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**Information Technology Infrastructure Improvements Since 1999/2000**

Intangibles – Leadership, Organization, Staff, Budget, and General Support

The IT Organization has been completely reorganized under a new Chief Information Technology Officer. Effective levels of middle management have been created and balanced under three Associate/Assistant CIOs, focused on: enterprise system implementation (Banner); system and network operation; and instructional technology support, Web facilities, and client services. Staff has been added in each of these areas, with a particular focus on the creation of effective subgroups focused on the new technologies related to central directory services and Web support. In addition, an entirely new group has been created led by an IT Security Officer, reporting directly to the CITO.

IT staff previously located in six locations on campus have been consolidated into three locations – Brantley Hall 4th floor, Social Science 1st floor, and Liberal Arts basement. Four previously separate support offices, each with clerical staff and responsibility for aspects of budget, personnel management, and purchasing have been merged into one office. Staff in the central office have as their primary focus the support of a specific group, but are cross-trained to back each other up during vacations, staff turnover, or times when a particular group’s workload is high.

The IT Organization’s budget has been completely revised. Although it still draws funding from a variety of direct, charge-back, and fee sources, four key changes have been implemented: an IT Utilities account was created to encapsulate externally set expenses (i.e., so that IT is not forced to sacrifice staff to pay inflationary increases in the software that the staff support); a capital expense account was created with a management plan updated annually to address major equipment refresh as a matter of routine; a personnel budget was created that clearly identifies and isolates staff costs, ties staff directly to particular IT functions; and an overall revenue/cost flow plan was developed and is updated annually that ties all IT sources of funding and costs together.

Compute Facilities and Resources

The major physical facilities housing UM computational and network resources in the basements of Social Science and Liberal Arts have both been overhauled to provide better electrical power, air handling, overall environmental conditions, and access control. A reliable emergency power generator has been added to the Social Science facility to provide emergency power for UM’s core telephone, network, and enterprise systems.

New computer systems based on smaller, denser “blade technology” have been implemented to support UM’s enterprise system and email system, and are gradually being expanded to also incorporate other systems (i.e., to replace individual servers). In order to provide better tolerance to hardware faults the blade systems have been implemented with redundant components and “on-the-fly” adjustment to adapt to component failures, including processors, disks, disk controllers, and power supplies. In order to provide better tolerance to external failures involving power and air handling, these systems are each physically split into two parts, with one part running in the LA facility and one part running the SS facility.

A modern “hosting” facility has been added to the LA site to extend enhanced power, air handling, environmental, and access control to other units who have been using housing departmental systems/servers in space carved out of what were previously offices, classrooms, or labs.

Network Facilities and Resources

As noted above, the SS facility containing the campus core networking systems (i.e., those components related to the “campus edge”, “firewall”, and similar elements) has been dramatically upgraded. The other core campus facility in the Clapp Building was moved to a more environmentally friendly location, from the basement in the middle of other electro-mechanical components to a new, isolated, and environmentally controlled location on the 1st floor.

Equipment in each of the two campus core sites has been upgraded to support a campus backbone network with multiple 10Gb links. Fiber connecting the two sites has been upgraded to implement physically diverse paths between the two sites. UM is currently in the process of selectively upgrading individual building feeds from 1Gb to 10Gb, where the increased capability is needed.

A process has established to upgrade network facilities within UM’s individual buildings, on a priority schedule established by the University. The first priority is to standardize and secure network facilities, and provide an appropriate base level infrastructure in all buildings (e.g., move from the original “10Mb shared networks” to “100Mb/1Gb switched”). Each upgrade assures that standard, dedicated, and secure network closets are available by upgrading or remodeling original facilities. The upgrade also assures that standard vertical runs are established between building floors, vertical cabling is up to standard, standard horizontal runs are established within building floors, horizontal wiring is up to standard, and appropriate wall and other connectors are up to standard. This process has been completed for all buildings except those with “extraordinary” circumstances, i.e., typically those building involving major remodeling and/or asbestos abatement prior to remodeling or reconstruction.

UM’s network links to other campuses and the State of Montana were upgraded during 2009 as part of a major upgrade to the state-wide network. UM’s links to regional and national networks were dramatically upgraded during 2009 with the completion of the Northern Tier Project, which provides UM an initial 10Gb link to the national research and education networks (Internet2, NLR) plus additional 10Gb links as needed, at incremental cost.

