University of Massachusetts – Boston
Information Technology Enterprise Architecture (ITEA)

Phase 1 - Report of Options – Summary of Recommendations

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1. Introduction

This document is the Executive Summary of the University of Massachusetts – Boston IT Enterprise Architecture Phase 1 Report of Options based on Vantage Technology Consulting Group’s (Vantage) activities at the University of Massachusetts – Boston (UMB) to date. Please see the full Report for details and back-up documentation for the recommendations in this Executive Summary.

Over the past eight months (September 2010 through April 2011) Vantage has worked with UMB Information Technology Services Division (ITSD) and the various Information Technology (IT) groups to determine alternatives for addressing the IT challenges that UMB will face over the next several years.

Like most Universities, UMB is dealing with rapid changes in technology – not only in the technology itself but also in how technology is used. Changes in technology include technologies to support convergence, unified communications, mobility, collaboration, access to resources anytime/anywhere, and services “in the cloud”. These in turn are being driven by the shifting physical workspace (remote workers and teleworkers), increased use of flex work schedules, consumer-grade technologies accelerating new work styles, and the emerging “new worker” persona (multi-tasking, technology native, expected to work despite location or time).1

At the same time, the UMB campus is undergoing a series of its own changes. The underground garages are deteriorating and, after having been closed for more than five years, are now slated for demolition. In addition to the obvious impact on building facades and inter-building spaces, all of the communications utilities need to be replaced as a result. Two new buildings, an Integrated Science Center (ISC) and a General Academic Building (GAB1) are being built in the near future (by 2014) with several more buildings (another academic building as well as residence halls and parking structures) to follow thereafter. At the same time, the present Science Building, which houses the UMB data center, is slated for demolition and the data center must be relocated before that can occur.

There are numerous ways to address any given technical problem. All of those ways have advantages and disadvantages in terms of cost, performance, operations, and support. Therefore, the purpose of this report is to refine the results of Vantage’s assessment and interactive design meetings into a series of straightforward choices that UMB can develop into an overall IT Enterprise Architecture.2

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1 Source: The Future of Workplaces, A study by Gigaom Pro. March 2011

2 It should be noted that Vantage’s original scope of work called for two options to be developed. As the project progressed, it was agreed by all parties that it made more sense to provide options for each of a number of technologies so that those options could be mixed and matched to create the Enterprise Architecture approach to be used for Phase 2 of the project.
2. Methodology

Vantage’s methodology for this portion of the work consisted of the following tasks:

- Development of a technical baseline of technologies presently in use at UMB.
- Interactive design sessions with ITSD staff.
- Meetings with UMB stakeholders.
- Meetings with UMB providers, other vendors, BVH Integrated Services (UMB’s utility corridor consultants), and other internal and external project team members
- Review of standards and best practices at peer institutions
- Vantage off-site design activities.

Pursuant to the UMB project scope, this Phase 1 report has been designed to present a series of design options in each of several technical areas (data center, telephone system, data networks, etc.). After the UMB ITEA Team selects their desired approaches, as Phase 2 of this project, Vantage will work with the Team to prepare the gap analysis, address migration strategies, and address other areas such as organizational issues and governance.

3. Systems and Design Options

3.1. Data Center

Since the Data Center is located in the Science Building which is slated for demolition by mid-2014, a new data center needs to be sited, designed, built, populated, and tested well in advance of that time. Vantage explored several different designs for the new data center at UMB including various on-site and off-site options. Vantage recommends an on-site modular data center with off-site disaster recovery as the optimum mix of cost containment, future flexibility, and disaster recovery support.

This option sets aside the same amount of space as a fully-built-out data center, however, only the space needed for near-term data center requirements would initially be built-out. Sufficient utilities (power and chilled water) will be brought to the data center space for potential long term growth that can accommodate power and heat densities well beyond that supported by current technology. Significant capacity for growth is built into this recommendation to support future research computing resources. A number of data center equipment vendors provide modular units for cooling as well as modular power units that can start small and grow incrementally to meet increasing demands. This provides a highly flexible, cost effective approach for a data center when future demands are unknown and unforecastable.

All servers on campus which are determined by UMB to support mission-critical data or services should be located in the Data Center where they can be secured, environmentally protected, provided with clean power, backed-up, and professionally managed.

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3 The determination of “mission critical” will need to be defined by ITSD in conjunction with UMB management. Once determined, the policy must be enforceable and enforced.
3.2. Telephone System

The voice system serving UMB was initially installed in 1987-89 and most recently upgraded in 2008. The upgrade, among other things, enabled the system to support the latest technology (Voice over Internet Protocol or VoIP). The upgrade also included replacement the obsolete voice messaging system with a newer unified messaging system\(^4\). The topology of the voice system is a traditional star topology with the PBX at the center and copper cabling radiating out to all served buildings on campus. There are no plans by the manufacturer to phase-out this system they for the next 5 to 7 years. Once UMB completes the planned hardware upgrade in 2013/2014 and stays current with software versions, they will have a telephone system that will be supported until at least 2020.

