UCAR Computer Collocation Facilities Strategic Plan

Computing Facilities Planning Committee (CFPC)

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Contents

1 Executive Summary

A fundamental requirement for fulfilling UCAR's primary mission --understanding our changing Earth system -- is the availability of computational resources to explore new theories, develop integrative solutions, provide community support, and remain competitive in the pursuit of funding opportunities. This requirement is being addressed in two ways: 1) The Computation and Information Systems Laboratory (CISL) provides a super computer class production facility, which serves the organization and the larger university community. 2) Divisions and programs within the organization have developed their own computing facilities, which provide the flexibility for exploring innovative, experimental, and interactive research. In some instances, the computational capacity of these distributed centers approaches the capacity of super computer class systems. In both cases, these facilities are reaching the limits of existing infrastructure, which if not addressed will constrain their ability to fulfill our primary mission. Based on expected computer acquisitions, it is projected that the organization will fill all available computer infrastructure space by the end of 2007.

The strategic scientific direction of the organization clearly drives the need for computational resources, and from a budgetary perspective it is important to provide a strategic plan that is both affordable and sustainable for the long-term. Providing the technical solution for future computer collocation facilities will need to address the requirements in both these areas.

In developing this plan, scientific, technical, and administrative requirements were identified. A survey of the divisions and programs was conducted to identify their current and future plans with regard to anticipated computer acquisitions and associated infrastructure requirements. Information received from the divisions and programs has been incorporated into this strategic plan.

This document outlines a strategic plan for addressing the infrastructure requirements for the divisions and programs, which will transition existing computer facilities to central collocation facilities. The expected benefits of this plan, along with anticipated administrative components, are as follows;

- Reduction in the complexity of maintaining the infrastructure of numerous computer facilities will reduce maintenance costs.
- Provision of stable, secure, adaptable computational environments that meet industry standards, with the flexibility to address high availability requirements where needed.
- Realization of increased efficiency of utility usage and the maintenance of related equipment, which is expected to reduce costs.

- Implementation of a cost allocation methodology that will result in full cost recovery from divisions and charges based on actual resource usage to the best extent practical.
- Creation of a governance/management model with appropriate funding will support the efficient and successful management of computer collocation facilities.

As part of the process, an environmental assessment of existing division and program computer facilities was conducted. All of these facilities are currently reaching limitations in one or more infrastructure categories: space, power, cooling, or structural integrity. In addition, capital equipment, such as air conditioners, is reaching its life expectancy in some rooms. To accommodate future infrastructure requirements within the existing facilities, substantial upgrades would be needed. In some cases the current infrastructure constraints cannot be rectified.

A detailed analysis of available space and associated infrastructure that would meet basic requirements for a computer collocation facility was conducted by the Computing Facilities Planning Committee (CFPC). Two feasible alternatives were identified. 1) The Center Green Building 3 (CG3), which currently serves as a warehouse and houses Physical Plant Services staff, has 12,000 sq. ft of assignable space and adequate space around the perimeter for infrastructure location. Construction could be phased over a number of years; however, the initial phase is estimated to cost $4-5 million dollars. It is recognized that bond funds will not likely be available until FY09. A period of nine to twelve months would be required for the design process, and depending on scope construction could take a year. 2) The Data Center Planning Committee (DCPC) is currently exploring options for a next generation cyber infrastructure facility for the Computational and Information Systems Laboratory (CISL). The current CISL computing facility, Mesa Lab 29, has 13,000 sq. ft., and could be repurposed once CISL vacates this space in the 2011 time frame.

The above scenarios do not account for the impending problem, which is, the organization will likely run out of space for division computer systems within a year. In FY06, two collocation facilities were created to address critical space requirements for a few entities. FL0-0110 was constructed with only basic infrastructure, power and cooling. Systems rely on rack-mounted uninterruptible power supplies (UPS), which is not optimal. This facility is currently at 75% capacity, and pending acquisitions will fill this facility in Fall 2007. FL2-3095 was designed as a high availability facility. Its infrastructure has power, redundant cooling, a whole-room UPS, and a backup generator. Currently, this facility is at 30% capacity. It may be necessary for affected groups to consider collocation facilities in the commercial market. This may impact their ability to compete for research funding as commercial collocation costs would be significant.

Collocation facilities will require a different management model to ensure the equitable allocation of resources across programs, compliance with policies and procedures, coordination of equipment location, and to provide oversight of infrastructure planning and implementation. There are two components to this

model. It is important to have a management entity that will be responsible for the day-to-day operational activities of computer collocation facilities. In addition, it is important that there be an oversight group that is informed about the potential acquisition of systems on proposals and within division and program strategic plans along with their associated infrastructure requirements, that would review and approve requests for placement of systems, arbitrate issues related to the facilities, and proactively plan for necessary facility upgrades.

