Administrative Excellence
UNIVERSITY OF WISCONSIN–MADISON
Shaping our Future

Data Center Aggregation Project

Final Report and Recommendations

January 30, 2014

Approved by the Administrative Excellence Steering Committee on January 30, 2014

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Notes on Revisions to the Final Report and Recommendations

An **Initial Draft Final Report and Recommendations** was shared and discussed with the Steering Committee on October 22, 2013.

A **Second Draft Final Report and Recommendations** was shared and discussed with the Steering Committee on December 18, 2013. This version included the following edits suggested by members of the AE Data Center Aggregation Organization / Governance Sub-Team during their final meeting on December 2nd and additional correspondence through December 13th:

- Delivery of Services and the Customer Engagement Process (section added to page 15)
- Campus Readiness (edits to the disincentives section on page 22)

The **Final Report and Recommendations** includes additional content which the Steering Committee asked the Executive Committee and Organization / Governance Sub-Team Leader to provide. In addition to feedback received from the Madison Technology Advisory Group (MTAG) on December 17th, the following additional content was shared and discussed with the Steering Committee on December 18th:

- Data Center Aggregation Implementation Team – Change Management Plan (page 23)
- Engagement Framework for Potential Data Center Aggregation Sites (page 26)
- Central Data Center Service Operational Plan (page 30)
- Power Metering Plan for Distributed Data Centers (page 32)
- In January 2014, members of the Executive Committee and the Organization / Governance Sub-Team Leader refined the proposed structure of the Campus-Level Data Center Services Unit to one in which the CIO's strategic vision is operationalized within the DoIT organization while still retaining accountability to the CIO in a dotted-line fashion. It should be noted that the refined structure found in Appendix 9 (page 49) includes edits that were completed after the December 18th meeting with the Steering Committee. This revision was approved by the Steering Committee on January 30, 2014.

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Executive Summary

Steering Committee	Paul DeLuca, Darrell Bazzell
Executive Committee	Alice Gustafson, John Krogman, Bruce Maas, Ed Van Gemert
Sub-Team Leaders	Steve Krogull, Rick Konopacki, Kevin Cherek, Terry Bradshaw
Project Managers	Brian Goff, Dan Koetke

Project Goal (articulated by the Phase II team)**:** Develop a new model of server and data center structure to serve the needs of the University's academic, research, and administrative communities, leveraging industry-leading practices for server administration, virtualization, and management to save costs, improve service levels, and minimize data security risks. During the September 2013 update meeting, the Steering Committee expressed interest in eventually reducing the number of campus data centers from its current number to two.

Solution Summary: This team's final report describes a proposed Central Data Center Service that offers and manages a portfolio of data center solutions that will serve the vast majority of campus customers. This portfolio includes co-located facilities, virtualized solutions, and a small number of physical facilities here on campus. The benefits to the University will be improved services and data stewardship practices, risk reduction, expenditure avoidance, utility savings, reduced staff time and maintenance costs, and improved space utilization. Due to the ramp-up costs associated with building capacity and funding campus utilization incentives, the proposed implementation may not result in a net cost savings for at least five years.

Aggregation Roadmap:

- The Central Data Center Service will drive the university toward a small number of aggregated data centers, with success measured as a reduced number of decentralized data centers and the total square footage they collectively occupy.
- The Central Data Center Service will track and report on cost savings realized over time. Areas of cost savings include expenditure avoidance, utility savings, reduced staff time, reduced maintenance costs, and improved space utilization.
- During the first two years, the Central Service will focus on ramping up capacity, virtualization infrastructure, and service capability to prepare for an increased migration volume.
- By the third year, the Central Service will be well positioned to accelerate campus adoption and will have had experience with pilot engagements and incentive strategies.
- By utilizing off-campus solutions and more efficient hardware on campus, the number of data centers to be managed centrally under a single portfolio is likely to max out at eight, and total central FTE required will likely level off at 30.
- In order to drive down both the of distributed data centers and the total square footage utilized by distributed data centers, campus engagements during and after the third year forward will focus on a balanced mix of large and small data centers.
- In order to be successful, this implementation will require significant central financial support. This is likely to be in the range of $1-$2 million per year for the first five years as the Central Service ramps up its capability, followed by a tapered reduction in the level of central support needed.

Proposed Process for Assessing Distributed Data Centers: The team developed a systematic and objective data center assessment process for engaging and evaluating potential aggregation partners. The work product of each

assessment will be brief decision document for each unit's technical and business leadership (e.g., Dean and CIO). This document will include the following the following elements:

- *Facilities Assessment* – evaluates a unit's facility against the set of minimum specification requirements; team's research shows that very few data centers on campus will meet these, and mitigation tends to be prohibitively costly
- *Risk Assessment* – identify known data, environmental, and other risks; many very significant risks will be unknown
- *Services Assessment* – identifies services delivered by a unit's data center
- *Cost Assessment*
    - The team created a standardized cost model to serve as an easy-to-understand foundation for a fully-burdened cost model, enabling apples to apples comparisons of <u>all</u> costs related to campus data centers.
    - Captures costs to individual campus units as well as those paid at the University level such as power and cooling utilities.
    - The team has found it prohibitively difficult to gather cost information from units in a standardized format because these costs are typically not managed in any way other than hardware & software purchases.
- *Decision Point*
    - Key aggregation drivers will be the need for risk mitigation and ensuring minimum facilities standards are met, not a reduction in overall operating costs
    - In the majority of cases, the objective answer will be to utilize the Central Service

Proposed Campus-Level Data Center Services Unit:

- Will serve as the primary business unit for the campus data centers.
- The campus data centers will have unified facilities management, shared and common support staff, integrated services across the campus facilities, a common client engagement and support model, a single financial model, and accountability through the CIO office.
- The team recommends direct accountability to the CIO through an explicit change in organizational structure. The Executive Committee refined the proposed structure to one in which the CIO's strategic vision can be operationalized within the DoIT organization while still retaining accountability to the CIO in a dotted-line fashion.

Funding the Central Services Unit & Campus Incentives:

- To keep the price of utilizing the Central Service below market alternatives, campus customer pricing should be based on their consumption only, not the cost of maintaining infrastructure.
- While non-financial incentives will be important drivers of campus adoption (summarized in the Customer Readiness section of this report) financial incentives will be particularly important for two reasons:
    - Potential campus customers indicated that price is their number one decision driver
    - At some point in the future, possible financial disincentives may help fund the Central Service
- This price reduction will result in a very significant reduction in revenue that needs to be replaced by other funding sources:
    - Once utility metering is in place, shift utility costs currently paid by the University to campus unit
    - Actual utility cost reduction, regardless of funding source
    - "Common good" central funding
    - Labor costs (difficult to assess, but it is recognized that over time and across campus, we will see productivity gains)

Immediate Next Steps:

- Over the next 2-3 months, continue to develop the funding and staffing model of the Central Services Unit such that the availability of a new campus service can be communicated to campus in January 2014.
- Continue to engage campus Governance, functional groups, and other stakeholders as outlined in the Communication / Socialization Plan.

Project Background

Introduction:

UW-Madison operates many campus data centers, server rooms dedicated to maintaining local information systems. An Administrative Excellence team was created to assess the current state of these centers, adopt industry standards for security, power and backup and consider ways to aggregate centers providing redundant services. The aim is to improve efficiency, reduce costs and provide affordable, streamlined assistance for the campus.

Chartered Project Goal:

Develop a new model of server and data center structure to serve the needs of the University's academic, research, and administrative communities, leveraging industry-leading practices for server administration, virtualization, and management to save costs, improve service levels, and minimize data security risks.

The following is a visual representation of the current and future state:

Projected Future State

Current State	Future State
97+ data center/server room facilities with varying degrees of energy efficiency, security, and performance	**Limited number of high-efficiency data centers, held to minimum security and performance standards to be defined**
Units/departments/end users are responsible for picking the best product, whether hardware or software, and obtaining value	Centralized purchasing of servers, software, and related equipment will ensure best practices/prices
Service level is dependent upon level of expertise and resources at the unit/department level	**A consistent level of service is provided to all departments that is easy to use and flexible**
Private service provider options are either ignored or considered on an ad-hoc, sporadic basis	**Central service provider will monitor the private market, match solutions with needs, and support the negotiation of contracts**
Some departments don't have the resources to effectively take advantage of virtualization technology	**Virtualization will be a core service of the proposed organization; tools and process support will be provided to all units/departments at the best price to campus**
Minimal collaboration between campus units/departments on data center best practices	Central service provider will provide a vehicle for collaboration and engagement across campus

In March of 2012, a cross-campus team surveyed data center administrators and identified opportunities for efficiencies via an aggregated data center model. For all of the details on the team's findings and recommendations, please review the full business case for the AE Data Center Aggregation Project Phase II. The business case may be found in the "Projects" section of the Administrative Excellence web site (http://adminexcellence.wisc.edu/project-areas/it-data-center-aggregation/).

Launch of the Data Center Aggregation Implementation Team (Phase III):

In October 2012 an implementation team was launched, comprised of the following three project sub-teams, each charged with completing deliverables in one of three functional areas:

1. Campus Services Sub-Team

The primary goal of the campus services sub-team was to identify the set of baseline service requirements service levels that a campus-level data center service should provide. The scope of these baseline service requirements included both physical and virtual data center needs and preferences and the service attributes of suitable hosting facilities, both on campus and off campus. The scope of their work explicitly excluded areas such as cost and pricing models, specific methods for the provision of services and other aspects addressed within other areas of the AE Data Center Aggregation implementation project.

The process used by the sub-team focused on collecting, understanding, and documenting the "voice of the customer" to ensure that new service offerings will meet the critical needs and preferences of campus. To accomplish this goal the team:

- Reviewed the outcomes of the Data Center Aggregation Focus Group held by the Phase II Administrative Excellence team in summer 2012 and then identified the appropriate areas for data collection.
- Developed an interview template to guide conversations through relevant topics such as data storage, networking, security, remote access, and availability. Interview participants were selected from a cross-section of campus customers and stakeholders. Interviewees included a broad range of data center service customers and their providers.
- Analyzed trends in interview responses and segmented these into logical service categories and related service attributes. Once organized, the team distilled minimum requirements within each service category (and also often within specific service attributes). The sub-team also captured and (separately) documented service requirements above and beyond the baseline service levels.

2. Data Center Facility Inventory Sub-Team

The primary goal of the facilities sub-team was to develop and refine an inventory of all UW-Madison facilities, both on and off campus, that qualify as operating as "campus data centers." Qualification involved meeting certain key attributes as defined by the team, including:

- Physical size
- Power capacity
- Cooling capacity
- Energy efficiency
- Physical security
- Environmental monitoring

The inventory began with collecting data through two campus surveys sent to data center administrators and campus building managers. This data was refined and then converted to a searchable database. The next step involved contacting all administrators of data centers larger than 200 square feet and scheduling on-site visits and interviews to get as much accurate data as possible about the facility.

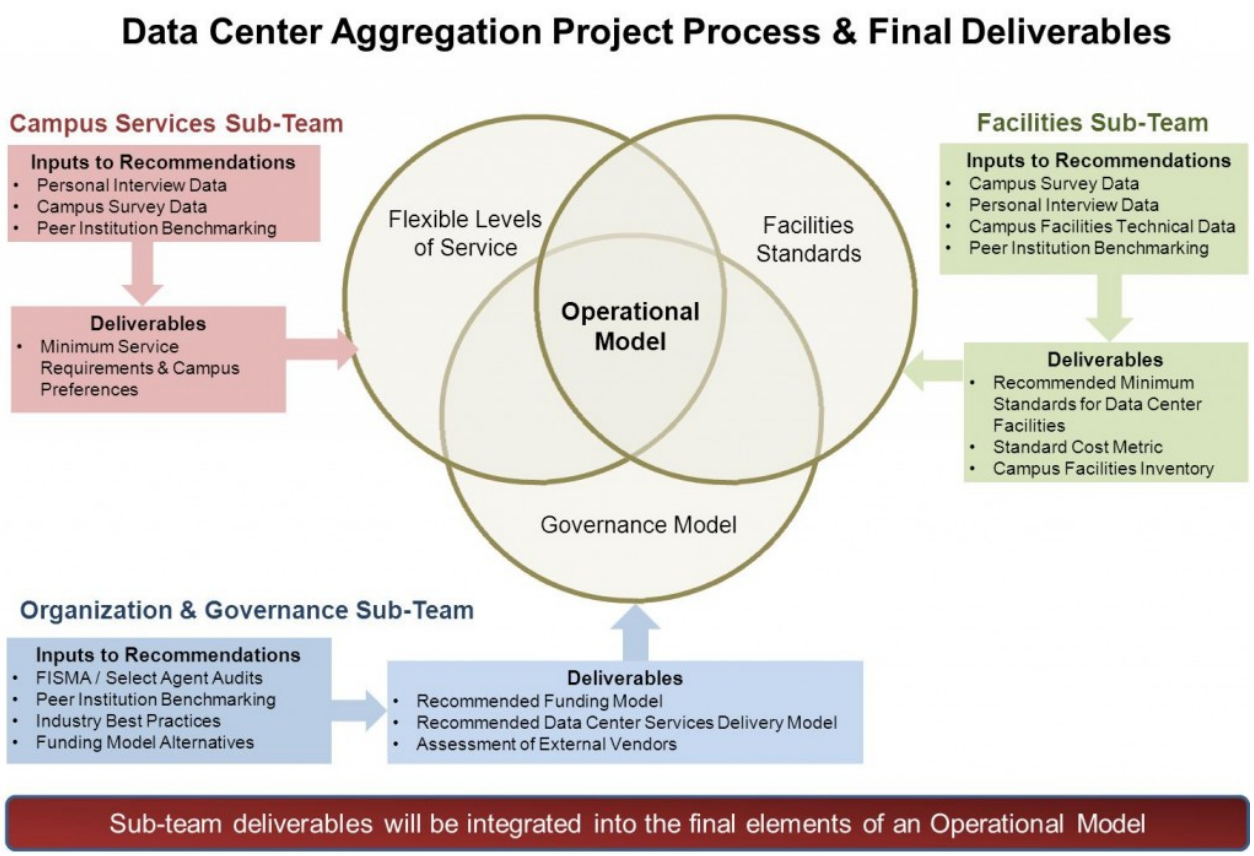
The facilities team developed recommended minimum standards for data center installations on campus and transitioned these to the Organization and Governance sub-team. Those who will continue to forward the work of the overall initiative may develop some additional levels of data centers akin to the Uptime Institute's data center tier levels, but more useful for the needs of UW-Madison.