Our understanding of this project is that UMB would like the selected telephony approach to meet the following goals:

- Provide the flexibility to allow UMB to meet changing demands.
- Position UMB for the future and changes in technology.
- Help UMB control cost and provide services cost effectively.
- Be reliable, both on a day-to-day basis as well as in cases of emergency.

Toward this end, Vantage explored various phone system alternatives including different options within the present phone system as well as replacement of the phone system with a newer, all VoIP system.

Vantage recommends that UMB remain with the present phone system, upgrade it as planned, and move various parts of the system (called Line Interface Modules or LIMs) from the PBX room out to all existing buildings. These remote LIMs can then be connected over the planned fiber optic ring rather than replacing the obsolete and expensive copper cabling presently used. All new buildings will use VoIP. This approach strikes a balance between newer technology (VoIP where needed and applicable) and extending the life of the present technology where it meets needs and is cost effective.

The charts below provide the relative costs for the phone system:

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\(^4\) Unified messaging provides for the delivery of voice mail messages through the email system offering a single point of messaging for email, voice and even fax.
The cost associated with a wholesale change to VoIP, either with the existing phone system or by replacing it, does not provide benefits to UMB commensurate with the significantly increased costs. All of the IP solutions cost significantly more for two reasons. First, UMB will be replacing functional telephone instruments and other equipment with new equipment with only limited improvements in functionality, and second, UMB will need to undertake some data network improvements in order to be ready to deploy VoIP. Therefore, Vantage does NOT recommend either a full deployment of IP or a Hosted IP solution at this time.

The approach recommended by Vantage offers a smooth, prudent migration path from traditional telephony to VoIP, when and where cost effective for the University. The recommended combination of traditional telephony and VoIP provides the following advantages:

- Reasonable cost.
- New technology where needed.
- Continues the investment made in staff training, spare parts, and vendor relationships.
- Allows for a smooth transition to VoIP rather than a much more disruptive “flash cutover”.

Vantage Technology Consulting Group
• Allows for continued testing of VoIP technology without a wholesale commitment to it.
• Allows for improvements to the UMB data network over time rather than all at once
• Allows for other options (such as more traditional and proven ways to support off-campus locations) to be implemented where they might be more cost effective or provide operational benefits.

3.3. Networks

3.3.1. Data

3.3.1.1. Internet and Wide Area Connections

Vantage stakeholder interviews indicated that available Internet bandwidth was insufficient for UMB’s teaching and research requirements. This is due to a combination of the size of the UMB Internet connection (260 Mbps\(^5\)) and the packet shaper settings. The addition of residence halls will place additional high-bandwidth demands on UMB WAN connections. Bandwidth utilization is something that needs to be proactively and continuously managed to meet the changing needs of the University. ITSD is planning on doubling the Internet bandwidth to 512 Mbps before the next academic year. It is important to note that the cost to upgrade to bandwidth is not just the cost of the bandwidth itself but also the potential impact on the redundant firewalls, IDS/IPS, and packet shaper. Vantage recommends that ITSD work more proactively with the UMB community to determine bandwidth needs and enhance connectivity accordingly.

Vantage also recommends that UMB investigate alternate provider connectivity to include vendor diversity and to continue to ensure that MITI is cost competitive with commercial alternatives.

3.3.1.2. Campus Network

The UMB data network runs primarily on Enterasys data switches. In January 2011, ITSD completed a project to upgrade the data network core, collapsing the three core nodes to two, dropping the Campus Center, and upgrading the core switches. As part of this core upgrade, most distribution level switches (generally one per building) have diverse and redundant 10Gb connections to the new core. The building distribution switches provide non-diverse 1Gb fiber uplinks to each edge switch located in the various data closets. The edge switches have a maximum speed to the desktop of 100 Mbps and do not provide power of Ethernet (PoE). PoE is a common way of providing power to VoIP telephone sets, wireless access points, and some video surveillance cameras.

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\(^5\) According to the Vantage Peer Review report, 260 Mbps is the lowest among UMB’s peers, however many of these also have on-campus residential students.
The existing edge data switches are ageing, have passed the end-of-sale date, and are approaching the end-of-support dates. Vantage recommends that UMB enhance edge switch connectivity to 1Gb ports by replacing these ageing switches.

Based on the new fiber ring topology proposed, Vantage recommends that UMB build a new network core in Service and Supply (or wherever the new data center is sited) and the Campus Center or GAB1. Because of phasing, it will likely be practical to build the new core infrastructure in parallel rather than migrate the existing infrastructure. The S-series cores installed in January 2011 may then be used in other applications, as part of a future N-series upgrade, or as spares. An appropriate placeholder budget is $300,000 for these core switches and any additional blades that may be required at the distribution layer.