It is anticipated that the initial funds for the construction of any computer collocation facility would be paid for out bond funds. However, it is a guiding principle of this strategic plan that collocation services need to be allocated equitably to both small and large programs through effective cost recovery models. Cost allocation methodologies should result in full cost recovery and charges that represent actual usage to the best extent practical. An initial model, currently being used for FL0-0110 and FL2-3095 has two components: a portion of the costs are allocated based on percentage use of room capacity, which is defined by the limiting resource whether it be space, power, cooling, or structural integrity; actual utility costs for power consumption are allocated through the use of power metering. Going forward, facilities may need to be evaluated and methodologies developed to better define their allocable costs.

Finally, and potentially the most important part of this plan. is transitioning divisions from the current division-hosted computing facilities to the collocation facilities. The transition would need to be phased to allow division and programs to adjust for budget impacts and to accommodate the normal computer upgrade cycles. Following normal upgrade cycles seems most reasonable. As obsolete systems are retired, their replacements and any new systems would be located in a collocation facility. This would allow for the gradual budget adjustments. However, it is recommended that a reasonable sunset date should be set, so that space can be effectively reallocated to the organization. Additionally, a freeze should be considered on any augmentation to existing division and program computer facilities.

Recommendations

Following is a summary of the recommendations put forward in this strategic plan:

- Formalize the commitment as an organization to proceed in a new strategic direction for provisioning computer infrastructure.
- Designate Center Green Building 3 and Mesa Lab Room 29 as future computer collocation facilities, and allocate funds ($50-75K) for preliminary studies of these options, so that the organization is positioned to respond when funding is available.
- Identify existing or create new entities to provide governance and management for existing collocation facilities and commit to appropriate

funding strategies to support the successful and efficient management of collocation facilities.

- Create an organizational process that would inform the governing body about computer systems included in funding proposals and division strategic plans along with their infrastructure requirements, so that proactive decisions can be made.
- Formalize the cost allocation methodology being used currently for existing computer collocation facilities, allowing for adjustments in future years as needed to accommodate maintenance and upgrades to computer collocation facilities.
- Develop a transition plan for migrating from divisional computer facilities to collocation facilities, which includes a sunset date and restrictions on further augmentation of division and program computer facilities.
- Disband the Computing Facilities Planning Committee.

2 Purpose

2.1 Background

Over the past two decades, most NCAR divisions and UOP programs have acquired their own computing systems to meet their individual programmatic needs. As a consequence, many divisions and programs maintain their own computer facilities to house these computing resources. As these systems became more robust and technologically advanced to meet the growing scientific requirements for computational resources, the requirements for power, cooling, and uninterrupted operational environments have expanded as well. It is projected that 20% of systems purchased in the future will have high availability requirements and 10% will need to always be available.

Current and future requirements for dedicated computing throughout UCAR will exceed local space, cooling, power, or structural integrity within the next year. In a recent survey of UCAR entities, 70% indicated they were constrained by power availability, 50% by cooling capacity, 35% by space and business continuity infrastructure, and 30% by structural integrity. In most instances, groups are constrained in more than one area. Many existing infrastructure components -- such as air conditioners and uninterruptible power systems -- are reaching the end of their useful life. In addition, new systems are being configured with Gigabit network connections, and most groups indicate they will be transitioning to systems with the faster network cards at the server and desktop level, with plans to go to 10Gigabit networking for select systems when it becomes available. Now is an opportune time as an organization to develop a strategic solution for meeting the future requirements for computer facilities.

This document will outline a strategy for providing computer collocation facilities for division and program computing systems that will be scalable over the next five to twenty years to meet the growing scientific research demands.

2.2 Mission

At the request of the UCAR President's Council, the Information Technology Council (ITC) formed the Computing Facilities Planning Committee (CFPC) to develop a strategic plan to address UCAR's computer facility needs over the next ten to twenty years. Based on preliminary investigations the committee was directed to focus on options for collocation facilities.

The committee assessed the short- and long-term needs for computing facilities at UCAR and developed strategies to meet those requirements while achieving economies of scale.