The team also investigated and considered several alternative models to determine facilities operations costs, such as cooling, power use and physical infrastructure which contributed to the recommended standardized data center cost model.

3. Organization and Governance Sub-Team

The primary charge of this sub-team was to integrate the findings of the Facilities and Campus Services sub-teams to define, develop, and ultimately deliver a scalable campus-wide data center services offering, including a multi-year operational plan for realizing the cost savings associated with increasing campus adoption of the centralized service.

Below is a visual representation of how the work of the three sub-teams fit within the overall project:



The UW-Madison Data Center Landscape (Current State)

Current State Summary:
The opportunity exists today to encourage best data center practices using incentives that will result in cost savings for central campus, individual schools, colleges, and administrative units through the reorganization and consolidation of server placements and solutions including increased virtualization, aggregation, and outsourcing.

While the primary driver of this project was to be able to recover cost savings from co-location and virtualization, the team found that the greatest benefits to the University as well as decentralized campus units lie in other areas such as providing safe, secure storage for sensitive data. There exists an increasing need to safely store data, and the current server/data center environment puts the institution at risk for data loss and the resulting financial and reputational costs.

The University is dependent on a wide range of IT resources to carry out its mission of teaching and research, and the proposal outlined in this report provides an operational strategy this will continually inventory and assess the fitness of the existing infrastructure in support of that mission and recommend changes as needed.

Data Center Services – Facilities Assessment:
There are a multitude of server rooms across campus, providing a wide range of hosting services. The team identified 97 facilities through its March 2012 survey of data center administrators and validation work completed in spring of 2013.

- Approximately 52,000 sq. ft. of identified hosting space; approximately 55 percent used for research purposes
- 60 percent of facilities host virtualized servers
- 25 percent of facilities are 500 square feet or larger; 16 percent are 100 square feet or smaller
- 50 percent of facilities cannot freely share their facilities with others due to restrictions on how their funding can be used or particular security policies they must follow
- 53 percent have lockable racks; 34 percent have card access systems
- 76 percent of facilities have a dedicated cooling system; 30 percent have a backup cooling system

The current primary driver for developing server room space leans towards expediency and convenience with little emphasis on reliability, energy efficiency, or security. The result is that most of these data centers are not managed according to industry norms and are inefficient. None are managed as a campus resource. Some aren't properly sized. Almost all were designed before the advent of virtual computing.

For some departments with access to facilities and services, recent virtualization efforts have reduced the need for expansion into additional spaces. Meanwhile, other departments who need server room services but don't have access to them must beg, borrow, or lease space, or hope that their department has enough money to modify an existing space appropriately. Ultimately, to minimize cost and space, some end up utilizing sub-optimal spaces for server hosting. While the biggest return on investment is in encouraging the virtualization trend, smaller departments don't have the resources to take advantage of this technology effectively. Departments with resources for virtualization are building parallel infrastructures across campus at the departmental level. The result is "haves" and "have-nots" in an inefficient and wasteful environment.

Data Center Services – Campus Needs Assessment:

The process used by the sub-team focused on collecting, understanding, and documenting the voice of the customer to ensure that new service offerings will meet the critical needs and preferences of campus customers. To accomplish this, the team first reviewed the results of a survey shared by the Phase II Administrative Excellence team in summer 2012 and then identified the appropriate areas for additional data collection. Next the team developed an interview template to guide conversations through relevant topics such as data storage, networking, security, remote access, availability, and many others. A list of interview participants was developed with the intent of including a representative cross-section of campus customers and stakeholders. The list of interviewees included customers of data center services as well as providers of these services, and it was designed to capture as broad a set of campus needs and preferences as possible. Both academic and administrative units were represented. Examples of the types of customers and service providers that participated in interviews include college CIOs, academic computing directors, researchers with high-performance computing needs, people that support research computing, faculty, and Assistant Deans.

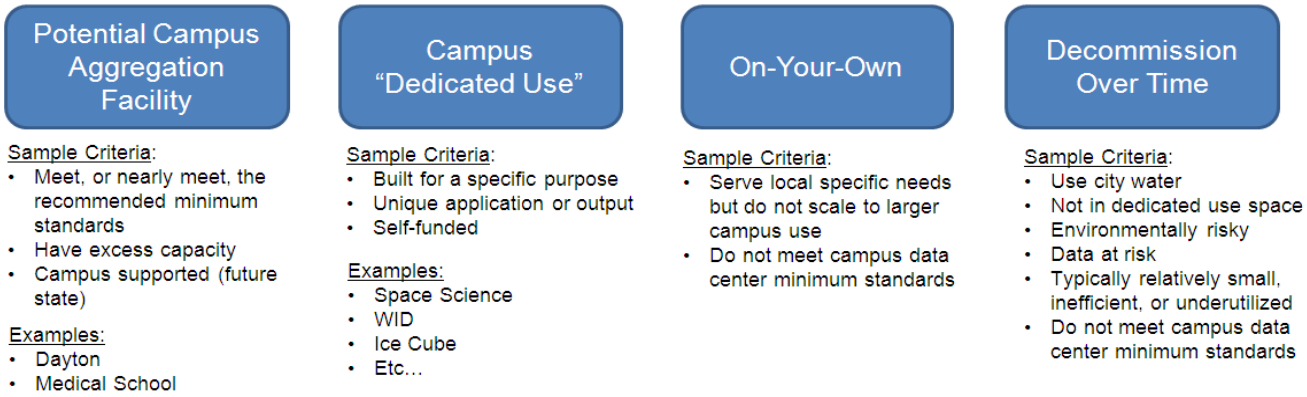
Team members then completed an affinity diagramming exercise to analyze trends in interview responses and segment the data captured into logical categories of campus needs and preferences. Once organized in this fashion, the team distilled the minimum service requirements expressed by interviewees for each of these categories as well as other needed or preferred options above and beyond the minimum requirements.

The document outlining the specific baseline needs of campus customers, as well other preferences identified, is found in Appendix Six.

Findings & Recommendations

As expected, the facilities ranged considerably in capacity, configuration and level of security. After comparing this data to the recommended minimum standards (see Appendix Two), the team created four categories to structure how we think about the facilities landscape going forward: centrally-funded potential aggregation facilities, self-funded campus "dedicated use" facilities with little excess capacity but with relatively efficient and secure operations and potentially appropriate for continued independent operation, and data centers that are relatively small, inefficient and/or underutilized.

Visual representation of a Forward-Looking View of the UW-Madison Data Center Facilities Landscape:



Summary of Findings:

- The vast majority of data centers do not meet recommended minimum standards
- Some service providers are eager to have at least some of their needs met by a central service
- Cost and funding options will be the key motivation for campus participation
- Much of campus is already engaged in virtualization (roughly 60%)
- Anticipated growth, particularly in research, will quickly exceed capacity
- Internal and external audits have identified the need for increased geographical diversity
- The percentage of facilities in the "decommission over time" category is significant (almost half of the total) but collectively these facilities house a small fraction of the total number of servers on campus
- By replacing physical servers with virtual servers, there exists sufficient excess capacity in some of the existing larger data centers to allow significant aggregation
- Approximately eight data centers on campus that with minimal improvement could provide the space, power and cooling required to accept the majority of servers contained in the "decommission over time" category of facilities

Summary of Recommendations:

- Establish an enterprise-level data center services unit (i.e. the "Central Services Unit"), available to serve the needs of all of campus
- Leverage DoIT's Data Center Operations team as a campus resource

- Align the Central Services Unit with Campus Governance, the CIO reporting structure, and the pending Enterprise IT Decision-Making Structure
- The new Central Services Unit should follow a multi-year approach to incrementally drive aggregation
- Develop a funding and staffing model that supports the Central Services Unit and provides campus with financial incentives to utilize the service

The next several sections of the report provide detail regarding the proposed Campus-Level Data Center Services Unit and its value proposition to campus.

Proposed Campus Level Data Center Services Unit (aka, the "Central Service")

Description:
This unit will serve as the business unit responsible for managing a single portfolio of campus-level data centers (i.e., the aggregation sites), off-campus facilities, and cloud solutions, and would also serve as the single point of contact for campus customers in need of data center services. Campus data centers managed under this unit will have unified facilities management, shared and common support staff, integrated services across the campus facilities, a common client engagement and support model, a single financial model, and accountability through the CIO office.
To accomplish this vision, the Central Service will be the primary point-of-contact for data center operations. The Unit's manager and staff will engage in strategic planning for data center operations, manage budget and staff, contract and manage external vendors and services (i.e., cloud services), comply with internal and external audit and certification processes, maintain service and support relationships with data center facility managers across campus not designated as "campus facilities" or not aggregated into common facilities at this time, oversee the aggregation of distributed data services towards common campus infrastructure, partner with FP&M to provide high quality facilities services, and act as a member of the Enterprise IT Decision Making process to inform their decisions and directions.

The Central Service will need to maintain accountability and transparency in operations through collecting and reporting relevant performance metrics, publicizing aggregation progress and timelines, maturing and promoting the customer engagement model as the unit gains more operational experience, and refine and document the evolving financial model as infrastructure costs change, incentives and subsidies evolve, and data center services mature. In partnership with FP&M, the unit will plan and operationalize data center maintenance, upgrades and decommissions as part of the overall aggregation and facilities management processes. The structure of the proposed business unit is composed of two groups - a Central Services Unit and a Campus Data Center Operations team.

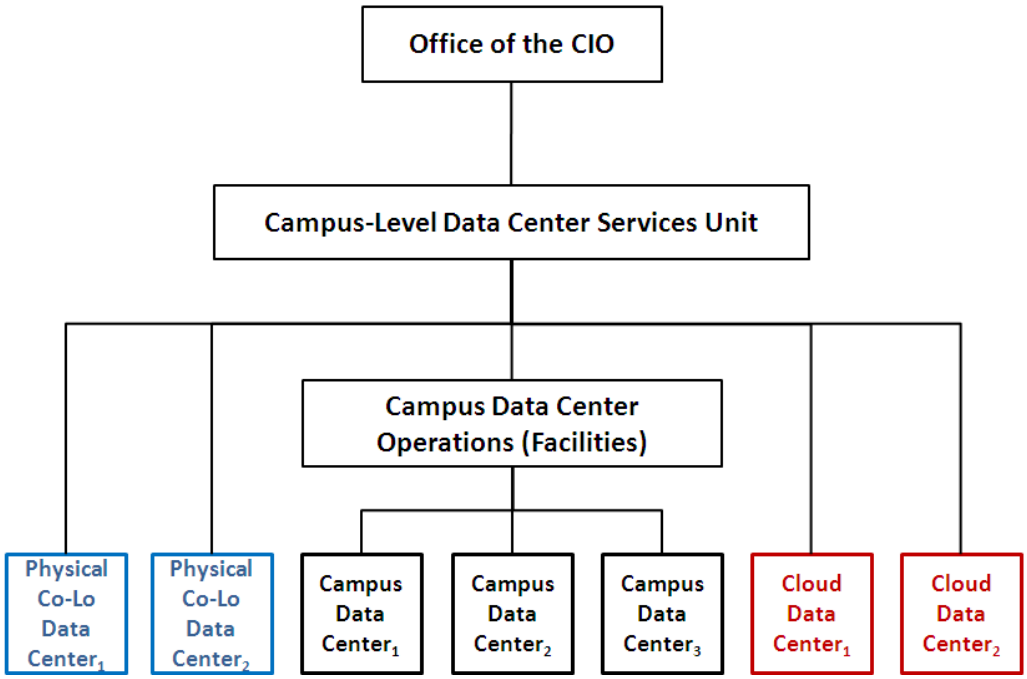
The ***Central Services Unit*** will be structured and staffed as a business unit. Due to the operational complexity, cost, accountability, and need for consistent on-going processes for campus data centers, a business unit model is the desirable approach. The unit will be staffed with a manager to coordinate business operations of the unit and provide a primary management point-of-contact. The manager will supervise staff in the Services Unit including the "Campus Data Center Operations" team (detailed below). A Business & Policy Analyst will also be needed to support budgeting, billing and planning services. The Unit will need two full-time staff to coordinate client engagements for aggregation, report and analyze performance metrics, manage vendor and campus partner relationships, and support other business operations. A number of campus partners have staff who are skilled in data center operations, but are not full-time engaged in that effort. The Services Unit can incorporate this distributed expertise through adjunct or part-time appointments.

The ***Campus Data Center Operations Team*** is the hands-on support group for the campus data center facilities. This team is accountable to the manager of the Campus Level Data Center Services Unit. The Administrative Excellence Data Center Aggregation team has asked that the data center team in DoIT's Systems Engineering & Operations (SEO) group be charged with extending their current service to include designated campus data

centers. A unique characteristic of this team moving forward is they will have a formal relationship with FP&M staff (i.e., steamfitters, electricians, carpenters) in the support of campus data center operations.

The Operations team currently has five staff in support of the Dayton and Walnut Street data centers (plus a manger). This staff is fully engaged in supporting these data center operations. Scaling of staff to meet an expanding number of campus facilities is difficult at this point. It is anticipated that a number of project appointments will be needed to accomplish early aggregation efforts as that is "front-loaded" in the overall aggregation process. Normal day-to-day operations following aggregation will not require an on-going large increase in staff, but will require more than the five staff currently in place. Determination of appropriate staffing will need to occur as the Services Unit gathers operational data.

Visual Representation of the Campus-Level Data Center Services Unit Structure:



The Campus-Level Data Center Services Unit focuses on leadership & service delivery:

- Stewards campus IT resources to benefit IT services
- Strategic planning
- Integrates with Enterprise IT Decision Making
- Leads the aggregation process over time
- Interface with vendors

The Campus Data Center Operations Team focuses on operation of on-campus physical facilities and integration with third-party providers:

- Centralized coordination with FP&M – trades shops, We Conserve, other related items

- Inventory and asset management
- Capacity planning & monitoring
- Continuance of Operations (COOP) / & Disaster Recovery (DR)

Value Proposition to Campus:
The Central Service will provide the combination of core infrastructure and services outlined below to best meet campus needs.