Vantage recommends that during the switch upgrade planning, alternate vendors be involved to ensure pricing and feature parity. Vantage also recommends that UMB consider the potential cost savings and implications of collapsing the distribution layer and/or stacking edge switches as part of the edge switch upgrade project.

3.3.1.3. Wireless

A consistent theme in Vantage’s stakeholder interviews around the UMB campus has been a request to significantly improve wireless network coverage on campus within buildings well beyond the perception of that budgeted by ITSD. The perceived need for “more wireless” may be indicative of spotty coverage, slow speed, access restrictions, or complex log-in procedures. It may not necessarily indicate that wireless coverage is nonexistent, only that in the eyes of the users it could be better. As UMB has experienced with the recent wireless deployment, determining the density (and thus the cost) of access points is a very difficult exercise. For existing buildings, Vantage recommends an interactive design session to help determine the resources required to cover and support the vast majority of building spaces. For new buildings, Vantage recommends that ITSD work with the low voltage IT consultants assigned to those projects (e.g.: ISC, GAB, etc.) to design as close to ubiquitous coverage as is practical in those spaces.

3.3.1.4. Network Management

Vantage has made a series of recommendations to improve network management on campus. These include implementing a secure out-of-band (OOB) network for the management of all critical devices, log aggregation/analysis and monitoring systems, Active Directory consolidation, on-site spares in-lieu of a rapid response time on support contracts, and replacing the ageing and insecure DNS system with a current and supported tool with zones properly configured using best practices.

3.3.2. CATV

CATV service is supplied on the UMB campus by Comcast cable. There is a great deal of hard-line coaxial backbone cabling that runs through the garages for CATV backbone distribution. However, at the present time, UMB has less than 50 total cable boxes
campus-wide making the hard-line coaxial backbone significantly over-built for present usage.

Based on meetings between UMB, BVH, and Comcast to date, the present Comcast approach appears to favor continued use of analog hard-line coaxial cabling for CATV distribution throughout the campus. While this may be an inexpensive approach (for Comcast) as they can continue to deploy readily available, in-stock, obsolete equipment, it may not be in the best interest of UMB. The hard-line coax used for the CATV backbone is large and takes up a great deal of conduit space for its performance characteristics.

Since the hard-line coax will be removed as part of the garage demolition, this is an ideal opportunity to move away from obsolete analog technology and on to newer digital technology using the investment that UMB is making in single mode fiber optic cabling.

UMB’s fiber ring design provides more than ample single mode fiber to every building. Use of this fiber not only improves signal quality, but also improves the utilization of limited conduit space and positions the University to better use future video solutions (HD, video on demand, IPTV, etc.). Under this recommendation, CATV would be brought to campus and distributed over fiber. In each building, a fiber to coax converter would allow the continued use of the in-place coaxial building cabling and the existing distribution amplifiers and taps.

### 3.3.3. Audiovisual, Distance Learning and Educational Technologies

While much of the technologies for AV/DL/Ed Tech are beyond the scope of the ITEA project, Vantage met with these groups to determine the impact on infrastructure and systems within scope. This impact has been incorporated into the appropriate sections of this report. Other relevant aspects associated with these services will be addressed as part of Phase 2 of this project.

### 3.3.4. VBrick

VBrick is a product that allows the capture and transport of video signals over IP data networks. UMB presently uses VBrick to transmit up to four (4) discrete video streams to various digital displays throughout the campus. The VBrick network uses ITSD fiber and copper but does not ride on the ITSD data network at this time.

The fiber optic plant options proposed all leave sufficient capacity to dedicate fiber for the VBrick network similar to today’s topology. In the proposed fiber topology, fiber strands could be patched through to Healey for VBrick streams thus providing sufficient capacity (based on the existing VBrick deployment) for any location served by the new fiber plant. The key advantage of this option is that VBrick traffic will have no impact on the data network. ITSD is actively working towards VBrick convergence with anticipated completion by Fall 2011. Vantage recommends that UMB continue converging the VBrick network onto the enterprise data network. This option is the most easily scalable and takes advantage of the fault tolerance designed into the data network.
3.3.5. Sodexo

Due to PCI\textsuperscript{6} compliance concerns, the Sodexo point-of-sale (PoS) network utilizes a dedicated network running on an SMC Tiger Access Digital Subscriber Line (DSL) unit located in the Quinn PBX room.

Vantage recommends that UMB converge the Sodexo network onto a secure portion of the enterprise data network. Vantage believes the additional risk posed by converging the traffic can be effectively mitigated with best practice network management methods to ensure the Sodexo portion of the network is secured to only Sodexo traffic. If for either technical or contractual reasons convergence would place any PCI liability or compliance efforts on UMB, Vantage recommends a separate LAN to ensure UMB avoids any such liabilities. Regardless of which option is chosen, none of these changes precludes UMB from continuing to charge Sodexo for network services and retaining the revenue source.

