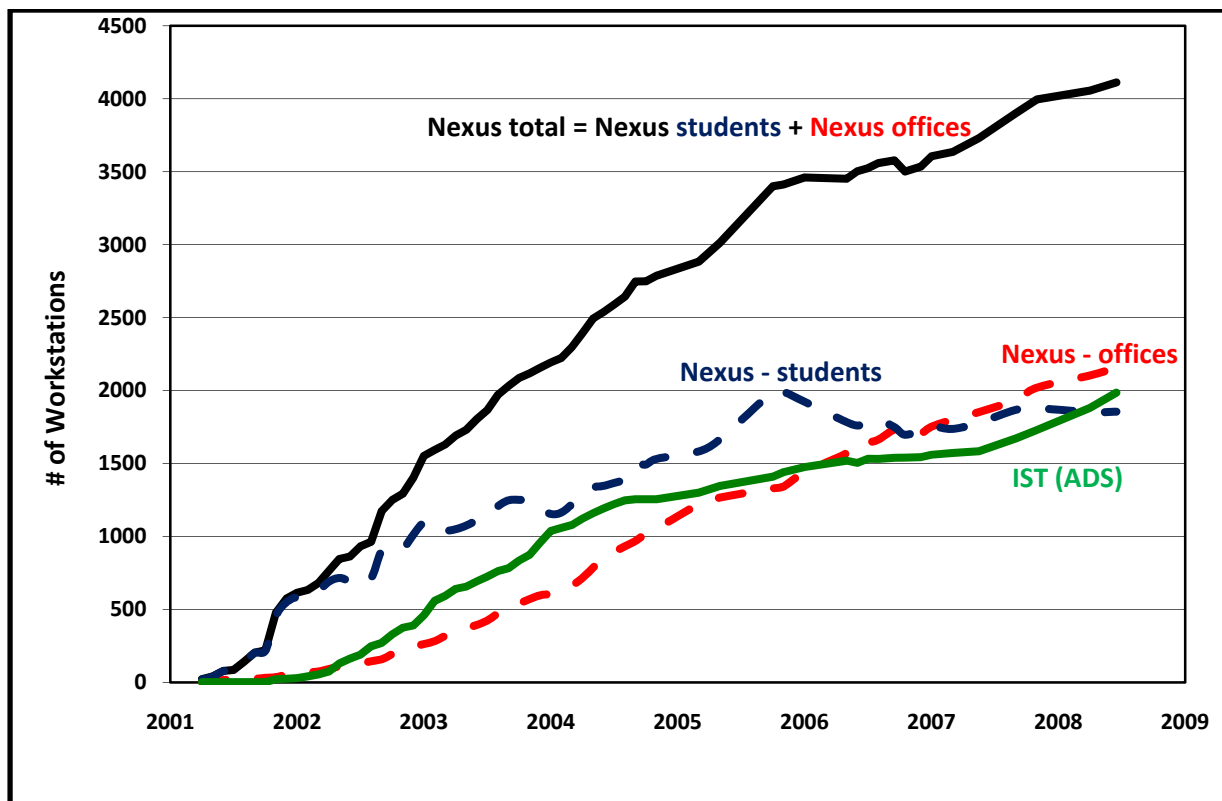
We often rely on open source software which in additional to being free, is usually more extendable though it may require more knowledgeable staff to install it. This grants us the flexibility to deploy the services we need, customized so they require minimal one-on-one user support.

EC has a history of being an incubator for new ideas, ones which often gain campus-wide acceptance. This happens because the ideas and implementations resulted from a 'bottom-up' approach driven by the needs of our clients. Our solutions are tailored to UW's needs and we must remain flexible to gain the support of other departments.

We have also readily adapted new technologies (wireless, laptops, unmanaged devices, web access) and thus continue to play an important role in campus IT delivery.

Computing Model in Engineering

In the Faculty of Engineering, Engineering Computing supports technologies which are common to all our academic departments including:

- various Nexus technologies including infrastructure servers, software delivery, security
- many undergraduate facilities (1GB email, web space, file storage, account maintenance, common student labs)
- networking (routers, faculty switches, capacity planning, security, wireless, cabling)
- support of non-academic offices reporting to the Dean:
    - Dean of Engineering office
    - Associate Dean of Engineering (Undergraduate Studies)
    - Associate Dean of Engineering (Graduate Studies & International Agreements)
    - Associate Dean of Engineering (Research and External Relations)
    - Associate Dean of Engineering (Co-operative Education and Professional Affairs)
    - Associate Dean of Engineering (Outreach)
    - Associate Dean of Engineering (Computing)
    - PDEng
    - Engineering Machine Shop
- faculty-wide initiatives and resources (OFIS, Faculty of Engineering web site and many tools)
- common helpdesk (staffed mostly by graduate and co-op students)
- maintain a network cabling plant

All academic departments (with the exception of CBET) have staff to address the needs local to their department, including:

- needs of researchers
- specialized software and hardware particular to that department
- specialized student labs
- hardware installation and trouble shooting
- faculty/staff front-line support
- departmental web space, web development

Distributed Computing: Engineering Computing and IST

There are many EC-initiated services that are used campus-wide, Nexus, MyWaterloo, MinUWet, ONA etc. (see the list on page 1).

In many cases, EC and IST have developed a transfer or sharing of responsibilities for specific services e.g. XAS, ONA, MinUWet, NAA and Emerge. So, while EC is the initiator of the technologies, the combined expertise of EC and IST has been used to evolve and maintain these systems.

Not all systems make sense to transfer, either because no further development is required, or IST is not yet ready to take on the task.