Provides Core Infrastructure:

- Data center facility
- Power – two different routes
- Generator
- UPS (uninterruptable power supply)
- A-side/B-side distribution of power (alternate routing of power to support computing devices)
- HVAC (Heating, ventilation, air-conditioning) / CRAC's (computer room air-conditioning)
- Fire Suppression
- Physical Security (Cameras, Door access pads…)
- Environmental monitoring & alerting (automated systems monitoring temperature, humidity, air quality, water leaks, etc…)
- KVM's (keyboard, video, mouse) remote server control
- Racks for servers
- Asset Inventory

Provides Core Services:

- Networking – higher capacity, specialized relative to most of campus
- Firewall – extremely robust due to aggregated risk
- Compute - shared virtual server pools (Windows, Solaris, AIX, Linux…)
- Storage
- Backup / Restore
- Archive – records requirements, data of institutional value, etc…
- Shared database pools – a single, managed instance (Oracle, SQL, MySQL…)
- Data Repositories – "big data" archival (institutional reporting, student data, etc…)
- Service Monitoring – robust monitoring of the performance of applications
- COOP (Continuity of Operations Plan – required by state statute / Redundancy & Failover
- DR (Disaster Recovery)

Leverages Economies of Scale and Service Level Accountability:

- Full-time data center services & facilities expertise
- Service and infrastructure quality is accountable to the EITDM structure and the CIO rather than self-determined by a single unit
- Data stewardship is a core competency of a Central Service - DRMT (Data Resource Management Technology) team
- Shared services and database hosting
- Scalability gives units leverage to utilize the physical infrastructure, cost containment models, expertise of the greater collective versus having to develop local staff expertise

- Unified testing and auditing processes, failsafe procedures
- Confidence in service and infrastructure (external accountability and audits) rather than "good enough"
- Units can align staff to activities that add value to the University Mission as well as unit-level strategic operational objectives

Best-Practice Data Stewardship & Risk Mitigation:

- Regular audits by various organizations, both scheduled and ad-hoc, provide campus customers with compliance assurance:
    - Externally audited (Legislative Audit Bureau)
    - State of Wisconsin Data Center Audit Team
    - Federal agencies as appropriate to grants and contracts
    - Internal audits

- Migrate data and applications, not devices - a team of campus experts from Records Management, Libraries, Risk Management, Security, and DoIT Systems Engineering are working together to help define a model for having good data management practices guide aggregation processes instead of relocation of physical devices based on "ownership" or physical location
    - There is not enough physical floor space in campus aggregation data centers to have everyone on campus relocate all of their physical devices
    - Relocation of devices does not improve efficiency, reliability, reduce risk or improve accountability
    - The University has interests in data stewardship from several perspectives:
        - Academic, research and administrative activities
        - Records retention to meet operational and legal requirements
        - Security interests to reduce risk, comply with discovery holds, and meet security requirements
    - Preservation of institutional assets through data curation and digital archival

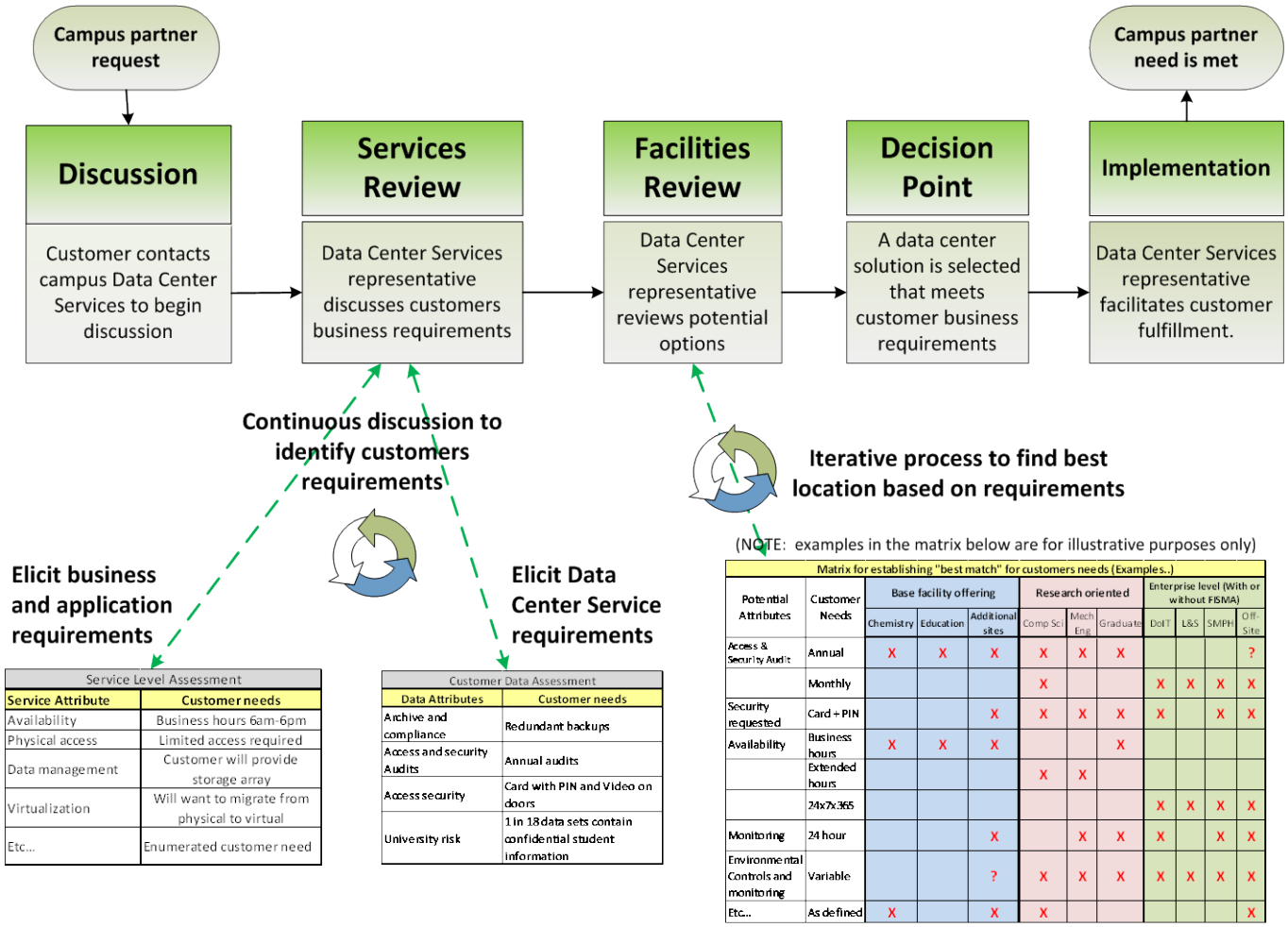
- The eight Generally Accepted Recordkeeping Principles aka "The Principles" guide information management and governance of record creation, organization, security maintenance and other activities used to effectively support recordkeeping of an organization. While these principles translate directly into the principles of responsible data stewardship that will guide activities of the Central Service, meeting these ideals is cost prohibitive for nearly all decentralized data centers
    - Accountability
    - Transparency
    - Integrity
    - Protection
    - Compliance
    - Availability
    - Retention
    - Disposition

Delivery of Services and the Customer Engagement Process:
To be successful, the new Central Service will need to significantly broaden the set of data center services available to campus customers relative to those available centrally today. To accomplish this, the Central Service will need develop the right portfolio of services to meet or exceed customers' needs, priced competitively enough to be attractive to campus. This will start with an initial set of service offerings, each priced appropriately (some less expensive, some more expensive), that will necessarily be expanded and adjusted over time as the Central Service matures. One of the primary mechanisms through which the Central Service will accomplish this is a Data Center Services Advisory Group, perhaps structured similarly to the Network Advisory Group already established for network operations.

The implementation team created a customer engagement model which outlines the high-level process steps the Central Service will follow to learn about a potential customer's data center service and facilities requirements, match those needs with recommended solution options, and ultimately facilitate the customer through their decision making process and solution implementation.

The following page provides a visual depiction of this model. Each of the five major steps is then outlined in greater detail.

Visual Representation of the Customer Engagement Process:



Service Level Assessment

Service Attribute	Customer needs
Availability	Business hours 6am-6pm
Physical access	Limited access required
Data management	Customer will provide storage array
Virtualization	Will want to migrate from physical to virtual
Etc...	Enumerated customer need

Customer Data Assessment

Data Attributes	Customer needs
Archive and compliance	Redundant backups
Access and security Audits	Annual audits
Access security	Card with PIN and Video on doors
University risk	1 in 18 data sets contain confidential student information

Matrix for establishing "best match" for customers needs (Examples..)

Potential Attributes	Customer Needs	Base facility offering			Research oriented			Enterprise level (With or without FISMA)			
		Chemistry	Education	Additional sites	Comp Sci	Mech Eng	Graduate	DoIT	L&S	SMPH	Off-Site
Access & Security Audit	Annual	X	X	X	X	X	X				?
	Monthly				X			X	X	X	X
Security requested	Card + PIN			X	X	X	X	X		X	X
Availability	Business hours	X	X	X			X				
	Extended hours				X	X					
	24x7x365							X	X	X	X
Monitoring	24 hour			X		X	X	X		X	X
Environmental Controls and monitoring	Variable			?	X	X	X	X	X	X	X
Etc...	As defined	X		X	X						X

More Detail on the Steps of the Customer Engagement Process:

Step One: Discussion

- Customer contacts campus Data Center Services unit to begin discussion.
- Overall engagement process is defined.
- Core elements of a memorandum of understanding are discussed.
- Timelines, resources and expectations are broadly defined.

Step Two: Services Review

- Customer engagement team meets with customer and customer's technical team to:
  - Outline business processes
  - Data requirements
    - Security
    - Retention

        - Audit
        - Performance
        - Risk analysis
    - Application and technical infrastructure requirements
        - Availability
        - Physical Access
        - Data Management
        - Virtualization
    - Trends and future needs, wishes and requirements

Step Three: Facilities Review

- Computation service portfolio
    - Use of central compute (virtualization), storage, backup, archive, database and other resources
    - Ability and/or willingness of customer to manage central service components in a federated management model
        - Allocation of blocks of storage, backup and virtualization resources to customer for self-deployment
        - Management of core services by Data Center Services staff as a service to customer
    - Use of local private cloud infrastructure, public cloud (i.e., Amazon Web Services, Microsoft Azure, RackSpace) or hybrid approaches
- Facilities service portfolio
    - Utilization of primary campus aggregation data centers and shared infrastructure
    - Utilization of dedicated campus data centers when appropriate when service requests are part of those service domains (i.e., Wisconsin Institutes for Discovery, IceCube, Wisconsin Energy Institute, Atmospheric and Space Sciences).
    - Use of designated secondary campus data centers as staging facilities for future aggregation efforts, housing of systems not requiring high availability infrastructure (some research systems), or those designated as special use for a defined business or operational purpose.
    - Requirements for Continuity of Operations planning, disaster recovery, and physical security controls will also be evaluated and will influence facility utilization.

Step Four: Decision Point

- A data center location is selected that meets the customer and institution's requirements and guidelines
- A services portfolio is made available to the customer including core technologies, staff support, and training where appropriate.
- A Memorandum of Understanding is established
- Cost and funding models are established and agreed upon
- Implementation timelines and deliverables are established

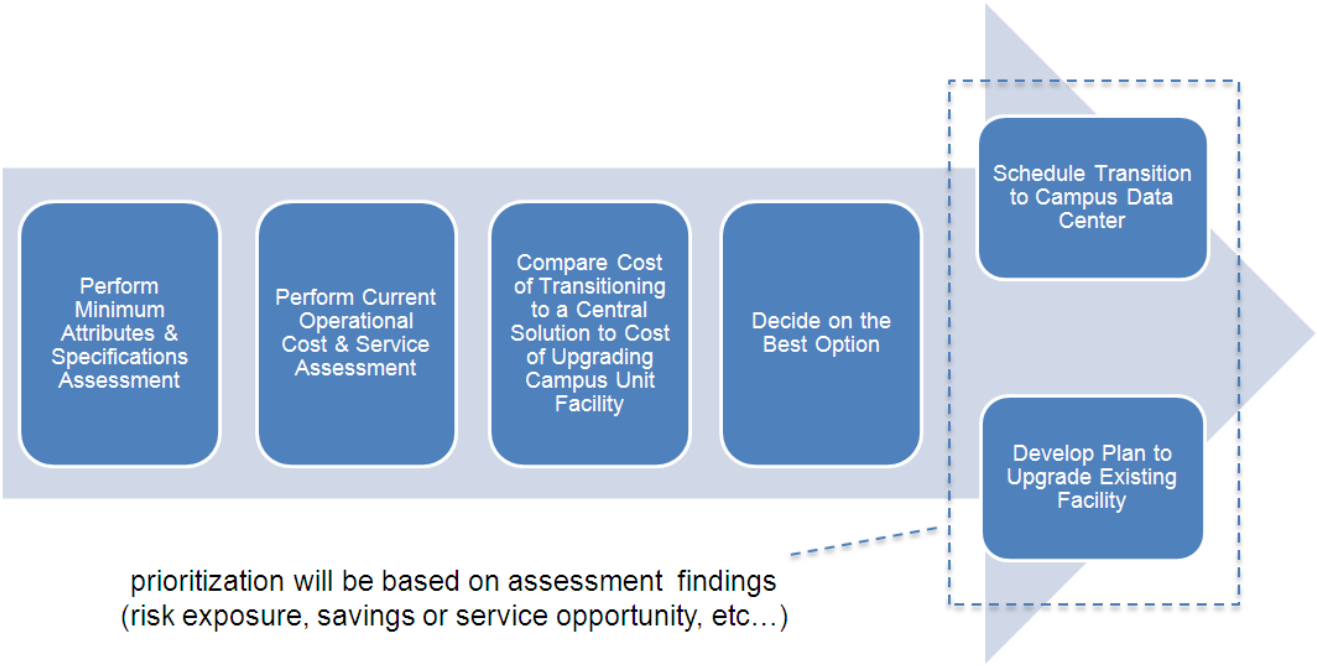
Step Five: Implementation

- The Data Center Services team and the Data Center Facilities team engage with the customer and appropriate staff to execute the project
- Project status is regularly reported to the customer by Data Center Services project managers
- Project activity reports are reported to Data Center Services management and stakeholders at regular intervals

- The customer becomes part of the Data Center Services Advisory Group (structured similarly to the Network Advisory Group already established for network operations)

Data Center Assessment Process:
While aggregating servers, data, and related applications to central, campus-level facilities is associated with a significant reduction in operational costs, improved data security and better reliability, it is important (from a change management perspective) that aggregation decisions be based on the findings of a systematic and objective process. To this end, the team suggests that the following Data Center Assessment Process be followed. Specific steps within this process are explained in more detail below.