A parallel yet separate effort by the Data Center Project Committee (DCPC) is underway for a new data center to support future cyber infrastructure needs. Although the goals are similar, the requirements and customer base differ. In a recent workshop at NCAR, High Performance Computing for the Geosciences, the geosciences community discussed the opportunity for developing a collaboratory for the geoscience community, a component of which would be high performance computing resources. A liaison member from the DCPC participated in the CFPC to collaborate on common issues.

2.3 Vision

This strategic plan sets forth an internal collocation model for UCAR to deliver computer infrastructure services and fulfill the long-term requirements for computing facilities to division and program users. The model and related strategies provide a framework for making broad decisions and serve as a point of reference for subsequent detailed action plans.

2.4 Strategic Goals

The CFPC defined the following high-level strategic goals as essential outcomes of the strategic planning process and the resulting collocation model:

- Use available physical space to meet the growing need across all of UCAR for dedicated, environmentally controlled computer collocation facilities in the most effective and efficient manner possible.

- Provide secure, managed, and environmentally-controlled collocation computing environments appropriate for division and program activities.

- Provide clear, straightforward accountability and cost-allocation for the planning, use of, and management of computer collocation facilities.

2.5 Guiding Principles

The CFPC also established the following guiding principles as overarching principles upon which all strategic directions and decisions are based.

Principle: Collocation vs. Consolidation or Centralization

The collocation model is a type of data center where multiple service providers, in this case UCAR's divisions and programs, locate their computer equipment in a common facility to minimize the cost and complexity of infrastructure services. The committee came to consensus that a collocation model would serve divisional and programmatic needs better than one in which computer resources are consolidated onto centrally-managed computing platforms.

Principle: Economies of Scale

Today, the largest component of the total cost of operations has shifted from hardware to efficient management and delivery of infrastructure and support of computationally intensive computing. Through the use of a collocation model, UCAR can avoid duplication of effort in designing, developing, and maintaining divisional computing facilities throughout UCAR that do not scale. Controlling operational and infrastructure costs over the entire life cycle may provide a more cost-efficient and effective environment for research initiatives to flourish. By diffusing initial and ongoing capital investments on computing infrastructure, UCAR should be able to achieve lower overall operating costs.

Principle: Cost Effective

Any solution to provide infrastructure to UCAR divisions and programs must be cost-effective and avoid material cost increases without commensurate increases in services.

Principle: Equitable Cost Allocation/Cost Recovery

Collocation services need to be allocated equitably to both small and large programs through effective cost recovery models. Cost allocation methodologies should result in full cost recovery and charges that represent actual usage to the best extent practical. Going forward existing computing facilities may have to be evaluated and methodologies developed to better define their allocable costs.

Principle: Consistent Management

With any shared resource, it is important that policies, procedures, standards, and service level agreements be developed for its effective use. In addition, there needs to be a consistent management process to ensure that these practices are being followed.

Principle: Design for Extensibility

To protect the organization's investment in creating collocation facilities, it is important from the outset to select an appropriate location that facilitates future expansion in terms of both physical space and utilities.

2.6 Critical Success Factors

A successful implementation of the computer collocation facilities strategic plan will ensure that the following criterions are met.

- Divisions and programs can acquire computing resources to meet scientific research objectives, without the need to design, build, and manage the infrastructure to support them on an ad hoc basis.
- High availability infrastructure resources are available when needed to support scientific requirements. Redundant services, where practical, are available to mitigate dependencies.
- All computer collocation facilities provide appropriate levels of security for computer access and remote monitoring.
- UCAR divisions and programs realize increased efficiency of utility usage and the maintenance of related equipment.
- Cost allocation methodologies result in full cost recovery and charges that represent actual usage to the best extent practical.
- Management provides commitment to the appropriate funding strategies and governance model (including associated policies, procedures, and standards) to support the successful and efficient management of shared spaces.
- Designs for collocation facilities are adaptable to changing technologies and extensible for future growth.

2.7 Constraints

- UCAR will not pursue new bond financing for capital improvements until FY2009.
- Potential locations for collocated computing facilities are restricted to Center Green, Building 3 and an undetermined location at the Mesa Lab campus.

3 Organizational Assessment

3.1 Requirements

The provision of collocation facilities to meet the requirements of the organization is more than a technical solution. Facilities requirements are driven by the strategic scientific direction of the organization and must ensure the facilities are capable of hosting the computer systems necessary to further scientific discovery. In addition, any solution must address the budgetary strategies necessary to build the facilities, develop methodologies to provide for the ongoing maintenance and upgrade of the facilities, and provide for their effective management and operation.