3.3.6. Building Management System (BMS)

The BMS utilizes two strands of the existing ITSD 62.5/125 multi-mode fiber from the PBX room to each building. It is not part of ITSD and is physically separate from the ITSD data network. The present BMS runs on obsolete data equipment (hubs) and is no longer supported by the industry.

As part of the new network design, multi-mode (MM) fiber will no longer be part of the fiber infrastructure on campus. Consequently, if the BMS continues to run as a segregated network, the hubs will need to be upgraded to operate on Single Mode (SM) fiber strands, or SM to MM transceivers will be required.

Vantage recommends that the BMS network be converged onto a secure VLAN of the enterprise data network eliminating the separate BMS hubs altogether. Depending on the locations of the various BMS endpoints, there may be a need for additional network drops to support BMS connectivity to the data network.

3.3.7. Fire Alarms

The fire alarm system requires four single-mode fiber strands per building (two in and two out), daisy-chained from building to building.

The fiber ring design recommended by Vantage will provide more than enough fiber strands per building to accommodate fire alarm as well as ITSD services.

The fiber optic ribbon cable recommended by Vantage is made up of packets each containing 12 strands of fiber. Vantage recommends that one of the packets of 12 single mode strands in the 720-strand fiber ring be dedicated to the fire alarm service. These 12 strands will be routed directly to the fire alarm panel and will not be terminated with the other 8 packets for data purposes.

\textsuperscript{6} PCI compliance relates to Payment Card Industry standards for protection of credit/debit card information.
As required by code, the fire alarm system is completely separate from ITSD, however it does use ITSD fiber infrastructure. Vantage understands from BVH that Fire alarm circuits will continue to be provided over dedicated fiber that is part of the ITSD infrastructure. Vantage further understands from BVH that the fiber planned for this purpose will meet the fire-rating and code requirements, however should this be closely monitored and coordinated with the relevant authorities.

3.3.8. Public Safety

Public Safety has a segregated network protected by its own firewall connected to the campus network. Public Safety maintains their own network as well as a number of servers. All of these servers are located in the hallway of the Public Safety office and while they are in a non-public area of the Public Safety building, they are not immune to damage. There are several different campus surveillance and access control systems which all terminate at Public Safety with the exception of the campus safety access control system which is housed at the Campus Center. The video surveillance digital video recorders (DVRs) consume significant critical space in the Dispatch area and add to the heat and noise in that area. UMB does not have a single standard for access control or video surveillance systems.

Vantage recommends that UMB:

- Standardize on an IP-based video surveillance system which rides on the enterprise data network.
- Select a single, uniform system for the campus, based on the system selected for ISC and GAB and then expanded to the campus as a whole. Access control and video surveillance systems should be compatible and linked.
- Move the servers and data storage housed in Public Safety to the collocation area of the data center.
- Select a single ‘owner’ (e.g., Public Safety, Facilities or IT) for all of access control and video surveillance.

Vantage recommends that Public Safety and ITSD continue to work closely together to ensure all systems are managed and maintained to best practice standards and commensurate with the importance of the systems to campus operations.

3.3.9. Parking

The Parking network supports a revenue-generating, critical service at UMB. Despite this, the parking application is on servers in the Parking office, on and under the desk. The server on the desk is sitting on bottle caps for cooling and makes the environment too warm, both for the personnel and equipment sharing the space. The parking network utilizes ITSD fiber and copper infrastructure supporting older modems to control parking access, card readers, and gates.

The present Parking System will have to be replaced as part of the move from open parking lots to new parking structures especially given the expressed desire for digital signage.
regarding parking spaces occupied/available, intelligent traffic control, etc. At that time, the new Parking Control System should be IP-based, distributed over the campus data network, and have the servers located in the Data Center and the hardware and operating systems (not the application) managed by, trained systems administrators. The parking control system should be interfaced with the video surveillance system and the access control system both of which should also be IP-based and either the system managed by ITSD and the application managed by Parking or the system housed in the data collocation center.

3.3.10. **Cellular Telephone**

Cellular telephones play an important role in today’s lifestyle for everything from getting work done on the move to emergency notification. Unfortunately, cellular coverage is not consistent throughout the campus for carrier to carrier or building to building. A Distributed Antenna System (DAS) is a radio and antennas designed to re-transmit cellular (and potentially other) signals to provide uniform coverage throughout the campus and its buildings. At the present time, UMB does not have a distributed antenna system. AT&T does have a macrocell located on the roof of the Science Building which does provide very good coverage for AT&T cell phones on the campus. The coverage for other carriers (Verizon, Sprint, and T-Mobile) is spotty at best. This situation has only gotten worse with “green buildings” that use heavy concrete walls and decks and low emissivity glass. (The same qualities that block thermal flow in low-e glass also block cellular radio frequency signals.)