Visual Representation of the Data Center Assessment Process:



While completing the above steps will provide the Central Service and other decision makers with comprehensive data, in most cases sufficient information to make a decision will be known prior to completing all steps. For example, the presence of even one or two significant failures to meet minimum standards that are cost prohibitive to upgrade may make the decision to schedule transition to a Central Service solution obvious, without the need for a rigorous operational cost and service assessment.

Minimum Attributes & Specifications Assessment:
Data centers are an expanding, critical infrastructure supporting administrative, instructional, and research computing on campus. Data centers must be operated securely, efficiently, and reliably not only to reduce costs, but to most effectively support the mission of the University.

The detailed list represents the set of minimum attributes and specifications for UW Madison data centers recommended by the Facilities sub-team. This working group that developed the list was primarily composed of data center service providers from across campus. Their recommendations are based on work completed in 2012

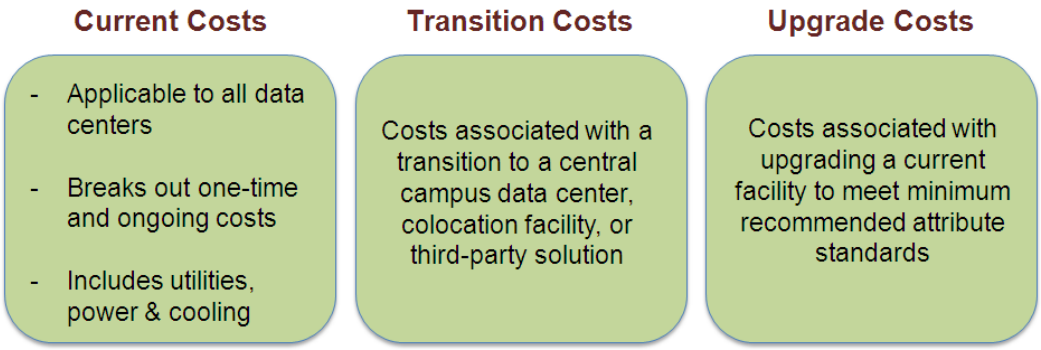
by the Phase II team, new interview data collected in early 2013, peer benchmarking information, and an assessment of the current landscape of campus data center facilities.

Adopting these minimum requirements will lead to significant improvements in energy usage, computing availability, safety, reliability, security and over time, reduced cost.

Operational Cost Assessment:

- A standardized cost model serves as an easy-to-understand foundation for a fully-burdened cost model, applicable to any data center on campus.
- The assessment captures costs to individual campus units as well as those paid directly or indirectly by the University such as power and cooling utilities.
- Enables the Central Service and a campus aggregation partner to determine the various costs, to a line level of detail, associated with upgrading an existing data center to meet the recommended minimum specification
- Provides the Central Service with a tool with which to compare the relative efficiency of campus data centers in an apples-to-apples fashion

Three Types of Cost Assessments Relevant to Aggregation:



See Appendix Five for an example of a populated, fully-configured data center cost model that compares the two data centers recommended as campus aggregation facilities.

Remarks on Cost Savings:

The team identified many sources of cost savings, both from the perspective of campus units that may utilize the Central Service, as well as from the perspective of the University as a whole. The team also discovered that this savings is very difficult to accurately quantify without first analyzing a relatively large number of distributed data centers. To that end, the team has developed the Data Center Assessment Process described above and anticipates that working through this process with many decentralized units will become a core activity of the Central Services Unit and assessment results will become a core driver of incremental data center aggregation. Below are the primary sources of cost savings identified.

Expenditure Avoidance

- Participating campus units will no longer need to purchase and maintain expensive data center infrastructures.
- By leveraging the expertise of the Central Service, units will not need to hire specialized technologists or develop them internally.

Utility Savings

- The University should expect reduced power usage resulting from improved capacity management and the utilization of highly efficient (central) hardware rather than less energy-efficient hardware and devices typically utilized by distributed units.
- By utilizing a strategy of managing campus data rather than campus hardware, the Central Service will be able to fulfill the needs of campus customers in a manner much more energy efficient than maintaining the hardware distributed across campus.

Reduced Staff Time

- Units may choose not to back fill positions previously occupied by their data center administrators.
- Units will be able to redirect staff from data center administrative work into value-add services that support the University mission.

Reduced Maintenance Costs

- Distributed units will no longer need to pay FP&M for expensive one-off data center maintenance, testing or assessments.
- By focusing its priorities through the Central Service, FP&M will spend considerably less money and effort fulfilling one-off requests for service, and more time on improvements aligned with the University's long-term data center strategy.

Space Utilization

- Over time, decommissioning tens of thousands of square feet across campus currently occupied by distributed data centers will free up significant space for other purposes. Alternatively, the University may choose to "close" space as appropriate.

Campus Readiness

Through various campus customer engagement activities, the team learned that while some distributed units are interested in utilizing a Central Service, others are not. Levels of interest, support, and resistance varied not only across campus units, but also depending on an individual's role within a unit. In addition to the work of the core sub-teams, the AE DCA Communications Team has led the development of a comprehensive campus Change Management Plan which lists the stakeholders impacted by the implementation, paired with a set of key message points to communicate to each stakeholder group, based on the individual needs of each. The Change Management Plan represents a working document that will continue to evolve over time. As ownership of implementation transitions to the Process Owner, the management and execution of the Change Management Plan will also be transitioned. Below is a brief summary of the team's findings and a recommended set of incentives and disincentives that could serve as tools to continually increase campus adoption over time.

Summary of Known Obstacles to Central Service Adoption:

Stakeholder(s)	***Known Resistance Points*** *(for at least a percentage of each stakeholder group)*
Data Center Managers	Strong desire to maintain the status quo
Data Center Managers	Sense of facility ownership
Data Center Managers and Customers Data Center Service Providers	Loss of control (hardware, data, etc…) Income is generated at certain hosting facilities Fear that skill sets are no longer needed
Campus Unit Leaders & Customers	Apprehension due to perceived lack of customer focus Fear of new or higher costs Perceptions that they will be coerced into services that Will not meet their needs
Campus Unit Leaders	Currently there are no power and cooling costs Sunk costs in existing facilities
Multiple Stakeholders	Lack of trust that DoIT will deliver the promise Lack of trust that the Central Service will deliver
Multiple Stakeholders	Fear of losing current nimbleness
Data Center Managers	Due to staggered equipment and software license lifecycles, aggregation timing strategies based on these lifecycles are more challenging than they appears at first blush

Incentives and Disincentives:
Both financial and non-financial incentives and disincentives will be required to promote campus adoption of the Central Service. Since potential campus customers indicated that price considerations will be the number one driver influencing their decision, financial incentives will be particularly important. At some point in the future, the Central Service may need to consider financial disincentives, depending on campus participation. The Central Service recommends the following:

Service Incentives:

- *Establish service level agreements*: documented service level agreements (SLAs) and memorandums of understanding (MOUs) that specifically address questions and concerns around control of assets and services, support response time, and other service expectations
- *Self-service*: availability for customer auto-provisioning of data center services
- *Focus on customer consultation*: make customers fully aware of the options available, resulting in fully informed decisions

Reliability Incentives:

- *Operational reliability*:
    - Reliable & predictable compliance and performance
    - Standardized plans and protocols for business continuity, security, etc…
    - Reduced "institutional data center knowledge" loss associated with personnel changes
- *Reduced risk:* The risk profile of every data center within the Central Services portfolio is well understood and supported by data-specific procedures
- *Improved capacity management*: provides customers with the ability to quickly scale as needed
- *Accountability:* accountable to the Office of the CIO and the pending Enterprise IT Decision Making structure

Cost & Pricing Incentives:

- ***Customer pricing to be based on consumption only, not the cost of infrastructure***
    - Free VM service available, or very inexpensive
    - Offer free webservers
    - Quota of server space is free for every customer
    - Storage, backup & archive
    - Disaster recovery
    - Compute (virtual servers)
- ***Moving costs*** associated with bringing in campus units will be absorbed by the Central Service
- ***Other Possibilities***: below are other possibilities that may require additional consideration by the Central Service
    - Should loss of revenue streams that currently exist for hosting facilities (e.g. SSCC) be compensated by either the University or the Central Service in the short term?
    - Could units that demonstrate efficiency gains be rewarded or recognized through programs such as WeConserve?
    - How can block grant funding subsidize the Central Service and/or individual units?
    - Other than through respecting hardware and software licensing life cycles, should the University and/or the Central Service recognize investments that units have recently made into their data center infrastructure through a buy-out or buy-back program?

Disincentives to Consider: **The team believes the primary incentive for campus to utilize the Central Service is to offer a portfolio of services that meets or exceeds customers' needs, and priced competitively enough to be attractive to campus. Additionally, some team members are supportive of implementing disincentives only as a last resort if campus incentives fail, while other team members are against instituting disincentives under any circumstances.**

- Once power and cooling metering is in place, consider shifting utility costs currently paid by the University to campus units.
- Additional investment proposals for current and new data centers must flow through the designated governance and decision-making structure for approval.
- Limit investment of campus resources (security, networking, power, cooling) into distributed data centers; this could be managed either through FP&M or through the EITDM structure.
- Data transfer is free, moving physical equipment may have associated costs - if it is determined by the central campus data center operation that a server needs to be physically moved, customer should not be charged for "moving costs."
- A long term possibility to consider, though not during initial years, is to "tax" units the lost savings opportunity associated with continuing their data center operation, perhaps based on their utility consumption.

Data Center Aggregation Implementation Team – Change Management Plan

The purpose of this plan is to support implementation by systematically identifying critical stakeholder groups, and then use what we have learned about their real and perceived benefits and concerns to develop communication strategies and messaging that will best address their concerns. Like any Change Management Plan, this is intended to serve as a working document that will continuously be refined as more information about stakeholders is learned over the course of implementation. The draft plan is outlined on the next several pages.

Stakeholder	Role/Contribution	Benefits	Burdens	Mitigation	Key Messages	Notes
Steering Committee	- Establish and champion vision - Direct project implementation to match vision - Deliver plan with appropriate messages to campus - Support funding model necessary for project success	- Long-term cost reduction - Confidence that UW-Madison is in step with peer institutions and best practices - Improved data security - Successful implementation of a campus-level service - Reduced utility consumption	- Year one startup costs - Manage expectations and pushback on reduced distributed authority - Oversight of redistributing IT responsibilities between DoIT and CIO's office	- Well defined year one roadmap with estimated financials - Incentive structure	- We are shifting some responsibility from DoIT to the CIO's office in order to support enterprise-level service - We need to be able to describe the cost model and incentives / disincentives - Regular updates on progress and cost savings	- Chancellor willing to carry message via blog, etc.
CIO	- Serves as leader for the new structure and service - Lead and manage MTAG throughout the process - Guide Deans and Directors - Key communicator to IT community	- Confidence that UW-Madison is in step with peer institutions and best practices - Improved data security - Successful implementation of a campus-level service - Ability to offer more stable data storage - Step forward in IT strategic plan	- Year one startup costs - Logistics of organizational changes associated with new operational unit - Continuing to strengthen relationships with resistors	- Well defined year one roadmap	- We are shifting some responsibility from DoIT to the CIO's office in order to support enterprise-level service - We need to be able to describe the cost model and incentives / disincentives - Regular updates on progress and cost savings	- Expectation that CIO will champion message
Deans	- Unit decision maker - School/college champion of the project goals - Prevent work-arounds	- Reduced risk of data storage in sub-standard facilities - Cost reductions via aggregated facilities / use of virtualization - May gain staff time	- May be surprised that many current costs are "hidden" and will need to reset budget / resources - May need to manage resistors within unit	- Cost model to include hidden costs (power and cooling) - Incentives / disincentives	- Project information - Timeline - Early adopters - Updates on cost savings realized	- Hard costs may be covered by funding as new model creates net gain to the university
VCFA Directors	- Unit decision maker - Unit champion of the project goals - Prevent work-arounds	- Reduced risk of data storage in sub-standard facilities - Cost reductions via aggregated facilities / use of virtualization - May gain staff time	- May be surprised that many current costs are "hidden" and will need to reset budget / resources - May need to manage resistors within unit	- Cost model to include hidden costs (power and cooling) - Incentives / disincentives - Presentations at VCFA Directors meetings	- Project information - Timeline - Early adopters - Updates on cost savings realized	- Hard costs may be covered by funding as new model creates net gain to the university

Stakeholder	Role/Contribution	Benefits	Burdens	Mitigation	Key Messages	Notes
Associate Deans for Administration (AC)	- Unit-level champion of the model - Integrate and assess cost model within local budget - May be responsible for communicating with deans	- Reduced risk of data storage in sub-standard facilities - Cost reductions via aggregated facilities / use of virtualization - May gain staff time	- May be surprised that many current costs are "hidden" and will need to reset budget / resources - May need to manage resistors within unit	- Cost model to include hidden costs (power and cooling) - Incentives / disincentives - Presentations at AC meetings	- Details to achieve strong understanding of cost model	- Need to connect MTAG and AC members through joint communications
CIO's (MTAG)	- Stewards of the university's longer-term IT goals - Represent unit requirements - Participate in decision making around current investments and timing for change - Manage to ensure against workarounds	- Reduced risk of data storage in sub-standard facilities - Cost reductions via aggregated facilities / use of virtualization - May gain staff time - May gain flexibility and speed in supporting infrastructure and staff	- Loss of control - Perception that their unit's current solution is deemed "inadequate" - Lack of trust that their unit's needs will be met	- Regular in-person updates and availability of current information - Inclusion within project team structure - Timely presentations and discussions prior to final decisions - MTAG members to provide testimonials to their peers (early adopters) - Thoughtful and repeated reassurance that change will occur over multiple years - Service moving to new CIO structure	- Service is moving to the new CIO structure - Project updates; ongoing plans - Peer to peer info on decisions, experience, savings	Strive for leadership, but potential for strong resistance
Data Center Operators	- Representatives of end-users; translation of business requirements to technical solutions - Implementation	- Current business owners - Reduced risk of data storage in sub-standard facilities - May gain flexibility and speed in supporting infrastructure and staff	- Loss of control - Potential large impact to their daily work - Perception that their unit's current solution is deemed "inadequate" - Lack of trust that their unit's needs will be met	- Availability of current information - Inclusion within project team structure - Timely presentation and discussion prior to final decisions - Involvement of unit leadership prior to any actions or detailed assessments - Thoughtful and repeated reassurance that change will occur over years	- Service is moving to the new CIO structure - Project updates; ongoing plans - Peer to peer info on decisions, experience, savings	Highest impact from any changes made is on this group

Stakeholder	Role/Contribution	Benefits	Burdens	Mitigation	Key Messages	Notes
Distributed tech community	- Awareness	-	-	-	- Updates via campus channels - Up-to-date web site	Demonstrates progress on AE projects and enterprise IT model
Fac/Staff/Students	- Awareness	- Reduced risk of data storage in sub-standard facilities - Improved speed to implement new data environment	- Existing relationships and tendency to use local services	- Language for inclusion in grant applications	- Up-to-date web site	Need to coordinate grant application language with RSP
DoIT Service delivery / new model management team	- Champions of the vision - Translation of project requirements into technical solutions - Implementation - Customer training and support		-	-	-	
First-year Early Adopters	- Pilot the assessment and aggregation processes - Provide testimonials to their peers		- Experience from the perspective of early adopters must be positive	- First several early adopters will be volunteers that support the vision		

Engagement Framework for Potential Data Center Aggregation Sites

Critical Messages to be Included in the Script (Meeting #1 & #2):

- Each meeting should have a clearly stated purpose that answers the following question – How, when, and where does my unit /data center fit into the plans of the Campus Data Center Central Service and the aggregation initiative?
- Each of the sections outlined below should be reviewed and edited as appropriate prior to each campus unit engagement.
- An engagement framework has been drafted, including stakeholders that should be invited into the conversation, meeting sequencing, and the high-level messages to be conveyed during those initial meetings.