Scientific

- To explore cutting edge research scientists need computational systems that are highly interactive and readily adaptable to test new theories (e.g. modifying operating systems, software, and hardware).
- As more integrative collaborations are being pursued, the need for dedicated, computing resources for the duration of a project are being required.

- UCAR may participate in projects that contain sensitive components, and participation in these projects may require more secure environments.
- The increasing demand for real-time forecasting both for scientific research and field program support requires dedicated resources.
- As UCAR divisions and programs continue to provide a variety of data and services to the global community, and internal and external entities become dependent on them, the expectation for high availability systems (i.e., 24x7 with the exception of scheduled maintenance windows and unplanned outages) is increasing.
- To remain competitive in the pursuit of external funding opportunities UCAR divisions and programs need access to computer infrastructure facilities that are secure, flexible, scalable, and have high availability . As some recent awards tend to indicate, organizations that have sufficient computer facility infrastructure in place have a competitive advantage in proposing for computationally intensive research opportunities.

Technical

- Design computer collocation facilities to allow for physical space, utilities, cooling, and redundancy features typical of a Tier 2 facility, which provide single delivery paths for electricity and cooling with redundant components at points most susceptible to failure, and can readily be expanded for the projected useful life of the space.
- Allow for different levels of availability requirements with a minimum standard of 90 minutes of UPS power.
- Allow for remote monitoring of collocation facility.
- Provide adjacent flex-office space for systems staff with phone and network connections along with secure storage for manuals, parts, and technical work space.
- Provide a suitable loading dock for delivery of large systems and equipment.
- Provide restricted card access to essential personnel.
- Provide the appropriate tools to efficiently track space, utility, and resource usage of collocation facility.

Administrative

- Identify funding strategies to construct, support, maintain and upgrade collocation facilities over the useful life of the facility.
- Develop a governance/management model for the equitable allocation and monitoring of collocation resources.
- Develop a budget sufficient for the day-to-day management of the collocation facilities [likely related to the funding strategies].
- Develop standards, policies, and procedures for use of collocation facilities.
- Develop an automated cost allocation methodology process to apportion costs to UCAR divisions and programs for use of space and utilities.

3.2 Business Continuity

Business continuity has come to the forefront over the last few years, specifically as it pertains to computing. The demand for computational resources and the services, software and data they provide to the staff and greater community has increased dramatically. The expectation that these resources will be available on demand exceeds the reality that in many cases the infrastructure to provide high availability does not exist. In addition, the failure of a single component, such as an air conditioning unit, could quickly result in the loss of expensive systems. A significant factor creating this situation is the lack of funds to support the additional infrastructure at a divisional level. With the creation of collocation facilities the costs to provide these additional resources will be collectively less expensive.

3.3 Computational Demand Forecasting

High-end computing has been important within UCAR since its inception with the focal point being the super computing facilities provided by CISL. However, as high-end computers have become more affordable over time, divisions/programs have acquired their own systems for doing scientific research. These systems provide the scientists more flexibility and control over their computing environment. This trend escalated in the last several years with the introduction of Beowulf clusters, which were comprised of inexpensive, off-the-shelf components, which overtime brought in systems with more power and cooling requirements and higher densities. It is anticipated that this trend will continue for the foreseeable future. (A white paper, NCAR's Analysis of Facility Needs for Future Computing, by Aaron Anderson and Richard Loft, provides an excellent overview of the trends in computer chip technology and facility requirements.

The problem introduced with the acquisition of the cluster systems is that these new systems have pushed the limits of existing computer infrastructure within divisions and programs. Many of the larger divisions within the institution have reached the limits of their space, power, and cooling, and are looking for ways to expand their infrastructure. Most divisions are planning continued incremental growth to their resources over the next few years. However, there are a couple of groups who are planning on more rapid growth. Now is the time to look at solving this problem from an institutional level and finding the most cost effective and efficient mechanism for providing this infrastructure.

3.4 Environmental Assessment

UCAR houses a number of divisional computer facilities at each of its campuses, occupying approximately 6800 square feet. The quality of these facilities varies. In addition, these facilities are reaching limitations in space, power, cooling, and structural integrity at varying levels. Maintenance staff spends significant time to support these facilities, which were not designed to accommodate the increased power consumption, cooling requirements, and density of clusters commonly used today. In order to continue to accommodate infrastructure enhancements to existing computer facilities, substantial upgrades are needed. Given the current conditions, and the increasing power and cooling requirements of new systems, it is not feasible

physically or economically to continue using the current approach to meet each division's computer facility infrastructure requirements individually.