DAS systems can be made up of macro cells (like your AT&T tower on the Science Building), microcells (smaller transmitters), distributed antennas, distributed radios, or any combination thereof.

Vantage recommends that UMB contact a company known as a “third party neutral host” to arrange for a cellular coverage survey and to open discussions with carriers about improving coverage on campus. A neutral host can be one of the carriers themselves or a specialized company like Next-G, ADC, Crown Castle, or American Tower. Clearly a good place to start is with AT&T since their antenna array on Science will need to be relocated regardless.

Where possible, all active electronics related to the DAS should be located in the data center collocation space or in the building distribution frame locations.

It should be noted that rooftop locations for antenna placement are of value to the carriers and provide a potential revenue source for UMB and/or an avenue for getting carriers to fund the DAS deployment.

3.4. **Computer Systems and Servers**

3.4.1. **Systems Management**
To improve systems management on campus, Vantage recommends:

- Implementing “lights out” best practice methodologies such that all management changes that don’t require a physical hardware change (e.g., moving a cable, racking a server) are managed through remote tools. The technology to do this is readily available and in most cases, part of the existing hardware.
- Log aggregation/analysis and monitoring systems where appropriate.
- On-site spares in-lieu of a rapid response time on support contracts.
- Standardize server hardware and operating configurations to the extent possible.
- Configuration documentation be kept up-to-date and coordinated with security decisions and the impact on disaster recovery.

3.4.2. Virtualization

Virtualization, in computing, is the creation of a virtual (rather than actual) version of something, such as a hardware platform, operating system, a storage device or network resources. Virtualization technology allows for management efficiencies and provides the ability to do many things faster, easier, and sometimes cheaper than without virtualization. While these management efficiencies have great value, the cost of providing existing services is typically higher than without virtualization. Virtualization decisions have considerable impact on storage, data center migration and disaster recovery strategies. Vantage recommends that as part of the kick-off for Phase 2, Vantage moderate an interactive design session with the systems group and ITSD management to discuss the pitfalls, costs and efficiencies gained in a virtualization deployment so that, together, we can develop a coherent strategy for the use (or not) of virtualization technologies.

3.4.3. ITSD Core Applications

Regarding ITSD core data applications, Vantage recommends:

- Consolidation of the various campus Active Directories (ADS).
- Continue the project to join Windows machines to the primary campus ADS and evaluate the need to enhance support for Macs.
- Offer, support and market a robust, enterprise class file sharing service campus-wide. A consistent message in the Vantage stakeholder interviews was the desire for what the users described as “desktop backups”. Vantage recommends that the best way to offer this service is secure and robust enterprise file sharing with large quotas and the ability to access files from anywhere on or off campus.
- Many groups within and outside of IT run their own servers (often under their desks) with critical UMB functions that would benefit from consolidation, data center facilities and professional systems administration.

3.4.4. Data Storage

UMB has five independent storage area networks (SANs). Vantage recommends that UMB standardize on a single, flexible enterprise-class SAN platform for most services, and only
employ other storage solutions if specific applications are not supported. As storage is a foundation technology for other services, Vantage’s recommendations for an overall storage strategy will be part of Phase 2. This strategy will be based on the decisions made in Phase 1 including virtualization, enterprise file sharing, service offerings, disaster recovery, and data center migration strategy. These same decisions will dictate the direction for backup technology and architecture as part of Phase 2.

3.5. Security

Regarding network security, UMB has come a long way in developing the elements necessary for an effective security management model. However, there are still improvements to be made. The present organizational structure separates security policy management and network security management making coordination much more difficult.

There is a tension between the desire to protect the institution and community (security) and the desire to make things as easy, transparent, and natural as possible for the users (access). The most secure data allows no access; the most accessible data is unsecured. Getting the balance right depends on perspective and complaints about restrictive access protocols are common in well-secured networks. Vantage recommends that UMB continue with plans to expand identity management in such a way as to allow increased access to services without compromising security and continue to work with the community to achieve that delicate balance necessary to protect information but allow access. As UMB builds its research and academic profile, this approach will increasingly become an issue with faculty.

ITSD believes they do not manage any infrastructure which contains personally identifiable information (PII) or other data with legal requirements surrounding its confidentiality. However, no audit has been conducted or users surveyed to confirm that this is the case. Vantage's experience with other similar institutions is that there is likely significant data covered by FERPA, HIPAA and other regulations on ITSD managed infrastructure that ITSD has not been made aware of.

UMB is actively working with the University of Massachusetts office of the CIO to develop a Written Information Security Plan (WISP) within the ISO 27001/2 framework. Many of the recommendation detailed in this report (including incident response and audit requirements) will likely be covered by the Controls surrounding the WISP as they are developed and detailed.