More Detail on Content Referenced in the Messages / Notes Section of the Engagement Framework

Initiative Background, Goals, and Benefits:

- To keep messaging current, planned message points should be matched against the current "Speaking Points" document.
- Under the guidance of the Administrative Excellence structure, a series of campus teams were formed and charged with developing a new model of a campus-level server and data center structure to serve the needs of the University's academic, research, and administrative communities, leveraging leading practices for server administration, virtualization, and management to save costs, improve service levels, and minimize data security risks.
- If you want to follow the progress of this initiative, information will be maintained and kept current on the initiative website.

High-Level One Year Plan:

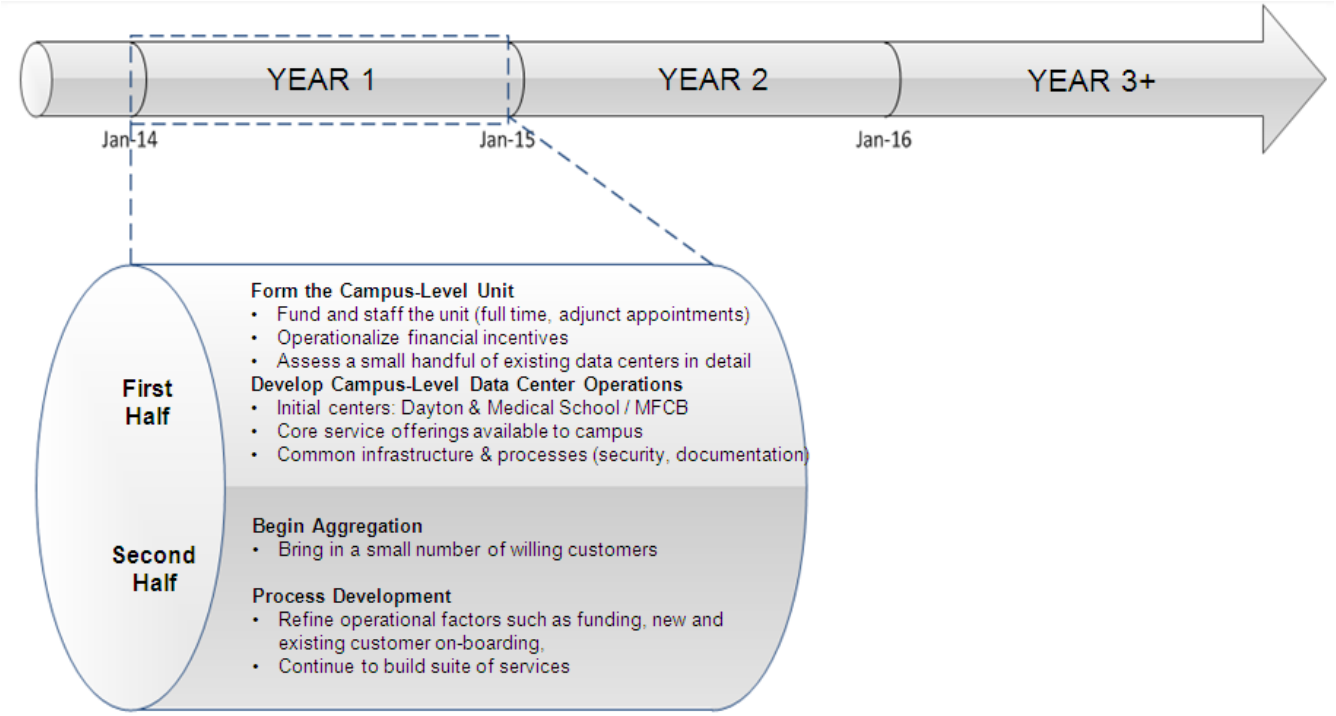
- Share the visual map of the one-year plan for the Campus Data Center Central Service.
- There is no need for immediate action or concern. In the first year, focus will be on Dayton St. and MFCB as they are in the process of aggregation for special agents and FISMA.
- There is a Physical Plant component to this. (Note: the details of the Physical Plant component will be refined over January and February)
- On-boarding will occur within the DoIT operation. This will take some time, and will require on-boarding plan. [may allow for other DC staff to move in]
- Virtualization needs to be set-up. Goal is to move your data, not your stuff. Will work with your equipment lifecycle.
- Central service will not necessarily administer your applications – local IT will still manage this.
- Ask about pressure points. Are there agreements with or commitments to other units? May lose "in kind" agreements.

What it Means to Be Re-commissioned in the Campus Portfolio:

- Discussion should address the question "what do I tell my existing clients?" The Central Service should be prepared to
- What happens to my space? You may lose access unless your data is in there.
- What happens to my staff? There may be room for some to on-board to central service; others can be reassigned to other work.
- Will try to make this neutral for staff. Look at position descriptions in School of Business. [Interview Meloney for specific examples]
- Physical access follows your physical assets/box. It expands the landscape for your assets to all of campus.
- Remember to keep track of COOP/COG.
- May need to prioritize who moves within a unit.

Operational Roadmaps

Year One Roadmap to Data Center Aggregation:



Primary objective of Year 1 is to establish and promote a set of attractive core service offerings, supported by financial incentives, that will incrementally drive data center aggregation

Five Year Roadmap to Data Center Aggregation:

Administrative Excellence UNIVERSITY OF WISCONSIN–MADISON		Data Center Aggregation Implementation Team: Five Year Roadmap (Aggregation Activity)					
		Ramp-Up Period			Expansion Period		
		Current State	Year 1	Year 2	Year 3	Year 4	Year 5
Managed Centrally	# Data Centers	3	6	8	8	8	8
	# FTE	15	20	27	30	30	30
	Total Square Footage	18,000	19,500	21,000	21,000	21,000	21,000
Distributed	# Data Centers	94	91	89	Two primary factors will determine the speed of migrations: 1. The selection, balance, and timing of incentive strategies 2. Capacity constraints (Technical Operations, FP&M)		
	# FTE	While metrics describing the productivity of staff supporting distributed data centers is currently unknown, collection of this data will be part of the assessment process					
	Total Square Footage	16,900	15,400	13,900			

Key Points on Aggregation Strategy:

- For two years, the Central Service will focus on ramping up capacity, virualization infrastructure, and service capability to prepare for an increasing volume of data center migrations.
- Ramping up capacity will double labor costs from approximately $1 MM to $2 MM annually.
- By year three, the Central Service will be well positioned to accelerate campus adoption and will have had experience with pilot engagements and incentive strategies.
- By utilizing off-campus solutions and more efficient hardware on campus, the number of data centers to be managed centrally will max out at 8, and total central FTE required will level off at 30.
- In order to drive down both the # of distributed data centers and the total square footage utilized by distributed data centers, campus engagements in year 3 forward will focus on a balanced mix of large and small data centers.

Notes & Assumptions:

- Time and resources required to complete a data center transition varies greatly from engagement to engagement.
- Criteria driving the prioritization of data center migrations will change over time (e.g., early transitions will heavily weigh excess capacity).
- Square footage data represents the total square footage of data centers and does not place a value of space utilization.
- Model assumes that the Central Services secures a contracted off-campus Disaster Recovery site (NOT an aggregation site).

Central Data Center Service Operational Plan

AE Data Center Aggregation Stage 1: Startup to 12 months

Initial Aggregation Effort – Facilities:

1. **Identify campus aggregation point facilities: (completed)** Due to FISMA and SA work, the Dayton data center and the Medical Foundation Centennial Building data center are the primary aggregation destination sites. The WARF data center will be operated as a staging facility and research system site due to the facility size, networking resources, and available power/cooling infrastructure.

2. **Upgrade these facilities to meet AE DCA requirements and operational / service needs.**

   Work/funding needed:
   a. Dayton – approximately $200,000 needed for FP&M work on electrical and cooling routing within the data center facility. This will allow optimization of rack configuration to provide large shared central services such as storage.
   b. MFCB – needed upgrades are unknown at this time.
   c. WARF - $68,000 is needed to prepare the facility for the CloudLab infrastructure. Additional funding may be needed for room modifications to accommodate temporary location of systems for aggregation into the shared virtual resources. No new space, cooling or electrical capacity will be added to WARF, rather there may be needs to relocate existing facility infrastructure to accommodate higher density use of that data center.

Initial Aggregation Effort – Campus Data Center Operations Unit Staffing:

Request from the AE DCA team to ask that DoIT's infrastructure team be a campus resource for all facilities designated as "campus" data centers. Funding source needed to support what is now a cost-recovery service through data center hosting fees. Core services provided by these staff members include the following:

1. **Mechanical and operational support for data center facilities**: DoIT's Data Center team partners with FP&M staff to provide 24x7 coverage. This partnership includes electrical, cooling, other mechanical, and building / room environmental support.

2. **In-room operations support**: DoIT's Data Center team provides services including:
   a. Access control and security (in cooperation with UW Police),
   b. New equipment intake, pre-configuration, asset tagging and management
   c. "Racking" of devices including power configuration, networking and other device cabling, firewall configuration, connections with storage system and other peripheral systems.
   d. Decommissioning of devices. Secured deletion of data from decommissioned devices. Device and drive disposal or destruction based upon security and policy requirements.
   e. Asset management including identification all devices, logging device attributes and physical/virtual location in the configuration management database, establishing Continuity of Operations (COOP) documentation and priority for devices and support staff, and establishing knowledgebase, help desk and operations documentation and procedures to facilitate normal operations and emergency response.

3. **DoIT's Systems & Network Control Team (SNCC)** provides 24x7x365 on-campus staffing in support of monitoring, alerting and initial event response for networking, physical and virtual devices.

4. **SNCC provides "**service management" for all campus data center activities. This includes event and problem management, and asset and system configuration management and reporting. SNCC's service management team ensures uniform business processes across facilities and technical support teams. This team also leads the Continuity of Operations (COOP) and Disaster Recovery (DR) planning and testing effort for the campus data centers.

Initial Aggregation Effort – Establish Campus-Level Data Center Services Unit
Using the financial and business model developed from the Medical School MFCB facility and DoIT's Systems Engineering & Operations, establish the Central Services Unit responsible for managing the portfolio of campus data centers.

1. Establish the business and billing models for services and infrastructure.
2. Establish subsidies and incentives to encourage adoption and use of campus data centers and services.
3. Establish governance, communication and reporting models to ensure alignment and transparency with customers, governance committee(s), and management and executive teams.

Initial Aggregation Effort – Establish Core Aggregation Services

Following the recommendation of incentivizing campus IT services to aggregate data and applications and not physical assets as much as possible, the initial technical service components offered through the data centers need to allow for that transition. The initial service portfolio includes:

1. Advanced network infrastructure
2. Firewall services
3. Shared computing infrastructure (Windows, Linux, Solaris)
4. Shared multi-tiered storage
5. Bare-metal restore for physical devices
6. Backup and restore services for data
7. Archive services to meet records retention requirements
8. Shared database services (Oracle, SQL, MySQL)
9. Data repositories ("big data" stores supporting analytics)
10. Service monitoring and alerting
11. Continuity of Operations (COOP) documentation and planning
12. Disaster Recovery (DR) documentation, planning and operational exercises

Additional services will be added as service needs are defined through customer engagements. A more detailed set of recommendations for service requirements is located on page 30 of the Final Report.

Initial Aggregation Effort – Initial Aggregation Customers: work with initial aggregation customers already identified through AE and DoIT engagements.

AE Data Center Aggregation Stage 2: 12 months – 24 months

1. **Facilities**
   - Identification of additional primary aggregation facilities.
   - Upgrades to the facilities to meet AE DCA requirements and operational / service needs

2. **Campus Data Center Operations Unit Staffing**
   - Mechanical and operational support for data center facilities
   - In-room operations support
   - Monitoring, alerting and initial event response for networking, physical and virtual devices.
   - "Service management" support for all campus data center activities.

3. **Operational Review -** Campus-Level Data Center Services Unit business and financial operations review with the Customer Advisory Group, CIO, and EITDM Planning Board as appropriate

4. **Services Review -** Review, enhance, extend or revise core aggregation services

5. **Continue Aggregation Engagements -** continue to engage with aggregation customers already identified through AE and DoIT engagements.