There are external forces that are also compelling UCAR to find more efficient and effective mechanisms for providing stable and reliable resources to our customers. Though contractually we are not bound to provide 24x7support for systems at the division/program level, the expectation that our datasets, software, and forecasts be available on-demand is becoming the norm. Security of our computational systems has become a primary concern for the organization, the National Science Foundation, and other external funding agencies. Remaining competitive for funding sources is also critical to the financial viability of the institution. Having a reliable infrastructure to readily accommodate new computer systems with higher availability is an important factor in many proposals.

As the divisions and programs are challenged by volatile funding scenarios and budget restrictions, providing collocation facilities built to industry standards which are shared across the organization, would allow infrastructure costs to be shared. Using the philosophy of the The Uptime Institute, the approach would be to identify space to accommodate requirements for 20 years, build the shell for 10 years, and outfit for five. This would provide the flexibility for future upgrades in a field where predicting technology beyond five years is not possible.

A collocation model will also allow UCAR to leverage capital investments, achieve economies of scale, and provide the infrastructure to facilitate business continuity. Individual divisions would be able to house equipment in better facilities that are less problematic. Maintenance would benefit by having to spend less time servicing smaller facilities that are becoming inadequate for supporting today's computers. In addition, savings in utility costs can be realized by pulling in larger feeds to a collocation facility, creating facilities that are more efficient.

UCAR's situation is not unique to the industry. Commercial, government, and university organizations are facing the same problem and are developing solutions. A common solution is developing collocation facilities. In 2002, MIT began an extensive study of their campus computing facilities and developed a prototype collocation facility. Hewlett Packard announced their plans in May 2006 to consolidate 85 of their international data centers to six. The University of Texas at Arlington transitioned two outdated data centers into a new facility.

UCAR is already acquiring some experience in this area. The computer facility in CG2 currently serves several groups, and the recent build outs of FL2-3095 and FL0-0110 are being used as collocation facilities.

3.5 DCPC vs. CFPC

The question has arisen as to why there are two committees looking at computing facilities within the organization, the Data Center Planning Committee (DCPC), which is looking at new cyber infrastructure facilities for a broader community, and the Computer Facility Planning Committee (CFPC), which is looking at central collocation facilities for division and program computer systems. The answer is that although their goals are similar in that both are looking for long-term solutions for

providing computer infrastructure that provides stability, expandability, security, and manageability in a cost effective manner, the intended use of the space is quite different. The mission of the DCPC is to provide a next generation cyber infrastructure facility for the greater geosciences community. Their governance model will necessarily be more complex than that of an internal collocation facility. By the nature of the partnerships developed by the DCPC, their priorities would take precedence over division/program priorities. A primary difference between the two efforts is the DCPC will be developing a production facility whereas the facilities proposed by the CFPC for divisions and programs will be used more for innovative, experimental, and interactive research, which requires a flexible computational environment. In addition, researchers will need to respond to contractual requirements from various funding agencies that have fixed deliverables and deadlines.

If a new cyber infrastructure data center is built, the feasibility of providing divisional space within the facility should be considered. However, the need for a more flexible and dynamic environment for divisions should be recognized.

4 Resources Plan for Achieving Strategic Goals

4.1 Facility Location

The computational resources and the facilities infrastructure required to support the science in which the individual divisions engage compels us to locate a central collocation facility on each campus or at least on one of our campuses.

Given the weight of systems now being purchased, the facility should be located on a ground floor. Initial surveys suggest that a central facility would first require a minimum of 7,000 square feet of assignable space, with space to expand. A comparable amount of additional space, also with the ability to expand, should be made available for infrastructure. With these projections in mind, there are two options that could meet the organizational needs.

A detailed analysis of available space and associated infrastructure that would meet basic requirements across all of UCAR's facilities suggests that one site for a collocation facility is Center Green Building 3 (CG3). This warehouse building is approximately 12,000 assignable square feet. The roof deck is approximately twenty-four feet above the floor. Adequate space exists around the perimeter for infrastructure location, with expansion capabilities. While construction could be phased to upgrade the facility and its size over a number of years, the initial investment to provide a Tier II facility is estimated to be approximately four–five million dollars. (This cost assessment was completed in April, 2005.)

Currently, our institution is in competition for the management of NCAR. Until we are awarded the next management contract, bond funding is not an option. Raising bonds for this project will likely not be possible until FY2009. A period of nine to twelve months should be planned for the design of such a facility. Construction, depending on the scope, could be expected to last approximately one year. It should be noted that currently CG3 houses office space for Physical Plant Services

staff, along with providing a significant amount of warehouse space. An alternative location would need to be identified for each of these functions. In addition, there are plans to include a fitness center in CG3.