Other Vantage recommendations include:

- Create and maintain formal policies and procedures for incident response and analysis.
- Implement procedures for lessons learned and root-cause analysis after incidents.
- ITSD should work with the UMB community to ensure sensitive data is stored in compliance with all relevant regulations.
- Deploy additional Intrusion Prevention Systems (IPS).
- Integrate security best-practice into the future change management processes and related communications.
• Work with other area higher education institutions to apply their lessons learned in providing a sufficiently secure infrastructure that encourages the freedoms typically associated with successful academic environments.

### 3.6. Change Management and Stakeholder Communication

Change management is an approach for assessing, evaluating, and testing changes before implementing them and communicating to rest of the community the impact the change might have. Change management is not a product that can be purchased, but a way of doing things integral to the culture analogous to a safety culture in a manufacturing environment or a customer service culture in a sales environment. There are few formalized change management procedures or policies at UMB. As a result of the lack of formal policies for change management, communication of changes and their impact tends to be forgotten -- both within the ITSD organization and to and from the user community.

Vantage recommends that ITSD reach out to the UMB community to establish trust and two-way communication. While it will be a long process to change the “culture” of ITSD, this should begin with discussions amongst the IT groups (and with Vantage). Significant information can be gleaned in this area from the approaches of UMB Peers. Once a framework for change management has been agreed upon, it will be appropriate to find or develop tools that will assist in the implementation of this framework.

### 3.7. Research Computing

There are eight issues associated with building an information technology enterprise architecture to support research in general and research computing in particular. It is necessary to predict or determine the following:

1. The nature and amount of research expected.
2. The computing resources necessary to support the research.
3. Data storage resources necessary to support the research.
4. Location for computing and storage (UMB, UMass System, Vendor/Cloud).
5. Network resources necessary for UMB researchers.
6. Network resources necessary for peers/sub-contractors of grants.
7. Security obligations incurred by conducting the research.
8. Support necessary (desktop, programming, applications, database, interface) and how it is to be provided.

Since we cannot at this time reasonably assume that research or high-performance computing will be exclusively off-campus (relying on the UMass System, The Massachusetts Green High Performance Computing Center (MGHPCC) in Holyoke, outsourced services, or the cloud), the data center must be sized with the capacity to house any research and high-performance computing expected to be necessary for the types of research conceived, and to house the associated data storage. Additionally, the network must be designed in such a fashion that research applications requiring high throughput (e.g. high-definition video feeds) would be
possible without disrupting other mission critical data networking needs. Also Internet and Internet 2/research networks must have the capacity for UMB researchers to access resources located off-campus and for peers, subcontractors, and collaborators to access resources that are sited on the UMB campus.

It is also important to realize that new academic research, even that which pulls in large governmental and private funding, does not help the institution’s “bottom line.” On the contrary, even prestigious research universities typically put research on the obligation side of the ledger. This is because there are many research costs that cannot be recouped, even by grant overhead, and the grants obligate the institution to do particular research.

David Wedaman's 2006 ECAR Research Bulletin provides an excellent framework for further discussion.

Research computing is highly individualized and often driven by research and grant requirements that are outside the control of the University. The prudent approach is to be able to provide and support many different research computing approaches in order to best meet the needs of the specific department doing the research.

Vantage recommends that IT create a Research Computing Support Group starting with a Research Coordinator position that will work with the research community to determine how research computing will be best supported at UMB. As Research Computing grows, the Group can be expanded to include technical and systems support personnel as required.

### 3.8. Computing/Applications/Services - Outsourcing

While many of the applications in use at UMB are beyond the scope of the ITEA project, Vantage met with the Applications Services group to determine the impact on infrastructure and systems within scope. This impact has been incorporated into the appropriate sections of this report. Other relevant aspects associated with these services will be addressed as part of Phase 2 of this project. However, one aspect to be addressed at this point is outsourcing.

The options for moving technology and technology management out-of-house (collectively referred to as “outsourcing”) are more numerous than ever. The claims about these services can be compelling especially for an institution that is short on capital, dealing with personnel freezes and cutbacks, and facing replacement of obsolete technology. One specific area in question for UMB is whether to outsource Exchange mail services for faculty and staff.

Outsourcing has its place. It can be a cost effective method of supplementing in-house capabilities, providing additional expertise, and allowing an organization to concentrate its limited resources on those efforts which most greatly support its strategic mission. However, outsourcing is not an all-or-nothing decision. It can best be viewed as a continuum, moving from no outsourcing to full outsourcing. UMB must decide not only whether to outsource a

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function (IT, telecommunications, food services, custodial services), but which specific tasks within that function to outsource.