Power Metering Plan for Distributed Data Centers

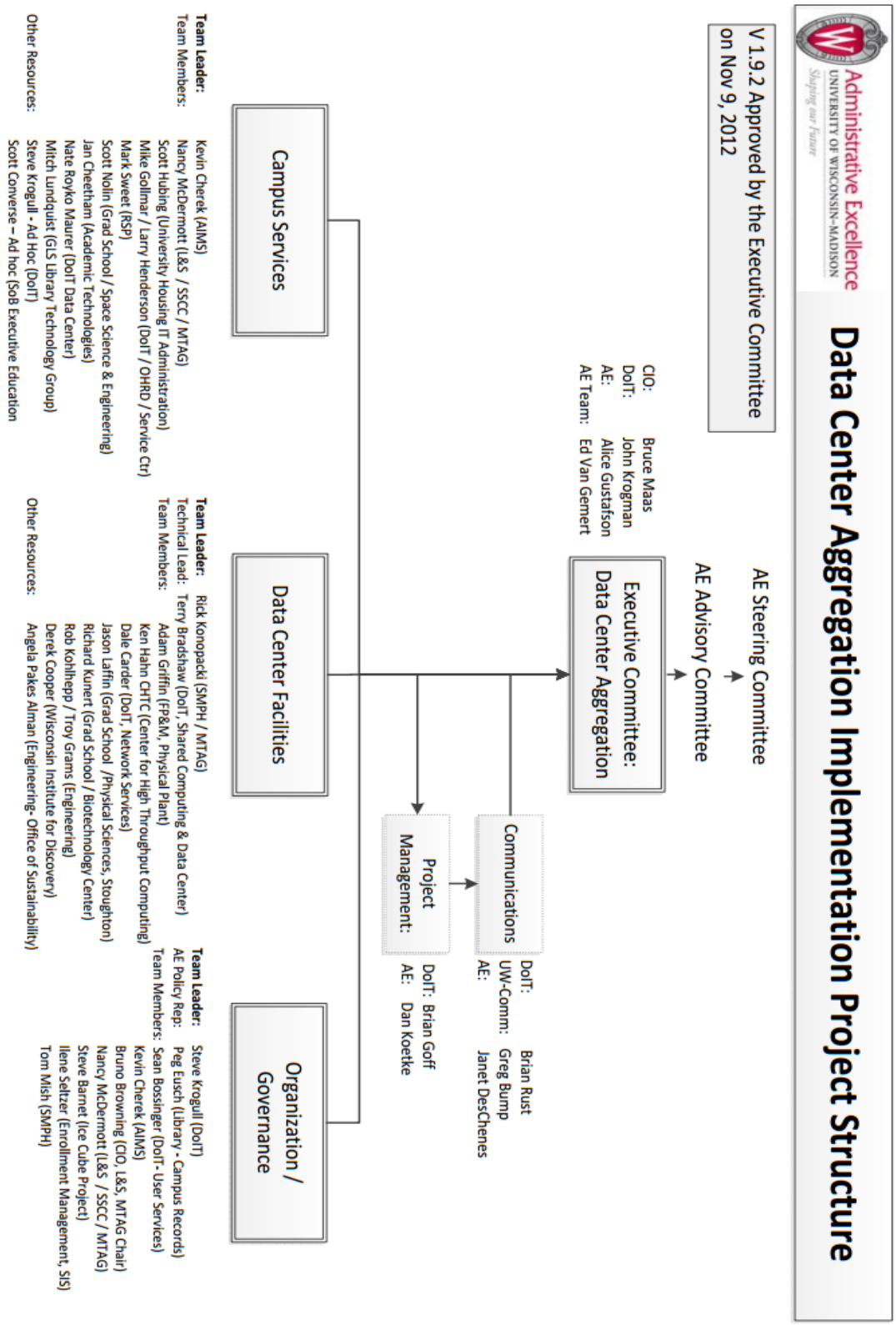
Beginning as early as late December 2013, we recommend beginning the process of metering power consumption in approximately 25 data centers. The AE Steering Committee has specifically asked the for an outline of this plan since understanding power consumption across distributed data centers will provide data points that to consider in the data aggregation process outlined within this final report. This will be an effort led by FP&M and will include collaboration with Steve Krogull. After planning logistics including staff and materials needed, Rob Lamppa will be coordinating the execution of the metering effort, which is expected to be completed within two months. The plan includes monitoring all of the following data centers listed on the following page, tentatively categorized into four groupings.

Next Steps

- Over the next month, continue to develop the funding and staffing model of the Central Services Unit such that the availability of a new campus service can be communicated to campus in January 2014.
- Continue to engage campus Governance, functional groups, and other stakeholders as outlined in the Communication / Socialization Plan.
- Begin to schedule initial meetings with the distributed data centers identified as potential campus aggregation sites.
- Execute the power metering plan, starting in late December or early January.

Appendices

<u>Appendix One</u>: Data Center Aggregation Implementation Team Structure



Appendix Two: Proposed Minimum Standards for Campus Data Centers

Physical Space

- Dedicated to data center purposes
- Floor load capacity >= 100 lbs. / sq. ft.
- Physical accessibility Pathway: 81" height, 30" width minimum
  (in order to allow a 42RU enclosure to pass)
- Floor space to allow four, 4' X 2' cabinets w/ all required code and manufacturer required clearances

Security

- Camera at entrance
- Limited physical key access
- Campus Card Access System (CCAS) with PIN
- Door logging
- Secured support locations (breaker panels / mechanical rooms)

Network - single mode fiber available

Power and Cooling

- Power/Energy efficiency (PUE benchmarking)
- Power Capacity (4kW per rack)
- Dedicated circuits for each rack
- Qualified supplemental cooling (TBD)
- Monitoring and metering of power and cooling
- Emergency Power Off (EPO) if required by code
- Emergency Water Off (EWO) when chilled water or glycol are in close proximity to powered IT equipment

Compliance with all relevant codes (NEC, IEBC, NFPA, etc)

Environmental

- Temperature and humidity metering (including trending) and monitoring
- Water detection

Availability

- 24x7 with best effort support

Fire suppression / general safety

- Based on code requirements

Appendix Three: UW-Madison Data Center Facilities Inventory (Page 1 of 2)

UW-Madison Administrative Excellence - Data Center Aggregation											
Data Center Inventory											
Building	Bldg #	Room	College / Division	Contact	Area (sq.ft.)	Free (sq.ft.)	Power (kW)	Free (kW)	Cooling (tons)	Card Access	Video Surveil
1410 Engineering Dr.	486	226B	Engineering	Troy Grams	300	250	68	68	0		
21 North Park Street	1078	7417	AIMS	Kevin Cherek	725	595	52	0	0	✓	
222 W. Washington Ave	8098	Suite 500	Graduate	Steve Barnet	529	0	250	200	20		
333 ECM	467	8403	Health Services	Theresa Regge	250	75	0	-5	5	✓	
425 Henry Mall	82	B1110	Graduate	Richard Kunert	900	400	140	107	44	✓	✓
5602 Research Park Blvd (URP Building)	0		Extension	Wayne Utke	384	0	16	16	0	✓	
Ag Hall	70	308K	CALS	Jason Pursian	60	0	0	0	0		
AHABS	94	215A	Veterinary Medicine	Jason Brenner	80	50	0	-3	0		
AOSS	156	649	Graduate	Scott Nolin	1680	16	260	100	65	✓	
AOSS	156	1448	L&S	Peter Pokrandt	240	0	0	0	15		
AOSS	156	515A	Graduate	Scott Nolin	132	60	15	6	3	✓	
B195	0	155	Wisconsin Union	Judi Benade	155	100	0	0	0		
Bascom	50	B34	L&S	Eric Straavaldsen	750	0	0	0	0		✓
Bascom Hall	50	264D	L&S	Derek Tessmann	50	40	0	0	0		
Biochemistry	204	B1118C	CALS	Kerry Tobin	400	0	0	0	0		
Biochemistry	204	B1121	CALS	Kerry Tobin	384	0	225	216	42	✓	
Biochemistry	204	B1129	CALS	Kerry Tobin	384	0	225	225	0		
Biochemistry	204		CALS	Kerry Tobin	200	0	0	0	3	✓	
Biotron	45	118	Graduate	Thomas Whitten	378	50	0	0	0	✓	
Birge	54	B172	L&S	David Bogen	120	0	0	0	0		
Bock Labs	33	B119	Graduate	Pete Hagen	350	20	0	0	0		
Capitol Ct	782	213b	Primate	Tom Lynch	0	100	0	0	0	✓	
Center for Limnology	483	214, 223a	L&S	Corinna Gries	20	0	0	0	0		
Chamberlin	55	3216	L&S	Steve Rader	1350	675	432	282	40		
Chamberlin	55	3241	L&S	Steve Rader	510	50	216	32	29		
Chamberlin	55	6296A	L&S	Aaron Teche	480	0	0	0	0		
Chamberlin	55	3245	L&S	Steve Rader	460	92	216	177	13		
Chamberlin	55	3121	L&S	Steve Rader	280	210	14	14	15	✓	
Chamberlin Hall	55	4103	Graduate	Steve Barnet	650	100	250	198	15		
Chemistry	47	9311	L&S	Alan Silver	1382	1000	58	6	18		
Clinical Science Center	1400	K6/283	Nursing	Brian Coulter	250	0	0	0	0		
Computer Sciences	155	2360	L&S	David Parter	5600	0	0	0	157		
Computer Sciences and Statistics	155	B380	DoIT	Chris Lund	7000	0	500	165	300	✓	✓
CSC	1400	J4/X401A	SMPH	Sandon Jurow ski	375	0	23	23	4		✓
CSC	1400	K4/564	SMPH	BCG System Group	350	0	50	20	0	✓	
CSC	1400	K4/326	SMPH	Matt Schultz	20	5	0	0	0		
CSC (UW Hospital)	1400	F2/403	SMPH	Andy Craven	450	0	0	0	0		
Education Building	400	L296	Education	Dean Winger	760	0	160	160	20	✓	✓
Educational Sciences	154	370P	Education	Dean Winger	192	50	20	15	5	✓	
Engineering Research Building	762	1010A	Engineering	Troy Grams	300	0	0	0	0		
Engr Hall	408	B011	Engineering	Troy Grams	500	0	135	80	20		
Engr Hall	408	2040	Engineering	Troy Grams	480	0	83	60	9		
Engr Hall	408	3620	Engineering	Troy Grams	480	380	34	34	0		
Engr Hall	408	3662	Engineering	Troy Grams	400	0	28	18	10		✓
Engr Hall	408	B245	Engineering	Troy Grams	400	300	65	65	0		
Engr Hall	408	3660	Engineering	Troy Grams	176	0	34	34	10		
Enzyme Institute	479	182	Graduate	Donald Elmer	12	0	3	2	0		

Appendix Three: UW-Madison Data Center Facilities Inventory (Page 2 of 2)

UW-Madison Administrative Excellence - Data Center Aggregation											
Data Center Inventory											
Building	Bldg #	Room	College / Division	Contact	Area (sq.ft.)	Free (sq.ft.)	Power (kW)	Free (kW)	Cooling (tons)	Card Access	Video Surveil
Extension Building	500	Room 837	Engineering	Paul Miller	200	0	0	0	0		
Fluno Center	139	2nd Floor	Business School	Steve Van Der Weide	200	50	0	0	20		✓
Goodnight Hall	508	Rm. 212	Graduate	James Grandt	160	0	0	0	2		
Goodnight Hall	508	353	L&S	Tyler DuChateau	100	0	0	0	0		
Grainger Hall	140	1425	Business School	Beth Wiebusch	441	221	0	0	0	✓	
Hasler Laboratory of Limnolgy	483	223A	L&S	Aaron Stephenson	30	0	0	0	0		
HC White Hall	18	4191H	L&S	Greg Putnam	325	0	0	0	20		
Health Sciences Learning Center	1480	2161	SMPH	Jeff Korab	729	100	29	9	12	✓	
Holt commons	574	B202	Housing	Sathish Gopalrao	200	200	0	0	0	✓	
Ingraham	56	B5	L&S	Bruno Brow ning	1500	1500	0	0	0		
Lakeshore Hall	576		Housing	Sathish Gopalrao	650	650	21	21	6	✓	
Law School	430	1324	Law	Eric Giefer	80	65	0	0	2		
Mcardle Laboratory	468	1018	SMPH	Tim Anderson	100	0	0	0	0		
Mechanical Engineering	407	4170	Engineering	Troy Grams	1700	0	230	230	80	✓	✓
Medical Foundation Centennial Building	1435	1240	SMPH	Rick Konopacki	1900	500	300	220	120	✓	✓
Memorial Library	15	541	Library	Mitch Lundquist	285	225	0	-6	4		
Memorial Library	15	M116	Library	Mitch Lundquist	100	80	0	0	0		
Memorial Union	8	B110D	Wisconsin Union	Judi Benade	480	0	0	0	0		
Memorial Union	8	B248c	Wisconsin Union	Judi Benade	200	0	0	0	0		
Microbial Sciences	60	1538	SMPH	Janet New lands	250	125	78	78	0	✓	
MSAE	520	146	Engineering	Troy Grams	750	0	136	56	23		
Nancy Nicholas Hall	85		SoHE	John Hilgers	200	100	20	18	0		
Ogg Hall	1243		Housing	Sathish Gopalrao	485	485	21	21	6	✓	
Pyle Center	6	L25	Extension	Wayne Utke	544	0	80	45	0	✓	✓
Pyle Center	6	L29	Extension	Mark Schneider	200	80	200	200	0		
Pyle Center	6	212a	UW Extension	Dave Wahlquist	0	0	0	0	0		
Rennebohm Hall	34	Rm 2415	Pharmacy	John M. DeMuth	144	0	0	0	0		
Russell Labs	114	B30	CALS	Paul Gunther	200	150	0	0	0		
Sew ell Social Sciences	46	4411	L&S	Andrew Arnold	1200	800	64	29	20	✓	
Stering Hall	57	2332	L&S	Eric White	80	40	0	0	0		
Sterling	57	6511F	L&S	Aaron Teche	198	0	0	0	0		
Sterling Hall	57	5507F	L&S	Aaron Teche	117	0	0	0	0		
Sw enson	573	B110-C	Housing	Sathish Gopalrao	82	82	0	0	0	✓	
Taylor Hall	464	B16	CALS	Eric Dieckman	220	187	0	0	1		
Union South	88	372a	Wisconsin Union	Judi Benade	276	133	40	40	8	✓	✓
Union South	88	Rm 388	Wisconsin Union	Judi Benade	87	50	0	0	0		
Van Hise	482	272	L&S	Bruno Brow ning	240	220	0	0	0		
Van Vleck	48	622	DoIT/CALS/L&S	John Heim	200	0	0	0	0		
Vet Med	93	2112	Veterinary Medicine	Wayne Thal	277	90	60	53	4		
Vilas Hall	545	3134	L&S	Peter G. Sengstock	177	0	10	7	0		
Vilas Hall	545	7115	Extension	Wayne Utke	93	35	11	2	0	✓	
WARF	39	Rm 1129	WARF	Richard Ross	140	0	140	98	7		
WARF Office Building	39	B156	DoIT	Chris Lund	3000	300	140	80	60	✓	✓
Weeks Hall	521	244	L&S	Ben Abernathy	240	0	20	15	30		
WID	212	1211	Morgridge Institute	Derek Cooper	2300	0	500	500	0		
WIMR	1485	B1024	SMPH	Rick Konopacki	900	700	100	60	20	✓	
WisPIC	456	1640	SMPH	Paul Counsell	132	0	0	0	0		✓