The other option is to repurpose the CISL computational facility at the Mesa Lab (ML-29) as a collocation space once CISL has vacated this space. This computing facility is approximately 13,000 sq. ft. and has been significantly upgraded in the past five years to meet CISL's high performance computing needs. Coordination would be needed as CISL phases out of this space and relocates into a new computing facility in the 2011 time frame.

The organization should also consider supporting both locations as computer collocation facilities. The CISL site is already configured with redundant equipment including generator backup, which qualifies it as a high availability site. Costs could be saved on the initial build out of CG-3 by not including generator backup in a phase one. Supporting both sites would provide additional business continuity with the ability to provide redundant infrastructure equipment at physically distant sites.

For the short term (i.e. next three years) there are no significant options available for additional computing facilities within the UCAR campuses. The organization will have to make do with existing computer facilities. Some divisions or programs may need to consider collocation facilities available on the commercial market, which may have an effect on their ability to compete for research funding as commercial collocation costs are significant.

4.2 Facility Design and Construction

In order to develop a central facility in CG3, a design and construction team would need to be assembled. This needs to include an outside design team consisting of:

- Architects
- Electrical Engineer
- Mechanical Engineer
- Structural Engineer
- Network Engineer
- Various consultants during the design phase
- Construction team
- Commissioning team

The purpose of bringing a construction team on board during the design phase is to provide estimating assistance and cost effective solutions for design and budget issues, as well as minimizing change orders after construction starts.

Commissioning of a computer facility is critical to success. A commissioning team can assist the design and construction process by critiquing the specifications, plans and control sequences for errors and omissions, working with the team to make sure the design and operational criteria are met in accordance with the documents,

and providing assistance in start-up and systems debugging on site. The ability to resolve issues prior to building activation is critical to the success of such a facility.

The onsite team should consist of the Facility Manager, Facilities Engineers, Network Engineers, System Administrators, and representatives from Safety, Security, Contracts, and Finance. Team members must be committed to the entire project, regardless of other obligations. Members new to the construction process must receive information and training regarding the process itself, as well as the timeline and guidelines for appropriate input. A system of communication needs to be established and maintained throughout the project, as it is critical for the participants and the success of the project. Finally, it is also important that the team agree to a defined scope and budget at the beginning of the project. Deviations from the scope should be minor and all should understand that these deviations are grounds for changes to the contract, which would impact the budget.

4.3 Governance/Management

Collocation facilities will require a different management model than has been used in the past. Most computer facilities currently serve one division and are managed by that division. To effectively serve the institution, collocation facilities should have a manager or management entity with the appropriate funding and budgetary responsibilities to manage the day-to-day operations. The responsibilities would include coordinating infrastructure build out, maintenance and upgrades, system moves, relocates, and removals, monitoring resource consumption, ensuring procedure and policy compliance, and communicating with facility occupants. Management of the existing collocation facilities, FL0-0110 and FL2-3095, along with new facilities at CG3 and potentially the Mesa Lab, would require a full time position.

In addition, it is important that there be an oversight group that would review and approve requests for placement of systems in the collocation facilities, have an overall picture of space availability, utility usage, upgrade requirements, long-term infrastructure and capacity needs, and arbitrate issues related to the use of these facilities. The membership of this group should include a representative cross-section of the stakeholders: facilities, finance, administration, scientists, network engineers, system administrators. There should also be a process in place to periodically assess the success factors of a facility, which would include input from facility managers, occupants, and maintenance staff.

One of the issues with the current distributed computer environments, is the organization does not have a big picture view of the computer resources installed and their collective impact on the physical plant of the organization. In addition, there is no effective mechanism in place to know what systems are in the proposal/purchasing pipeline to proactively plan for infrastructure requirements. As we move to collocation facilities, it will be important to have a mechanism in place that would inform the governing body about planned acquisitions of computer systems included in funding proposals and division strategic plans, along with their infrastructure requirements.

4.4 Collocation Facility Maintenance

Parallel to the design and construction phases of a collocation facility, it is important to develop management policies and procedures that are the same for all collocation facilities, so that policies are easily understood and enforced. Additionally, there should be electronic mechanisms for tracking adds, moves, and changes in collocation facilities. These should be developed collaboratively with the appropriate groups in accordance with operational and business standards, consistent with the information technology sector, and should include but are not limited to items in the following table. As the requirements are comparable, this is an area in which processes already developed by CISL could be leveraged to reduce redundant efforts.