Management of Nexus is different; Engineering is not only the initiator of Nexus, but also the biggest customer with more than 2,200 Nexus workstations out of a total or more than 4,000 Nexus workstations campus wide (see figure on page 1). We have a reasonable desire to influence the decision making of Nexus, and have always had the in-house talent to manage it. We gain efficiency by depending on other faculties, departments and IST to provide some services and expertise.

IST sometimes relies on EC staff to provide some automation for their systems; recently IST used the Engineering automation to distribute the OnBase client to IST's clients for the campus document management project.

MyWaterloo grew out of the needs of the Nexus community and our distributed computing environment. Anyone can download and install the Horde/IMP system on which MyWaterloo is based, but the system is customized to meet the needs of our collective users and to hide the distributed infrastructure that exists on campus.

Two new email systems have been initiated by IST, the Exchange project and the mail cluster. Engineering Computing has a long history of Email innovation, ranging from Email on the Polaris workstations login page to MyWaterloo. We currently provide a service (1GB mail folder, Web access) for a large number of users with relatively modest hardware and manpower requirements and maintain close communications with the users. Furthermore, our faculty relies on us for Email list management, academic violations checking, Email-based processes and a host of other services we are able to provide on our mail server.

Engineering Computing also maintains our own extensive network infrastructure (cabling plant and switches). Due to our extensive use of networking, Engineering's core network switches are connected at 10 Gbps to meet our higher load. We have higher capacity needs than most faculties, and local management ensures we remain responsive to these needs.

There is some degree of faculty-level duplication of services available from IST. In some cases, such as DHCP server, Engineering's servers currently provide a higher degree of reliability and service than those provided by IST. Nexus DNS is required to offer the DDNS features of an active directory domain.

EC servers which could likely be phased out with minimal impact include antivirus and windows update servers for which there are campus equivalents. Most other services have already been aligned with IST's offerings. The recent addition of a security unit in IST may allow us to offload some security-related work. We will transfer our wireless systems management to IST as soon as the Aruba system matches the reliability and features of what we offer internally.

Distributed Computing Within the Faculty

As stated earlier, Engineering Computing shares management of many of our devices with the departmental staff, including the management of undergraduate accounts, (which are all hosted by EC) and Nexus management. A key benefit is that there are more people available, especially during vacations and illness, to address user issues.

There are several resources which are duplicated at both the faculty and departmental level. Some of the apparent duplications make more sense upon further investigation.

EC hosts web pages for individuals as well as some groups. There are approximately 50 virtual host websites on Schooner, including web pages for student groups, research groups and the departmental pages of Systems Design and Mechanical and Mechatronics Engineering. Some departments have customized web processes which are easier to manage on their own servers. Some may have chosen different technologies (IIS compared to Apache) and there would be some expense to move the data and active pages.

For historical reasons, there are numerous Email servers spread across the faculty. Not all of them offer the features of Engmail (gigabyte of Email storage, nightly backups or the speed of maildir organization). Anyone in the faculty is free to move to Engmail if they wish. While there are arguments for having departmental Email servers, the situation is more perverse than that. There are actually 66 Email servers in the faculty, with 44 in Electrical and Computer Engineering alone.

Some departments offer file servers with greater quotas or other features than those provided by Engineering Computing. Moving very large users from the departmental servers would require additional spending in Engineering Computing for higher capacity storage arrays.

The aforementioned services have relatively little cost to continue as-is or to centralize to the faculty. Any efficiency gained by uploading would have to be balanced with some degree of conversion effort and user re-education. The major benefit would be increased service, reliability and support rather than cost reduction. Additional features may have to be available before this sort of offloading would be possible.

There is some other departmental duplication which offers little value. Local antivirus servers, Windows update servers and departmental domains are not as cost-efficient as using the respective campus or EC servers.

An area identified for improvement in our 2010 Vision Plan (Goal F1 in section III F) is the movement of unmanaged workstations into Nexus. Unmanaged workstations take a toll on EC and departmental administrators for security issues. They cost significantly more to manage, they are more costly and difficult to replace, they are typically outdated in software patches and provide inferior service to the user. The movement to a managed environment could address issues of costly software distribution, workstation security and integrity, shared consulting services, issues of vacation-time support, and improved user experience.

Another goal of the 2010 Vision (Goal F2) is the improvement of organization and computing across the faculty. In addition to providing faculty-level IT support during the absence of departmental staff, it is desirable to seek additional opportunities for interaction, teamwork and skills sharing between Engineering IT staff.

Computing expertise is not always located in the core. There are several examples where faculty-level projects relied on departmental resources. These include the Engineering Machine Shop Database (developed by Mechanical Engineering and maintained by EC), the OFIS database (developed and maintained jointly by EC and Management Sciences) and Nexus (departmental administrators are just as likely to come across Microsoft knowledge-base articles solving their own problems and use them to assist the wider group.

Faculty-Level Perspective

Engineering is in a period of significant growth in terms of faculty, staff and students; (faculty≈250, staff≈180, undergrad enrolment≈5500 and graduate enrolment≈1500). Computing and networking are becoming increasingly important to our workplace, our community outreach and our faculty's service delivery. Nevertheless, there remains an abundance of work to accomplish to meet our faculty's needs and goals. Increases in efficiency could free time to allocate to improved service, but would require changes in roles and organization. Some consolidation would improve service delivery and free up administrator time. There would be initial work and expenditures necessary to achieve this goal. However, given the short lifetime of server software and hardware (perhaps two to four years before software upgrades are required for security purposes or hardware becomes inadequate), the strategy of continued duplication also has real costs that are renewed with each software and hardware refresh and more frequently with regular systems management.

Centralization within the Faculty, however, is not always appropriate. Engineering self and external evaluations noted the success of having departmental IT staff available for departmental support. IT staff, who are physically closer to their clients, are able to develop long term relationships to address specific needs in an effective and timely manner.