Appendix Four: Alternative Data Center Solutions Considered

Build a Large UW-Madison Data Center to Supplement and/or Replace the Numerous Existing Data Centers

Real estate to build such a facility on campus is scarce and valuable. Alternatively, building such a facility off campus, as in Verona or Fitchburg, forgoes the advantage of low-cost cooling from co-gen plants on campus. The projected savings of server consolidation and co-location, as calculated by the accompanying financial model, could not pay for such a building in a 5-yr period. The need for a new data center could possibly disappear even as it is completed if current projections of cloud facilities were to materialize; alternative uses of space built as a data center are few

Outsource Servers, Services and Storage to the 'Cloud'

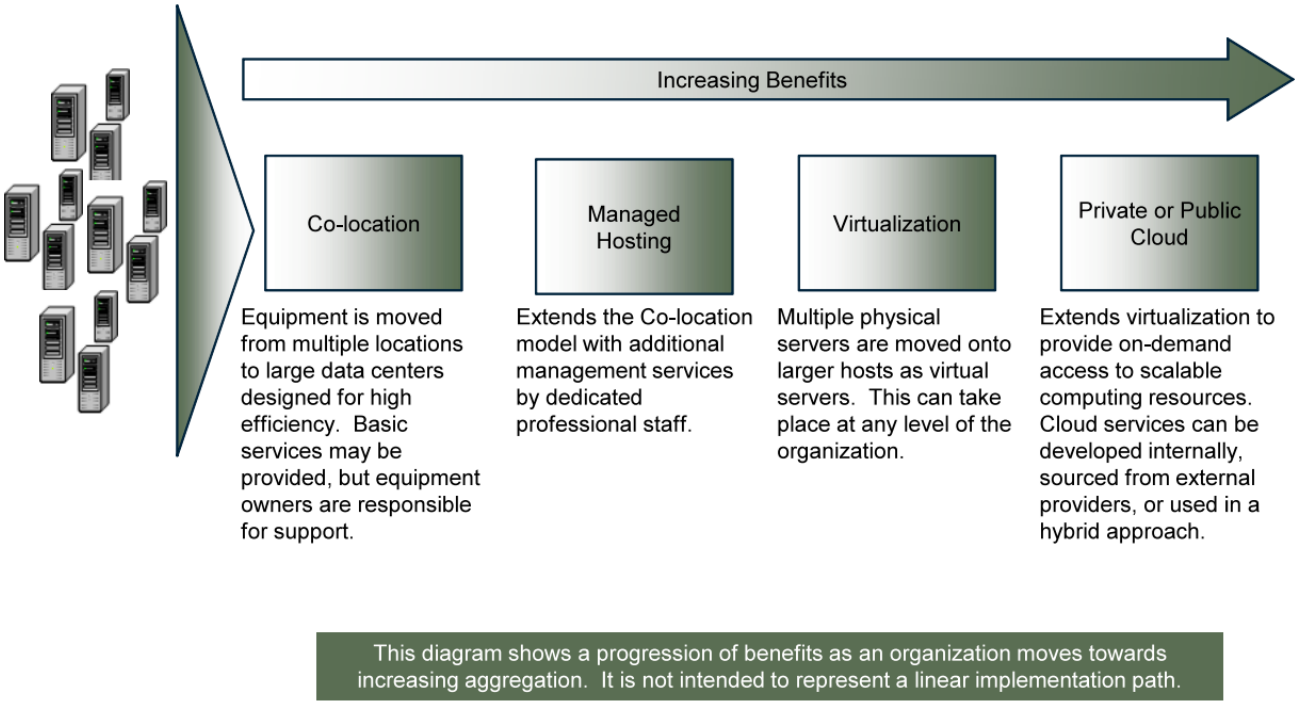
Clouds are designed to store data redundantly at multiple data centers, with automatic failover from one to another, thereby preventing a single point of failure in the system as with a single data center. Cloud data centers can be located wherever is most economical and are connected through fast fiber. Third-party commercial sources already offer servers, web hosting and bulk storage at competitive or near-competitive prices. There is institutional reluctance to house research data in cloud facilities that may extend overseas due to legal concerns about export regulations associated with federal grants. File serving and storage in the cloud is currently being negotiated with box.net through Internet2, which is aggressively pursuing additional cloud solutions that are designed to server universities with needs and constraints such as ours, and utilize university consortia-owned fiber to connect. Particularly high service levels, such as PCI for credit card information, could be outsourced to commercial data centers set up for such security requirements rather than trying to retrofit existing facilities or bringing entire facilities to that level when the bulk of their data does not require that security level

Upgraded Campus Data Centers

Some of the identified 97 server facilities on campus could be candidates for upgrades, increased server capacity and improved utilization by enhancing their power and cooling supply, efficiency, and space management.

Dedicated campus-level management could create a 'private cloud' from the aggregated campus infrastructure, where redundancy of data storage could avoid a single point of failure. However, without examining each existing data center in detail it is difficult to know whether the retrofitting of particular facilities is worthwhile.

Comparisons must be made not only based on the expense but also in comparison to the alternatives: building new buildings or jumping into the cloud. If properly equipped and managed, the remaining campus data centers could be networked to provide a 'private cloud'



This diagram shows a progression of benefits as an organization moves towards increasing aggregation. It is not intended to represent a linear implementation path.

Appendix Five: Standard Data Center Cost Model: Comparison of Two Potential Aggregation Facilities

Fully Configured Data Center Cost Model: Example Comparing the Two Data Center Aggregation Facilities Identified (labor is excluded & summarized in a separate document)

	DAYTON					MFCB					COMMENTS
	Start Up Costs		Annual Cost			Start Up Costs		Annual Cost			
Cost Line Items	Years Depreciated	Startup / One-time	Annual Cost Depreciation	Annual Cost Maint, etc.	Annual Total	Years Depreciated	Startup / One-time	Annual Cost Depreciation	Annual Cost Maint, etc.	Annual Total	
CRACs (Computer Room Air Conditioners) (20 yrs)	20	$450,000	$22,500		$22,500	20	$360,000	$18,000		$18,000	depreciation
Fire Suppression (20 yrs)	20	$400,000	$20,000	$4,200	$24,200	20	$400,000	$20,000	$4,200	$24,200	annual estimate plus depreciation
Racks	10	$384,300	$38,430		$38,430	20	$360,000	$18,000		$18,000	annual depreciation on racks
1 UPS (15 yrs)	15	$250,000	$16,667		$16,667	15	$274,000	$18,267		$18,267	depreciation
Batteries for UPS (purchase, install & annual test)	5	$82,100	$16,420		$16,420	5	$27,400	$5,480		$5,480	depreciation
Server Lifts (5yrs)	5	$7,246	$1,449		$1,449	5	$7,246	$1,449		$1,449	depreciation
Drive Crushers (5 yrs)	5	$5,000	$1,000		$1,000	5	$5,000	$1,000		$1,000	depreciation
Environmental Monitoring Devices (5yr)	5	$20,000	$4,000		$4,000	5	$20,000	$4,000		$4,000	depreciation
Security- Camera	5	$21,250	$4,250		$4,250	5	$21,250	$4,250		$4,250	depreciation
Security- Doors & keypads	5	$22,500	$4,500		$4,500	5	$22,500	$4,500		$4,500	depreciation
KVM replace (allows remote access to servers)	5	$33,821	$6,764		$6,764	5	$33,821	$6,764		$6,764	depreciation
Servers for DC Infrastructure (4 years)	4	$25,000	$6,250		$6,250	4	$25,000	$6,250		$6,250	depreciation 4 physical servers
KVM maintenance & infrastructure (2yr agreement)	2	$11,981	$5,991	$4,000	$9,991	2	$11,981	$5,991	$4,000	$9,991	annual estimate plus depreciation
DC Infrastructure Software (OVO, etc.) & Maintenan	N/A	$207,500		$104,320	$104,320	N/A	$207,500		$104,320	$104,320	approximate annual renewal costs
Tools (meters, gloves, carts, etc.)	N/A	$25,000		$5,000	$5,000	N/A	$25,000		$5,000	$5,000	annual estimate
Equipment Maintenance				$40,000	$40,000				$40,000	$40,000	annual FP&M estimate
Electrical Installation Maintenance				$45,000	$45,000				$45,000	$45,000	annual FP&M estimate
Fuel (Generator)				$1,000	$1,000				$1,000	$1,000	annual estimate
Copper Cable				$20,000	$20,000	20	$250,000	$12,500		$12,500	annual estimate
Fiber Cable				$20,000	$20,000	20	$100,000	$5,000		$5,000	annual estimate
Secure Data Destruction				$5,000	$5,000				$5,000	$5,000	annual estimate
Power strips				$3,000	$3,000				$3,000	$3,000	annual estimate
UPS maintenance				$6,880	$6,880				$5,000	$5,000	annual estimate
ITIL ITSM 'lite' (tool for asset and owner identification)				$948	$948				$948	$948	est min cost- 12 dedicated seats @ $79
Backup/Storage fees for DC Infrastructure Operations				$3,480	$3,480				$3,480	$3,480	costs for DC Infrastructure ONLY
WebHosting				$4,320	$4,320				$4,320	$4,320	annual estimate
Fully Configured Total		**$1,945,698**			**$415,369**		**$2,150,698**			**$356,719**	
					43					**43**	**racks**
					$9,660					**$8,296**	**per rack per year**
					$805					**$691**	**per rack monthly cost**

Notes:
Line 6, Dayton CRAC total is higher ($450K vs. $400K)
Line 8, Dayton racks depreciation schedule is 10 years, MFCB is 20 years
Lines 9 & 10, MFCB UPS was more expensive, but Dayton battery replacement cost was higher - Dayton 290 qty @ $56 per battery per year, MFCB 192 qty @ 16 per battery per year
Lines 24 & 25, MFCB has copper & cable total purchase from build depreciated over 20 years, Dayton has listed as an annual expense

Appendix Six: Minimum Service Requirements for Campus-Level Data Centers – Page One

AE Data Center Aggregation Implementation Campus Services Sub-Team: Summary of Baseline Service Requirements Identified			
Service Category	**Service Attribute**	**Baseline Service Requirements Identified (draft)**	**Additional Custom Options to Consider (discussed by team)**
Physical Hosting	**Security**	Specific requirements have been gathered by the Facilities Sub-Team (basic power, security, network, etc...)	Specific requirements have been gathered by the Facilities Sub-Team (basic power, security, network, etc...)
	Racks	Basic security (locked door) Hours of physical access / availability Environmental alerts to customer	Help with cabling Racks provided Locked racks Extended physical access hours Unlimited physical access hours (24 x7 x365)
	Hours of Physical Access	24 X 7 X 365	24 X 7 X 365
	Availability	Standard Working Hours (8-6)	Standard working hours (8-6)
	Collaborative System Admin	n/a	Optional
	High capacity network to other data centers	n/a	Optional
	High capactity network to desktops	n/a	Optional
	Environmental alerts to the consumer	Yes, basic No graceful shutdown	Automated graceful shutdown
	Standard Alerts to Consumer	n/a	Optional Shared monitoring and alerting service Also see Managed Services section
	Remote Access Capability	n/a	Yes Customer provides KVM, other method for remote access in minimum service tier
	Failover Site	n/a	Optional
	Data Storage	n/a	Optional
	Backup	n/a	Optional
	Managed Services	n/a	Optional, see "Managed Services" category below
	Other	n/a	n/a
Backup-Restore	**Inexpensive**	Free option	More robust solution at low cost Option for a unit to do this themselves
	Reasonable restore time	No backup service One-day response to the request	2-hour snapshot service One business day from request restore is complete Access to tools to allow for local restore
	Retention timeframe	n/a	Keep 2 weeks of backups on disk for fast restore Month end tapes should never be overwritten.
	Move to tape (archive)	n/a	Monthly and Yearly Tapes not to be overwritten
	Local IT support assist in restore	n/a	Self-service restore option
	Ease of use	n/a	Related needs & preferences are captured in the "Enticements" service cateogory
	Workstation/laptop backups	n/a	out of scope
	Offsite	None or optional (local backup / restore)	If offsite not available storage across campus may be an option
	Frequency	n/a	Nightly and weekly Disk to disk. Disk backups kept for 2 weeks
	Flexible (exclude sensitive data from backups)	n/a	Nightly and weekly Disk to disk. Disk backups kept for 2 weeks
	Other	n/a	Website views of backup status.