Communication	A method of communication for normal business as well as emergencies needs to be established. Phone lists, emergency numbers as well as qualified contractors for emergency situations need to be maintained.
Equipment Standards	Standard equipment requirements need to be specified to allow the most efficient use of the space, which include a strict policy of labeling and methods of work.
Staff Training	Training of the staff that will use the facilities should be required.
Access/Security	Access to collocation facilities will be authorized by the facility manager.
Change Control	A procedure should exist to provide for adds, moves, and changes to the facility.
Allocation of Resources	To appropriately manage a collocation facility a procedure should specify how resources will be allocated and how infrastructure usage will be measured and costs allocated.
Cleaning Procedures	As a clean computing facility optimizes equipment performance, a procedure should specify the requirements for maintaining a clean environment.

Responsibility for various aspects of the collocation facilities will be assigned to individuals with the following roles.

Collocation Facility Manager

A facility manager will provide oversight for all aspects of the collocation facility. They will be required to have a working knowledge of all physical aspects of the facility that will allow them to interface effectively between the various groups who have access to the facility. In addition, they will monitor the functionality of the facility, requests for access, and overall maintenance. Although facility managers will be the primary resource for handling the day to day operations of the facility, they will report to the governance group for overall guidance and future planning. The facility manager will notify the facility occupants of any scheduled service work or interruptions.

System Administrators

The system administrators are the users of the shared space. They are required to maintain the operation of their systems within the facility, through either direct contact or use of remote monitoring equipment to confirm the services provided by the equipment are functioning properly. In addition, they will be required to adhere to all policies, procedures, and standards defined for the facility. The administrators will be responsible for notifying the facility manager and operations of any disruption in service of their equipment.

Operators

Operators will be used as needed to monitor the functioning of the facility and systems or functions within it. A collocation facility will not require on-site personnel, and systems will be remotely monitored by the service supporting group or the CISL Computer Production Group.

Administrative

Finance personnel will be responsible for communicating utility usage and space allocation charges to the divisions/programs. Contracts and divisions and programs would be responsible for informing the governing body of potential computer acquisitions.

Facilities Personnel

The facilities staff will be responsible for maintaining power, cooling and the general mechanics of the collocation facilities. They will interface with the facility manager to schedule maintenance events, replacement schedules, and future upgrades. In addition, they will provide usage information to Finance for appropriate cost allocation. Their expertise will be required to maintain the stability of the infrastructure.

4.5 Cost Allocation Methodology

Arranging funding to build a collocation facility is only one piece of the solution to meet the future needs for computing infrastructure over the next ten to twenty years. To ensure the long-term viability of this investment, careful thought must be given to the cost allocation methodologies that may be used to cover long-term maintenance, support, and upgrade cycles, as well as provide reserve funds for facility upgrades to keep pace with advances in computing technology and changing requirements. In

their September 2005 meeting, the UCAR President's Council set the precedent that infrastructure costs associated with the remodeling and construction of collocation facilities, and the incremental costs to operate these facilities would be charged back to the divisions and programs utilizing these facilities.

There are different methodologies available for allocating costs, including a simple allocation method or a formal rate structure. Considerations in determining an appropriate base for allocating costs include the relative benefits received, the materiality of the cost, and the amount of time and cost to perform the allocation. The methodology used should result in an equitable distribution of costs to divisions and programs.

The committee recommends that UCAR begin with a simple allocation methodology. There may be reasons to revisit the cost allocation methodology once the collocation facilities have had a chance to become established. A rate structure could be considered once there is significant expenditure history and allocation base stability. The downside to a rate structure is the increased administration costs to develop and maintain it. A formal rate structure requires approval of a cognizant audit agency, fiscal year end variances, and the associated risk to cash flow.

To implement a simple allocation method, the committee recommends creating two cost categories -- infrastructure costs and operating costs – each with a separate allocation base.

1. Infrastructure costs - These costs include collocation facility construction costs and any specialized equipment required to operate the facility. Tax-exempt debt financing can be utilized for these infrastructure costs (except in any government-owned facility such as ML). The depreciation and interest charges will be collected monthly over the facility's and specialized equipment's useful life.

   Infrastructure costs will be allocated based on facility capacity. The capacity of each collocation facility will be determined based on floor space, power, and cooling limits. The collocation facility manager and facility engineering staff will work to determine facility capacity. Costs will be allocated to users based on the percentage of capacity occupied. Any idle facility capacity will be charged to the facility cost pool. All infrastructure costs collected during the fiscal year will be direct charged to divisions and programs or the facility cost pool. Facility administrative staff will work closely with the accounting department to insure proper allocation.