When technology is outsourced, there are numerous changes which take place. It cannot be assumed that one can transparently make a transition of this magnitude without significant and sweeping changes in day-to-day operations. Contrary to popular belief, outsourcing does not eliminate the institution's need to manage; it just changes the nature and level of management. Someone still has to manage the outsourcers, the contract, the interface with the school, etc. Failure to manage is the single most common cause that outsourcing endeavors fail. Outsourcing can work successfully for an institution in certain circumstances and for certain functions, but cannot be viewed as an across-the-board cure-all for the ills that plague IT in higher education. Outsourcing must be carefully evaluated and any financial benefits weighed against issues such as control, the strategic value of technology to the institution, staffing, and responsiveness. Properly applied, outsourcing offers many benefits; improperly applied, it offers even greater risks.

3.9. Help Desk/Desktop Support

Some aspects of Help Desk and Desktop Support are beyond the scope of the ITEA project. Vantage met with this group to determine the impact on infrastructure and systems within scope. This impact has been incorporated into the appropriate sections of this report. Other relevant aspects associated with these services will be addressed as part of Phase 2 of

3.10. Physical Infrastructure

3.10.1. Outside Cable Plant Overview

The outside cabling plant which interconnects the UMB buildings consists of copper, fiber, and coaxial cabling most of which will be destroyed when the garages are demolished.

Copper Cabling

The copper cabling at UMB is used primarily for voice, fax, alarm circuits, DSL (such as Parking), and ISDN (video). Vantage recommends that UMB begins with the basic design of 100 pairs per major building and 50 pairs per minor building and make adjustments on a per building basis for those locations where more or less cabling might in order. The overall design objective will be to keep the aggregate cable count where it enters the data center or PBX room from the north or south loop to less than 800 pair (what can fit in two 4” conduits).

Fiber Optic Cabling

The fiber optic backbone at UMB serves all buildings and consists of a mix of single-mode fiber, multi-mode 62.5 micron fiber, and multi-mode 50 micron fiber. With the exception of the recently-built Campus Center, no IDF has more than 12 strands of 62.5 multimode
fibers from the building distribution frame (BDF). In the future, additional fiber or higher bandwidth fiber may be required. UMB is planning to upgrade the riser fiber to 12 single mode and 12 50-micron multi-mode fibers to enable support of 10 Gbps connectivity to the IDF.

It is Vantage's understanding that the BDFs for Wheatley and McCormack are in jeopardy from the garage renovations and may need to be relocated and therefore redesigned. ITSD should investigate opportunities to enhance the environmental conditions in these BDFs or segregate the network BDF from the fire alarm and other utilities.

The design for fiber optic cabling for UMB is based around the concept that there will be two core data network nodes at opposite ends of the campus\(^8\) and that every building will attach to both of those nodes via diverse routes. In addition the network nodes will be interconnected by means of additional fiber in order to allow additional routing, patching, and disaster recovery options. The data network topology is designed to be fault tolerant for a single fiber cut anywhere in the utility corridor. A break in the branch fiber entering an individual building may not be fault tolerant. As is the best practice today, all fiber will be 8 micron single-mode.

Vantage recommends the installation of a fiber ring around the campus using fiber optic cabling known as ribbon fiber. Ribbon fiber is a large count fiber cable design to be split into smaller bundles without compromising the integrity of the whole cable. In this scenario, a large count ribbon fiber (for example 720 strands\(^9\)) would be run between the data center (assumed to be in Service and Supply) and Campus Center to the north and to the south. At each manhole where there are building entrance conduits, the required building count (e.g.: 48 strands) would be broken out from the cable, fusion spliced, brought into the building and terminated. The same count would then exit the building and be terminated in the manhole to continue on to the other end of the ring. This would provide the dual-homing from each building to S&S and CC.

The diagram below shows schematically how such a fiber ring would be deployed.

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\(^8\) Assumed at this time to be in the data center (S&S) and the Campus Center but GAB1 may replace the Campus Center.

\(^9\) Corning Fiber 720 strand ALTOS \(^\ast\)ribbon fiber, gel-filled, armored, loose tube.
The benefit of this approach lies in better conduit utilization (a single large bundle) and in future flexibility. If there are seven buildings on the south side of the utility corridor and 48 strands to/from each building, then 336 of the 720 strands would be in use. At any time in the future, additional strands can be tapped into for new buildings or for locations requiring additional fiber. In addition, if a new building is added, only the manhole feeding that building needs to be entered in order to tap into and fusion splice the cable. This approach will be particularly beneficial on the north section of the corridor where there are plans to build many new buildings.

3.10.2. Coaxial Cabling

See CATV section 3.3.2 above.

3.10.3. Physical Security of IT Spaces

Spaces assigned to ITSD for equipment rooms and tel/data closets has evolved over the years. Much of what IT has had to do is to make-do with available (often sub-optimal) spaces and conditions. Some IT spaces are shared and too many people have keys to IT spaces. Newer installations (such as the Campus Center) tend to more closely follow present standards and requirements and should be continued moving forward.

The physical security of IT spaces is critically important to communications security and reliability. Communications spaces should be dedicated to communications functions and not shared with any other department or service. Access should be limited to only those
with a need to be in the space. Vantage recommends the use of keypads or card readers to control and audit access.