Appendix Six: Minimum Service Requirements for Campus-Level Data Centers – Page Two

AE Data Center Aggregation Implementation Campus Services Sub-Team: Summary of Baseline Service Requirements Identified			
Service Category	**Service Attribute**	**Baseline Service Requirements Identified (draft)**	**Additional Custom Options to Consider (discussed by team)**
Virtual Hosting	Security	Basic	Compliant with: FISMA Compliant with: PCI Compliant with: FERPA Compliant with: HIPPA Compliant with: data sensitivity restrictions (varies) - driven by data type
	Availability	STD HRS	STD HRS
	Collaborative Sys Admin	n/a	Optional
	High capacity network to other data centers	n/a	Optional
	High capactity network to desktops	n/a	Optional
	Standard Alerts to Consumer	Yes	Optional
	Remote Access Capability	Yes	Yes vCenter
	Failover Site	n/a	Optional
	Data Storage	Basic	Basic/Advanced Large qty of basic, "mirrored" storage.
	Backup/Restore	Basic	Basic/Advanced
	Managed Services	n/a	Optional
	Monitoring	Basic	Optional
	Control over Maintenance Window	Yes	Yes
	Other	tbd	tbd
	Performance	tbd	tbd
	Cost	tbd	tbd
	Flexibility	tbd	tbd
Data Storage	General file storage	n/a	Optional
	High volume	n/a	Optional
	Archival/Backup	n/a	Optional
	Data management consulting services	n/a	Optional
	High performance (high throughput/high I/O)	n/a	Optional
	High availability (fault tolerent/mirrored)	n/a	Optional
Security	Lock on rack, card access (Andover), door video, rack video, vistor log, escort, front desk (staffed), compliance (HIPPA, FISMA, Select Agent, restricted data), etc…	Much of the specific content for this worksheet will be a direct deliverable coming from the Facilities sub-team. Will need to be mindful of how their deliverables tie-back to customer articulated wants and needs.	Much of the specific content for this worksheet will be a direct deliverable coming from the Facilities sub-team. Will need to be mindful of how their deliverables tie-back to customer articulated wants and needs.
Managed Services	Hardware layer	Customer owns hardware	Provider owns hardware
	Os layer	Customer maintains OS	Provider maintains OS
	Application layer	Customer maintains applications/programs	Provider maintains applications/programs
	Ability to self manage	Remove row (rows 2&3 captures it)	tbd
	Change management service	n/a	Yes
	Application deployment (Sccm)	n/a	Yes
	Virtualization	Remove row (Captured in another tab)	tbd
	Web services	n/a	Yes
	Vlan monitoring	n/a	Yes
	Patch management	Combine with "OS layer" row	
	Minor tech assistance	n/a	Yes (varying levels)
	Hardware replacement	n/a	Yes
	Other	tbd	tbd
Network	1/10 Gbit internal DC switch connections	Yes	Yes, This also assumes a connection to a 100Gbit campus backbone
	Low latency/high throughput between data centers (10/40/100Gbit)	n/a	Yes
	Servers appear in local IP space	n/a	Yes, presumably this could either be accomplished with a suitable network design or by the use of dedicated administrators
	4-6 hours for firewall changes	Yes	n/a
	Near immediate response for firewall changes	n/a	Yes
	Collaborative support model	n/a	Yes
	Delegated support model	Yes	n/a

Appendix Six: Minimum Service Requirements for Campus-Level Data Centers – Page Three

AE Data Center Aggregation Implementation Campus Services Sub-Team: Summary of Baseline Service Requirements Identified			
Service Category	**Service Attribute**	**Baseline Service Requirements Identified (draft)**	**Additional Custom Options to Consider (discussed by team)**
Monitoring / Reporting	Notification of space constraints	Yes	This likely does not have to be a live status, but a simple query to hosting provider for planning purposes?
	Security monitoring and reporting	n/a	Optional - provide services to align with UW Security Baseline requirements
	Network bandwidth monitoring	Yes, (provided by default by Network Services already)	n/a
	Push notifications (txt, email, RSS, etc.)	n/a	Yes
	Monitor everything	n/a	Optional
	Report of status - Datacenter	Yes - data available to query	Optional - provide application for reporting such as Nagios
	Report of status - Systems	n/a	Optional - provide application for reporting such as Nagios
	System failure reporting – graceful shutdown	n/a	Optional - include service to perform graceful shutdown? - note that for some things like disk arrays this requires a controllable PDU
Remote Access	Remote access	Yes	Options available
	KVM , IP KVM	Yes	n/a
	Access on/off campus	Yes	n/a
	Remote desktop tools	tbd	tbd
	Remote Server tools - ILOM, DRAC	Yes	n/a
	SSH access to servers	Optional	n/a
Service Level Agreements (SLAs)	Unrestricted access to data center	n/a	Yes
	Response time for important updates	tbd	tbd
	5 9's for core services	n/a	Yes
	Availability levels	Yes	tbd
	Ticketing system for support	Yes	tbd
	Specifics regarding price, availability, response time, performance, customer service	Yes	tbd
	Ability to seamlessly refer calls between local and central help desk	tbd	Integration of ticketing systems
	Network speed	Yes	tbd
Enticements	Cost	A specific quota of server space is free for every customer	Additional storage space beyond the quota has a cost Additional requirements and services add an additional cost
	Governance	Governance committee includes customers with representative requirements	Regular surveys of all customers and other feedback mechanisms are used to gather needs and opinions
	Control	The options for hardware, access to the data center, and services are highly customizeable, rather than package offerings that only fit the needs of some	Physical access and after hours access
	Responsiveness	Multiple modes for contacting service staff (phone, email, text). Service staff use lightweight customer database and issue tracking software to communicate and solve issues	After hours access to service team Physical servers
	Transparency	tbd - Communication pieces about customers and why they use the service and stories on high risk scenarios	tbd
	Flexibilty	Server space accessed through accounts Alerts/staus reports about lifecycle decision points	Public access servers/services Life cycle management Option for short term space rental
	Agility	One stop shopping website Service staff play matchmaker role	Consultations for HPC, HTC, and ad hoc computing scenarios
	Data security	Minimal security provisions, each customer signs an agreement about data ownership and responsibilities	Specialized and more restrictive security provisions for FERPA, HIPAA
	Appropriate way to charge grants	Flexible billing model for multiple customer scenarios, including ability to shift funding when grants change	External funding for infrastructure for providers

Appendix Seven: Campus Communications / Socialization Activities

Completed Campus Communication / Socialization Activities (as of October 18, 2013)

Date	Event / Channel	Location	Speaker(s) / Attendees	Comments
3.7.13	AE Advisory Committee	260 Bascom	Steve Krogull	Completed
3.8.13	AE Weekly Wrap-up	Union South	Alice Gustafson	Completed
3.13.13	AE Steering Committee	100 Bascom	Rick Konopacki	Completed
3.14.13	Administrative Council	260 Bascom	Steve Krogull	Completed
3.15.13	ITC		Rick Konopacki	Completed
3.15.13	AE Weekly Wrap-up	121 Psych	Alice Gustafson	Completed
3.19.13	MTAG		Steve Krogull	Completed
3.20.13	Showcase Poster Session	Memorial Union	APR Staff	Completed
4.12.13	Published Campus Services Report	Project Website		Asking for feedback
4.12.13	AE Weekly Wrap-up	Union South	Alice/Bruce	Completed (Directed folks to website for Campus Services report)
5.10.13	Campus AE Forum	Union South	Alice/Bruce	Completed (Brief mention of Data Center Aggregation)
5.17.13	ITC	3139 Comp Sci	Steve Krogull	Completed
5.21.13	MTAG	3139 Comp Sci	Steve Krogull	Completed
Fall 2013				
8.19.13	VCFA Directors	260 Bascom	Steve K, Rick K,	Completed (Awareness) Requested by VCFA Bazzell
8.20.13	MTAG		Steve K., Rick K.	Completed (Input, Support) postponed MTAG/AC event
8.21.13	AE Steering Committee		Steve K., Rick K.	Completed (Direction-Draft Report, Socialization Plan)
9.17.13	MTAG		Bruce, Alice, Rick K.	Completed - Timeline and next steps
9.18.13	DC Operators	Bascom 260	Steve K., Rick K., Bruce, John	Completed - Input, Assess Impacts
9.26.13	Administrative Council		Steve K.	(Input, Support) – Alice to coordinate – Confirmed

Upcoming Campus Communication / Socialization Activities (as of October 18, 2013)

Date	Event / Channel	Location	Speaker(s) / Attendees	Comments
9.27.13	Email to Tech Prime and Tech Partners			FYI, update and link to presented info – Laura to coordinate
9.27.13	Communications Team and Exec Committee Meetings	Bascom		Run-through of presentation
Oct 4	AE Steering Committee		Bruce, Steve K., Rick K., John, Dan, Brian G.	(Approval) – full report; Alice to coordinate
October	Inside UW-Madison			VCFA update; link to site – Janet to coordinate
10.15.13	MTAG		Bruce, Steve K., Rick K., Laura	Follow-up to August presentation – Alice to coordinate – Confirmed
10.18.13	ITC		Steve K.	(Input, Support) – agenda likely full – Alice to coordinate - Confirmed
10.22.13	Inside UW-Madison			Project approved and next steps
October	Classified Staff Governance			(Awareness) – Alice to coordinate
October	ASEC			(Awareness) – Alice to coordinate
October	University Committee			(Awareness) – Alice to coordinate
November	DC Operators			Service rollout / preview
	ACI			Bruce / Miron / Paul Wilson meet Thu AMs, invited attendees
	NAG			Network Advisory Group (Laura to look into contact)
	CTIG			TBD (Laura to look into contact)
	Medical School			Contacts: Jocelyn / Ken Mount / others?
	EITDM			

Appendix Eight: Labor Estimates – Campus-Level Data Center Services Unit

Data Center Support Staff Labor Cost (FY14 Estimates- Annual Salary only- Fringes NOT included)

						Baseline			Baseline											
		Year 1 - Baseline				FTE % per Facility			Year 1 Est		Year 2 Est		Year 3 Est		Year 4 Est		Year 5 Est		Year 6 Est	
		Data Center Role	Description/Duties	Ratio	Annual Salary w/o Fringe	Year 1 Dayton St. DC 1	Year 1 Walnut St. DC 2	Year 1 MFCB DC3	Est. FTE count	Est. Salary Cost Yr 1	Est. FTE count	Est. Salary + 1% Yr 2	Est. FTE count	Est. Salary + 1% Yr 3	Est. FTE count	Est. Salary + 1% Yr 4	Est. FTE count	Est. Salary + 1% Yr 5	Est. FTE count	Est. Salary + 1% Yr 6
Facility Operations Staff	Mgmt	Operations Manager	Operations Manager		$94,753				1.00	$94,753	1.00	$95,701	1.00	$96,658	1.00	$97,624	1.00	$98,600	1.00	$99,586
	Mgmt	Finance/Business Ops	Financial Ops & Business Consultation		$62,316				1.00	$62,316	1.00	$62,939	1.00	$63,569	1.00	$64,204	1.00	$64,846	1.00	$65,495
	Mgmt	Customer Relations	Customer Engagement, Onboarding, etc.	1:5 cust	$59,382				1.00	$59,382	2.00	$119,952	2.00	$121,151	2.00	$122,363	3.50	$216,276	3.50	$218,439
	Mgmt	Customer Relations	Customer Engagement, Onboarding, etc.	1:5 cust	$73,416				1.00	$73,416	2.00	$148,300	2.00	$149,783	2.00	$151,281	3.50	$267,389	3.50	$270,063
	Facility	Infrastructure Support	HVAC, Power, Space, Security	1:5 DC	$93,927	44%	22%	33%	1.00	$93,927	1.20	$113,840	1.60	$153,304	1.60	$154,837	1.60	$156,385	1.60	$157,949
	Facility	Infrastructure Support	HVAC, Power, Space, Security	1:5 DC	$71,127	44%	22%	33%	1.00	$71,127	1.20	$86,206	1.60	$116,091	1.60	$117,252	1.60	$118,424	1.60	$119,608
	Facility	Infrastructure Support	HVAC, Power, Space, Security	1:5 DC	$70,098	44%	22%	33%	1.00	$70,098	1.20	$84,959	1.60	$114,411	1.60	$115,555	1.60	$116,711	1.60	$117,878
	Facility	Technician- Floor Ops	Racking, Cabling, Labeling, Asset Mgmt	1:2 DC	$62,048	44%	22%	33%	1.00	$62,048	3.00	$188,005	4.00	$253,181	4.00	$255,712	3.50	$225,986	3.50	$228,246
	Facility	Asset manager -Opss	Racking, Cabling, Labeling, Asset Mgmt	1:5 DC	$60,548	44%	22%	33%	1.00	$60,548	1.20	$73,384	1.60	$98,824	1.60	$99,812	1.60	$100,810	1.60	$101,818
	Monitoring	Monitoring		1:10 DC	$77,425				1.00	$77,425	1.00	$78,199	1.00	$78,981	1.00	$79,771	1.00	$80,569	1.00	$81,374
	Monitoring	Monitoring		1:10 DC	$74,834				1.00	$74,834	1.00	$75,582	1.00	$76,338	1.00	$77,102	1.00	$77,873	1.00	$78,651
	Monitoring	Monitoring		1:10 DC	$87,458				1.00	$87,458	1.00	$88,333	1.00	$89,216	1.00	$90,108	1.00	$91,009	1.00	$91,919
	Monitoring	24 x 7 NOC staff	24 x 7 NOC (1 per each shift)	1:10 DC	$47,655				1.00	$47,655	1.00	$48,132	1.00	$48,613	1.00	$49,099	1.00	$49,590	1.00	$50,086
	Monitoring	24 x 7 NOC staff	24 x 7 NOC (1 per each shift)	1:10 DC	$56,940				1.00	$56,940	1.00	$57,509	1.00	$58,084	1.00	$58,665	1.00	$59,252	1.00	$59,845
	Monitoring	24 x 7 NOC staff	24 x 7 NOC (1 per each shift)	1:10 DC	$52,970				1.00	$52,970	1.00	$53,500	1.00	$54,035	1.00	$54,575	1.00	$55,121	1.00	$55,672
						Facility Operation total			**15.00**	**$1,044,897**	**19.80**	**$1,374,540**	**22.40**	**$1,572,238**	**22.40**	**$1,587,961**	**24.90**	**$1,778,842**	**24.90**	**$1,796,630**
Services Staff	Services	Primary 'Services' Administrator			$89,800				1.00	$89,800	1.00	$90,698	1.00	$91,605	1.00	$92,521	1.00	$93,446	1.00	$94,381
	Services	Backup 'Services' Administrator			$72,800				1.00	$72,800	1.00	$73,528	1.00	$74,263	1.00	$75,006	1.00	$75,756	1.00	$76,514
						Services Operation Total			**2.00**	**$162,600**	**2.00**	**$164,226**	**2.00**	**$165,868**	**2.00**	**$167,527**	**2.00**	**$169,202**	**2.00**	**$170,894**
						Facility & Operation Total			**17.00**	**$1,207,497**	**21.80**	**$1,538,766**	**24.40**	**$1,738,107**	**24.40**	**$1,755,488**	**26.90**	**$1,948,044**	**26.90**	**$1,967,524**

<u>Appendix Nine</u>: **Campus-Level Data Center Services Unit Structure (refined Jan 2014)**