2. Operating costs – These costs include utility charges along with staffing and ongoing maintenance costs for the facility and for any specialized equipment. These costs will be collected as costs are incurred and allocated monthly to divisions and programs.

Operating costs will be allocated based on power consumption. The power consumption for each collocation facility will be determined through separate metering systems. Facility engineering staff will maintain these separate meters. Costs will be allocated to users based on the percentage of power consumed. All operating costs collected during the fiscal year will be direct charged to divisions and programs. Facility administrative staff will work closely with the accounting department to insure proper allocation.

4.6 Transition

Currently, most divisions do not pay for their actual power consumption in their respective computer facilities: utility costs for divisional computer facilities are blended into the charge incurred for occupied square footage based on the UCAR facilities cost pool rate. This may have the unintended consequence of raising overhead costs of the institution as a whole to cover the power consumption for specific programmatic computing resources.

Two of the existing collocation facilities, FL2-3095 and FL0-0110, are charged for actual utility usage and a percentage of the cost of the facility. The move to central collocation facilities allows costs to be allocated to the occupants who are benefiting from the upgraded facilities as well as removing the burden from the facilities cost pool.

The transition from divisional computer facilities to collocation facilities will need to be phased to allow division and programs to adjust for budget impacts and to accommodate the normal computer upgrade cycles. Budgets are set two years in advance. It would be prudent to allow divisions to gradually transition their systems to collocation facilities in order to adjust for the increases to their costs. At present, all divisions do not have the standard equipment racks necessary for efficient collocation. In addition, divisions upgrade and replace systems at intervals. Staging these moves over a period of time would allow divisions to locate systems in new facilities as other systems are phased out of current facilities.

The proposed cost allocation methodology currently only applies to newly created collocation facilities. Below are options to assist during the transition period:

- Apply the cost allocation methodology to the existing division and program computer facilities. This would apply going forward and would not be retroactive.

- Reduce or eliminate ongoing maintenance or augmentation to existing division and program computer facilities. This would require coordination with the space planning office to insure divisions and programs phasing out of divisional computer facilities had space available to relocate.

- Develop a phased approach to transition existing computer facilities into newly developed collocation facilities. Existing computer facilities depreciation schedules and maintenance requirements would need to be reviewed to

determine optimal transition timing. A sunset date for completion of the transition should be determined.

4.7 Space Recovery

As divisions move into central collocation facilities, existing facilities will become available for alternate use. The former computer facilities could be assigned to the division or moved to a facility growth pool for assignment at a later date at the discretion of space management.

5 Recommendations

- Formalize the commitment as an organization to proceed in a new strategic direction for provisioning computer infrastructure.
- Designate Center Green Building 3 and Mesa Lab Room 29 as future computer collocation facilities, and allocate funds ($50-75K) for preliminary studies of these options, so the organization is positioned to respond when funding is available.
- Identify existing or create new entities to provide governance and management for existing collocation facilities and commit to appropriate funding strategies to support the successful and efficient management of collocation facilities.
- Create an organizational process to inform the governing body about computer systems included in funding proposals and division strategic plans along with their infrastructure requirements, so proactive decisions can be made.
- Formalize the current cost allocation methodology being used for existing computer collocation facilities, allowing for adjustments in future years as needed, to accommodate maintenance and upgrades to these facilities.
- Develop transition plans for migrating from divisional computer facilities to collocation facilities, which include a sunset date and restrictions on further augmentation of division and program computer facilities.
- Disband the Computing Facilities Planning Committee.

6 Implementation Outline

The following outlines the steps necessary to move into an implementation phase.

- Identify a governance body.
- Identify a management/operations group, and provide resources to enable them to lead the preliminary study.

- Approve funds ($50-75K) for a preliminary study of the potential collocation facilities. – 3 months to complete.
- Identify a limited number of participants for project input.
- Obtain feedback on results – 1 month.
- Determine Go/No go decision – 2 weeks.
- Initiate design – 9 months.
- Provide opportunities for feedback after design, construction document phases – 1 month.

7 Committee Members

Aaron Anderson	CISL
Mike Daniels	EOL
Ben Domenico	Unidata
Joanne Dunnebecke	RAL
Peter Fox	ESSL/HAO
Marion Hammond	F&A/Business Services
Dave Patterson	F&A/PPS
Karl Hudnut	COSMIC
Jim VanDyke	CISL/NETS
Pat Waukau – Chair	ESSL/MMM
Shawn WInkelman	F&A/IT