3.11. Disaster Recovery/Business Continuity (DR/BC)

The overall purpose of a Business Continuity Plan (BCP) or a Disaster Recovery Plan (DRP) is two-fold: to make information easy to find when needed and to make that information easy to keep up to date so that it is accurate when needed. There are four basic categories that need to be addressed as part of disaster preparedness. These are:

1. Physical spaces (server rooms, telecommunications spaces, building entrance facilities, etc.)
2. Systems and network topology (design, redundancy, back-ups, etc.)
3. Personnel (attitude, knowledge, flexibility, dedication, training etc.)
4. Documentation (policies, procedures, inventories, call-out lists, etc.)

As part of our design criteria, Vantage has incorporated disaster avoidance and recovery as basic design tenets. Some of our design features include:

- Fiber optic ring topology.
- Dual homing fiber from every building to each of the two core switch locations.
- Redundant servers added into the telecommunications system design.
- Remote LIMs on the telephone system will be interconnected via the data network. The inherent network redundant and self-healing nature of the data network will extend to the telephone system as well.

The best approach for disaster planning is to accept the fact that a large, complex institution such as UMB can’t plan for everything and realize that most of the response to any disaster must be done in the field and on-the-fly depending on the specifics of the situation. The disaster plan should have basic information – who, what, where, how many, areas of responsibility, etc. This way, it is much easier to define what constitutes a disaster and what you need to be ready to respond to it.

UMB does not have a complete inventory of all equipment – per building, by type, make, model, ports in use, configuration, etc. A comprehensive equipment database that can be sorted by any field can be an extremely useful tool. It can be used to obtain a list of all equipment in a damaged building or to locate a similar piece of equipment that can be re-purposed to meet a more critical need.

While there is a great deal of information available throughout ITSD (and a great deal in the heads of ITSD personnel), the information is not complete or consolidated in such a manner as to facilitate restoration. For example, if some of the servers had to be rebuilt, one would have to go to multiple sources to obtain full information on server type, make, model, capacities, operating software, applications, configuration, etc. This kind of information should all be consolidated in the disaster recovery documentation for easy access. UMB, as part of a UMass System initiative, plans to use Kuali Ready as the DR documentation and process template tool.
4. Stakeholder Coordination

Because of the scope technology and the number of inter-related projects that UMB is conducting simultaneously, it is extremely important to coordinate all of the technology aspects of these projects. The design work that Vantage is doing should be coordinated with BVH’s utility corridor work, the low-voltage design for the ISC, the low-voltage design for the GAB, Facilities siting of the Data Center, the UITS relocation of the DTR racks for the Data Center, campus entrance facilities for Verizon, Comcast, and MITI providers, video surveillance and access control systems selection, and numerous other related projects. Vantage suggests a technology planning session where the stakeholders and associated consultants for all of these projects meet, discuss the inter-relationship of the activities, and determine how to best coordinate and communicate to avoid waste, duplication, and missteps.

Vantage is aware of the fiscal constraints under which all institutions of higher education are operating. IT has no inherent value in and of itself. IT’s value to the institution lies where IT investments can be leveraged for improved innovation and efficiency in administration, teaching/learning, and research. In order for IT to be funded and supported properly, IT must be seen as a critical part of how other departments operate. The worst thing for the institution is for IT to be seen as just another utility, or, worse than that, an impediment. The challenge for UMB ITSD is to establish itself as a critical partner to all other departments in their operations. As part of this effort, Vantage recommends the establishment of an IT governance advisory group to improve communications and information flow between IT and the other departments on campus as well as a renewed commitment to customer service.

5. Conclusion

The University of Massachusetts – Boston has its share of both opportunities and challenges. But Vantage recommends that the challenges be regarded as further opportunities. While the renovation of the garages, the relocation of utilities, the redesign of roadways, and the new building construction projects will greatly complicate day-to-day IT operations, it also provides ITSD with unprecedented opportunities to replace systems, improve operations, and establish new directions and policies for IT moving forward. ITSD must make a clear decision to either narrow its focus and support an appropriate set of core services or provide a more complete suite of services. As part of Phase 2 Vantage will work with ITSD to determine what systems and services (but not necessarily applications) to support and manage across the UMB community.

Few colleges and universities have the chance to make the kind of wholesale changes and improvements that UMB will. The decisions made as a result of this Phase 1 report will establish the framework and context for IT at UMB for the foreseeable future. It is not an opportunity that should be squandered or taken lightly. The challenges facing UMB regarding Information Technology may be significant but need not be overwhelming. A focused, phased approach to understanding and resolving the issues (of which this report is part) will produce major benefits for the institution.

Vantage appreciates the opportunity we have to be a part of this exciting project and looks forward to assisting UMB in Phase 2 and making the recommendations in this Phase 1 report a reality.