UM has also implemented an extensive 802.11b/g wireless network consisting now of over 100 wireless access points placed around the campus. All normal connections are secure and authenticated, available to any and all campus users based on standard campus credentials. UM generally does not support “open wireless” or “open visitor” connections. That said, special provisions are available for short term visitors and special events.

Software Systems

The primary enterprise system, Banner, has undergone multiple software upgrades to keep it current. The next such upgrade is now underway, with UM’s implementation of Banner 8 scheduled to go live in March 2010. Numerous additional small systems are operated on the interface with Banner to provide additional and/or specialized functionality. These Banner “edge systems” have grown in sophistication and importance, and have been instrumental in allowing various UM business units to streamline their business practices to provide better service at lower cost.

Learning management support, at UM provided by the Blackboard product, has emerged as a new enterprise class system. Beginning in 2000 as a system supporting a few distance education classes, this system now supports an extensive array of distance learning courses and provides supplementary support for the majority of UM’s traditional courses. Current estimates are that about 90-95% of current UM students have at least one course supported by the BB LMS. UM has upgraded the hardware and software several times to support the extraordinary growth of the LMS. During 2009 UM initiated an evaluation to look at next generation options to move to true enterprise support level. Those options include possible new software systems, new hardware, and externally hosted solutions.

Like all institutions, UM has experienced a huge growth in all aspects of email, including the sheer volume of email plus the need to actively address the huge increase in email “spam” and email-carried problems (e.g., viruses, phishing attacks). UM has continuous upgraded its entire email operation, from email servers to filtering capability to protocols related to viruses and phishing attacks. During 2009 UM committed to outsource its student email, to an “email plus” service provided by Microsoft. That process should be complete by the end of 2009. Concurrently UM has committed to implement an email archival and retrieval system for UM staff, as required to meet and facilitate obligations under e-discovery and freedom of information requests. The archival/retrieval system is expected to become operational during 2010.

Also like all institutions, UM has experienced a huge growth in its commitments to support Web facilities, from a UM home site to various unit home sites to a wide variety of on-line services. UM’s Banner system makes full and extensive use of Banner’s on-line capabilities, locally labeled as “CyberBear”. UM has also implemented an extensive set of local on-line services, collected in a portal locally labeled as “OneStop”. Included in this, critical by mostly invisible to users, are background directory services that provide central authentication and authorization for a variety of central and campus systems, recognizable to end users as “single sign-on” to an ever increasing number of campus systems using a single account name/password (locally referred to as the “NetID”). In 2008 UM implemented a Web content management system to help reduce the cost of maintaining Web content, as well as to assist UM in standardizing various look and feel aspects of its content.

And finally like most other institutions, UM recently implemented an Emergency Notification System to allow designated campus personnel to send email, portal based instant messages, and/or (on a voluntary “opt in” basis) cell phone text messages to the entire campus or selected portions of the campus. UM’s ENS is locally developed based on its campus portal, and tied into the broader cell phone infrastructure through a standard cell phone vendor interface.

Telephone System

In response to rapidly changing telephone technology (and end user preference) UM has dramatically overhauled its telephone system and the organization used to support that system. The emergence of cell phones has had a huge impact, but IT has essentially no role there (UM Business Services has approved two “umbrella” cell phone service contracts, and any individual’s service is managed directly by his/her department and the vendor). In UM’s residence halls wired phones were changed from mandatory to an option, and as a result essentially disappeared, causing the telephone system to be downsized by about 1/3. Revenue streams associated with brokering long distance and 800-call trunking disappeared. Dispatching functions that originally grew out of telephone switchboard operations grew and evolved into an extension of campus security, and as a result were moved from IT into the Campus Security Office. Long haul telecommunication evolved to the point where IP networks carry both voice and data traffic, a similar evolution has occurred as inexpensive IP transport became available for UM metro sites, and voice over IP has been implemented in selective cases on campus. With the retirement of the former Director of Telephone Services in 2008 IT downsized the original telephone group and merged the remaining members into a new network group responsible for both voice and data networks.

Classroom and Instructional Technology Support

In 1999 responsibility for classrooms and instructional technology support was divided among several units. That responsibility is now (generally) centralized with a unit within IT. Until recently although UM invested heavily in new instructional technology for new buildings, and individual schools and colleges invested in facilities in rooms they controlled, UM had no systematic plan to place and replace technology in its general classrooms. That changed in 2009 with the initiation of a project that over a period of 5-7 years will upgrade virtually all UM’s classrooms to include technology appropriate to the size and purpose of the room. Further, this program is on-going, including support to maintain the equipment that is placed and systematically replace it on a standard schedule.